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Prepared by
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MEDVision Global Academy

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GCE O/L Science (English Medium)

Fast Track Work Package

Eleven years of past papers (2015 to 2025), arranged from the newest to the oldest, with every Paper I answer explained, every Paper II question matched to a marking scheme, a full analysis of what the examiners ask, and a road map to the top grade.

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The seven sections

No.	Section	What it gives you
1	**Analysis report and road map to an A+**	What the exam asks, in figures, and a 12-week plan.
2	**MCQs with answers and reviews**	Paper I, 2025 to 2015, fully retyped: every question, the key and a one-line reason for every answer.
3	**Structured essays with answers**	Paper II Part A (four compulsory questions), retyped with the answer and marks under every part.
4	**Essays with answers**	Paper II Part B (choose three of five), retyped with the answer and marks under every part.
5	**Definitions**	Key terms for all 35 textbook units, Grade 10 and Grade 11.
6	**Equations**	Every formula and chemical equation you are expected to use.
7	**Short notes**	Fast revision notes for each unit, with the points examiners repeat.

How to use this booklet

- Sit each paper before you look at the answers: Paper I in 60 minutes, Paper II in 3 hours (plus 10 minutes reading time).
- Mark Paper I with the key in Section 2, then read the review line for every question you got wrong or guessed.
- Mark Paper II with the green answer boxes under each part. Official schemes are given with their marks; where no official scheme exists, answers prepared from the Grade 10 and 11 textbooks are given and clearly labelled.
- Use Sections 5 to 7 every day: learn five definitions, rewrite the equations of one unit, and read one unit of short notes.

Answer key status. Official Department of Examinations answers: 2018, 2019, 2021, 2022, 2023, 2024, 2025, and 2015 (Evaluation Report). Prepared answers (no official scheme in the collection): 2016, 2017 (new syllabus), 2017 (old syllabus) and 2020. Where the examiners accepted more than one option, the key shows this (e.g. "1/2" or "All").

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1

Analysis report and road map to an A+

What eleven years of papers tell you to study

- The collection used, after removing duplicates
- Exam structure and marks
- Figures: subject split, unit weighting, heat map
- Recurring questions and the Paper II template
- Road map: 12-week plan, score targets, exam technique

1.1 The collection behind this booklet

The original folder held 28 PDF files. Five were exact content duplicates and were removed; the 2020 file that looked like a duplicate was kept because it is the only copy of 2020 Paper II Part A. The four Grade 10 and Grade 11 textbooks were kept as source material for the definitions, equations, notes and prepared marking schemes.

Kept and used	Removed (duplicates)
• Past papers: 2015, 2016, 2017 (new), 2017 (old), 2020 (two copies, complementary), 2021, 2022, 2023, 2024, 2025 • Marking schemes: 2018, 2019, 2021, 2022, 2023, 2024, 2025 (2018 and 2019 contain the full question papers) • 2015 Evaluation Report, Part II (answers, examiners' comments and facility data) • Textbooks: Science Grade 10 Part I and II; Grade 11 Part I and II	• gce-...-2015 (same as 2015 past paper) • gce-...-2016 (same as 2016 past paper) • gce-...-2022 (Part A missing; same as 20222023 paper) • gce-...-2023 (same 8 pages as 20232024 paper) • gce-...-2024 (same as 20242025 paper)

1.2 The exam at a glance

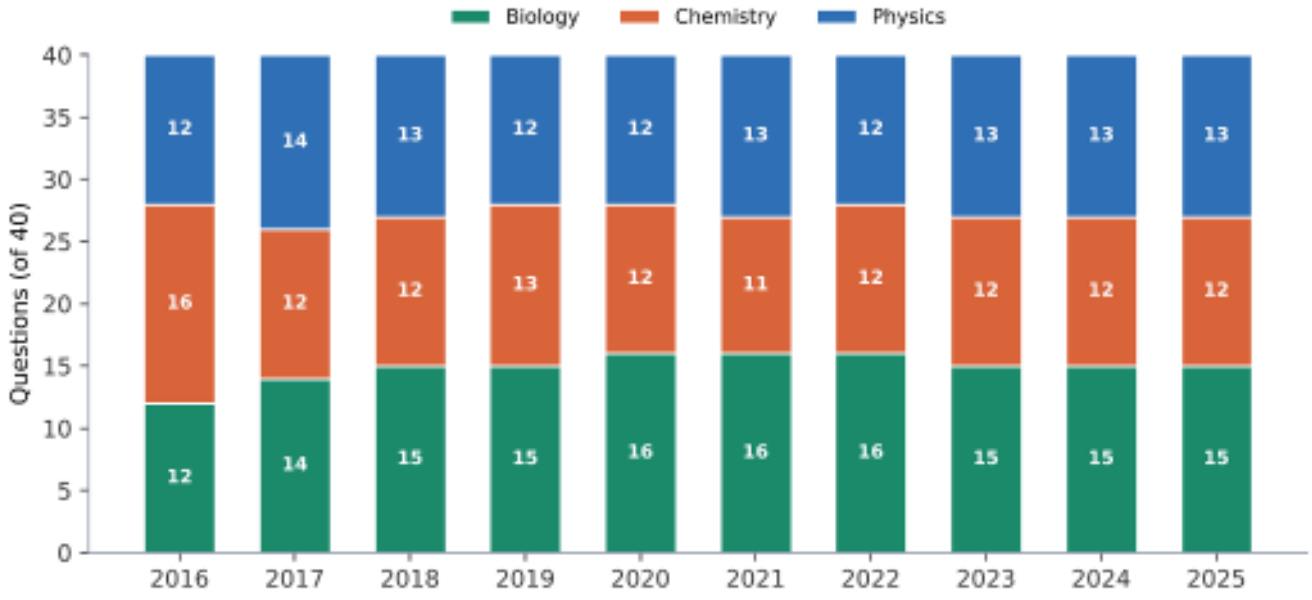
Paper	Time	Format	Marks
Paper I	1 hour	40 MCQs, four options, all compulsory	2015-2020: 2 marks each (80). From 2021: 1 mark each (40).
Paper II Part A	3 hours (whole paper) + 10 min reading	4 compulsory structured questions	15 each = 60
Paper II Part B		5 essay questions, answer any 3 (2015 old syllabus: 6 questions, one each from Biology, Chemistry, Physics)	20 each = 60
Final mark		2015-2020: (Paper I 80 + Paper II 120) / 2. From 2021: Paper I 40 + Paper II 120 / 2.	out of 100; Paper I = 40% of the final mark

One mark rule. Since 2021 each MCQ is worth exactly 1 final mark and each Part B question 10 final marks. Paper I is therefore the fastest place to gain marks: 40 marks in 60 minutes.

1.3 What the examiners ask: figures

Figure 1. Paper I subject balance, 2016–2025

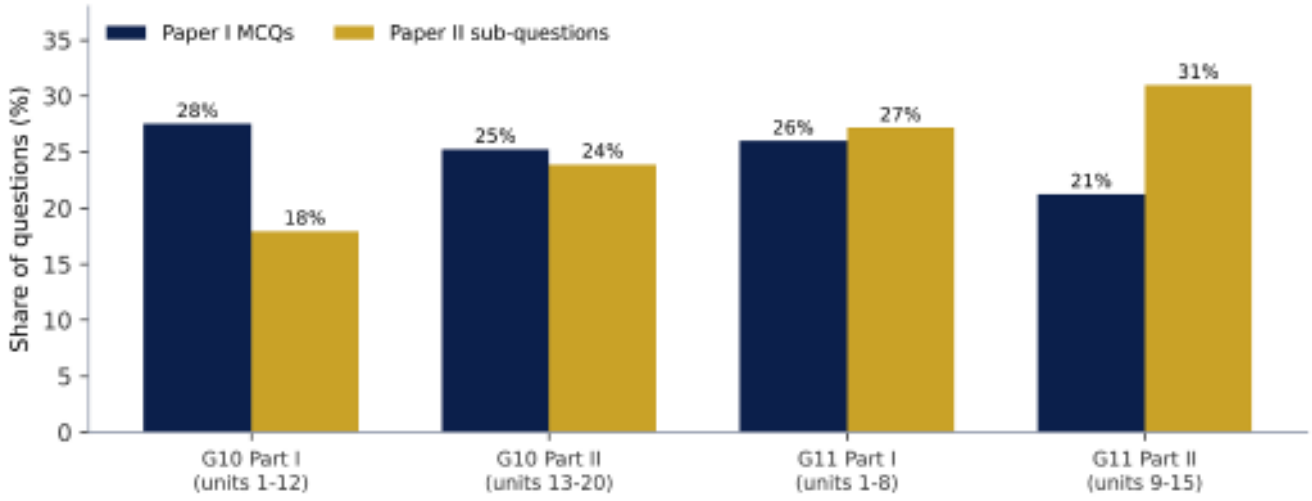
Every new-syllabus Paper I contains about 15 Biology, 12 Chemistry and 13 Physics questions (Biosphere and environment questions are counted under Biology). Only the first new-syllabus paper (2016) broke the pattern.



Each MCQ was assigned to one textbook unit and its subject. 400 questions, 2016–2025.

Figure 2. Weighting by textbook volume

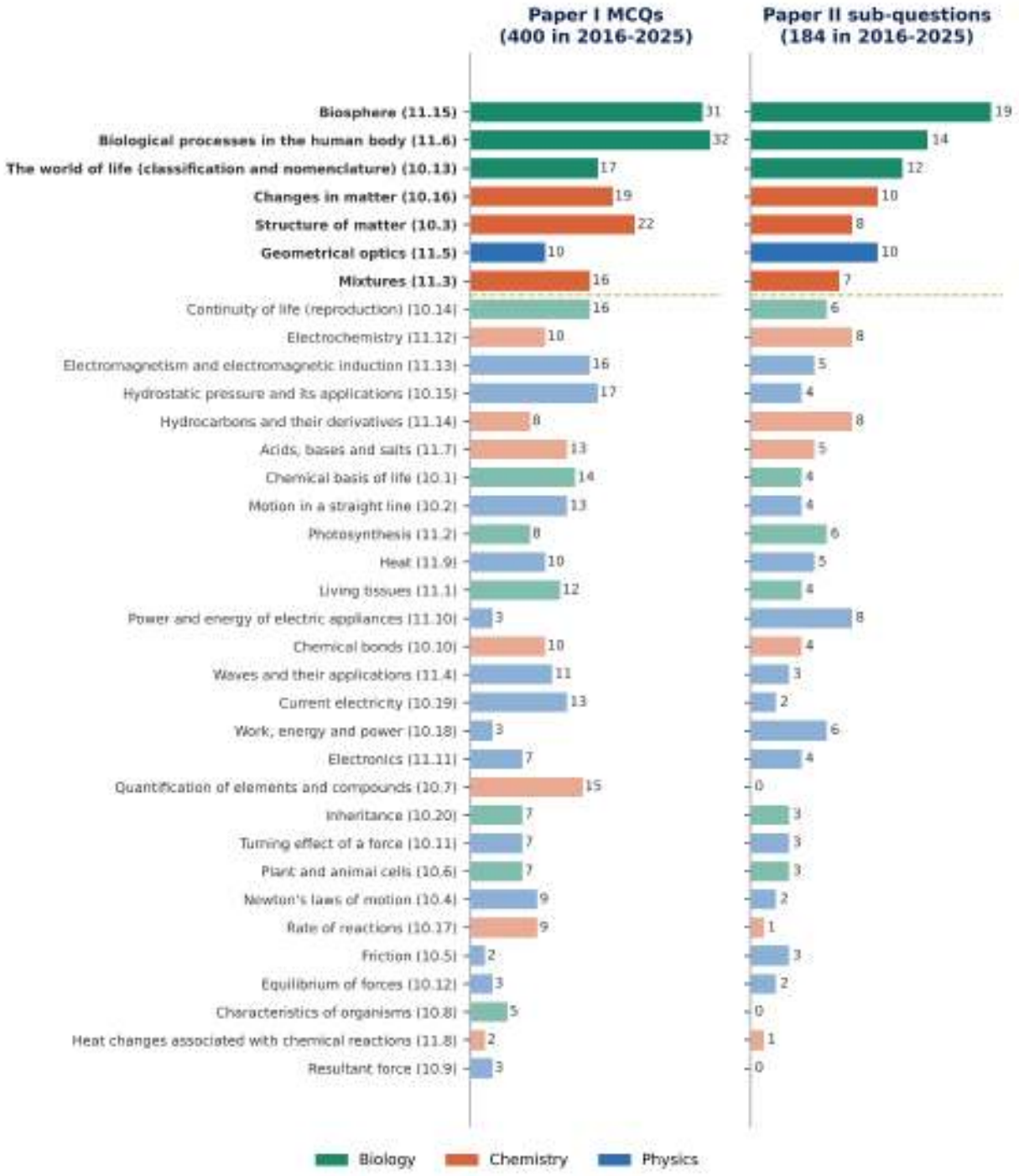
All four textbook volumes are examined. Grade 10 supplies about half of Paper I, while Grade 11 Part II (heat, electricity, electrochemistry, hydrocarbons, biosphere) carries the most Paper II weight.



Share of unit-coded questions by textbook volume, 2016–2025.

Figure 3. Unit weighting: where the marks come from

Seven units (bold, above the dashed line) supplied 37% of all MCQs and 43% of all Paper II sub-questions between 2016 and 2025. Master these first.



Units ranked by combined share of Paper I MCQs and Paper II sub-question blocks (A, B, C parts), 2016–2025. Paper II counts show how often a unit appears, not its mark value.

Figure 4. Heat map: every unit, every year

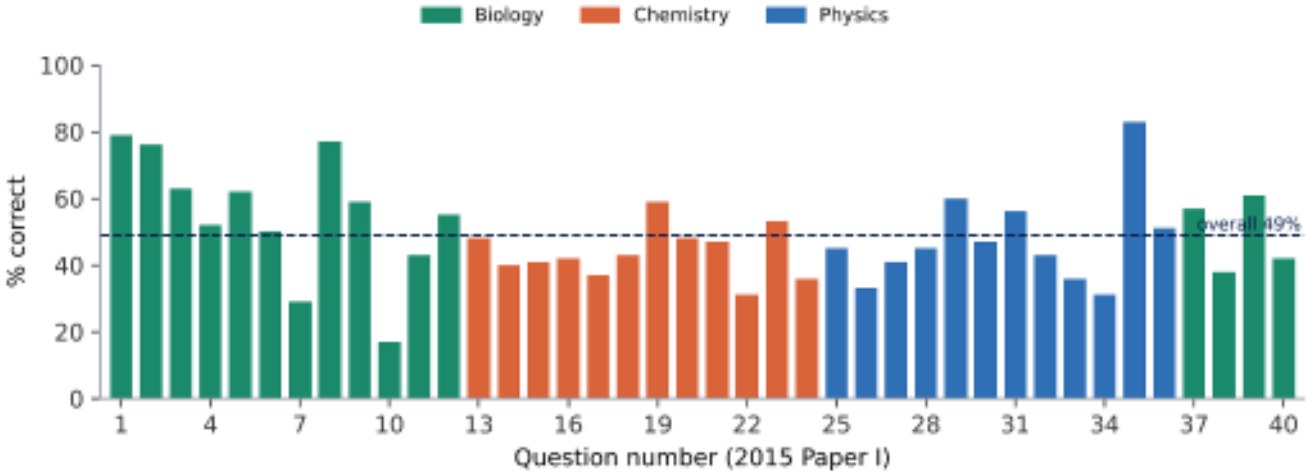
Number of questions (MCQs + Paper II sub-questions) on each unit in each year. Darker cells mean more questions. Units with no blank cells are examined every year and must not be skipped.



Grade 10 units above the gold line, Grade 11 units below. Dots mean the unit did not appear that year.

Figure 5. Where candidates lose marks (2015 evaluation report)

The only official performance data in the collection. On average fewer than half the candidates chose the right answer; Chemistry was the hardest section. In Paper II Part A, between a third and a half of candidates scored 3 or less out of 15 on each question.



Percentage of candidates answering each 2015 Paper I question correctly (Department of Examinations, Evaluation Report 2015).

Examiners repeatedly named the same weak skills:

- Writing balanced chemical equations (facility as low as 25%).
- Labelling axes and drawing graphs from experimental data (16%).
- Recalling how a practical set-up works and what each piece of apparatus is for.
- Multi-step calculations: heat of reaction, moles, simple machines, resistor networks.
- Reading a question carefully: choosing the false statement, or the respective order asked for.

1.4 Questions that keep coming back

The same items reappear, often with only the numbers changed. Practise each until it is automatic.

Recurring item	Unit	Years in Paper I
Resistors in series/parallel; wire length and thickness vs resistance	10.19	2018, 2019, 2021, 2022, 2023, 2024, 2025
Food chains, food webs, ecological pyramids	11.15	2016, 2017, 2020, 2022, 2023, 2025
Reading displacement-time or velocity-time graphs	10.2	2016, 2017, 2019, 2020, 2022, 2023
Upthrust and floating	10.15	2017, 2018, 2020, 2021, 2023, 2024
Moles or particles in a given mass	10.7	2016, 2020, 2021, 2022, 2023
Identifying muscle tissue types	11.1	2016, 2020, 2021, 2022, 2025
Brain region functions (cerebellum, medulla)	11.6	2017, 2019, 2021, 2023, 2025
Transformer turns, voltage or current	11.13	2019, 2021, 2022, 2024, 2025
Corrosion and sacrificial protection of iron	11.12	2017, 2020, 2022, 2024, 2025
Seed and fruit dispersal adaptations	10.14	2016, 2017, 2018, 2020, 2021
Electromagnetic induction with magnet and coil	11.13	2016, 2018, 2020, 2023
Mass of solute for a solution of given concentration	11.3	2017, 2019, 2021, 2022
Weight on the Moon (g / 6)	10.4	2016, 2019, 2023
Mole fraction	11.3	2016, 2018, 2020
Food miles and sustainable development	11.15	2016, 2017, 2019

1.5 The Paper II template

Paper II has followed the same subject pattern every year since 2016. Use it to decide in advance which three Part B questions you will answer.

Question	Subject	Typical content
Q1 (Part A)	Integrated Biology, Chemistry and Physics; data or graph reading	NO_2 pollution graph (2020); energy sources (2022); nitrogen cycle (2025)
Q2 (Part A)	Biology	Classification, photosynthesis set-ups, cells and tissues
Q3 (Part A)	Chemistry	Periodic table period 2/3, gas preparation, metal reactions, bonding
Q4 (Part A)	Physics	Circuits, light, forces and friction, heat
Q5 (Part B)	Biology	Digestion, circulation, excretion, nervous system, reproduction
Q6 (Part B)	Chemistry	Polymers and hydrocarbons, acids and bases, extraction of metals
Q7 (Part B)	Physics	Lenses, motion and energy calculations, household electricity
Q8 (Part B)	Biology + Physics	Classification or inheritance with forces, pressure or EM induction
Q9 (Part B)	Chemistry + Physics	Electrochemistry or metals with electronics, optics or heat

A student strong in Physics and Chemistry can plan on Q6, Q7 and Q9; a student strong in Biology has Q5 and Q8 as Biology-led options. Prepare four, so you have a fallback on the day.

1.6 Road map to an A+

The target. The highest O/L grade is A, awarded for 75 marks or more out of 100. "A+" in this plan means aiming clearly above that line, at 85 or more, so that one weak question cannot pull you below an A.

Score targets (2021 format)

Goal	Paper I (of 40)	Paper II (of 120)	Final (of 100)
Secure A	34	82	34 + 41 = 75
A+ (safe A)	36	98	36 + 49 = 85
Top of class	38	110	38 + 55 = 93

The 12-week plan

When	Focus	What to do
Weeks 1-2	**High-yield Biology**	11.6 Human body processes, 10.13 Classification, 10.14 Reproduction. Learn their definitions and short notes; do every MCQ on them from Section 2.
Weeks 3-4	**High-yield Chemistry**	10.3 Structure of matter, 10.16 Changes in matter, 11.3 Mixtures, 11.7 Acids/bases, 10.7 Moles. Practise 10 mole and concentration calculations a day.
Weeks 5-6	**Core Physics**	11.5 Optics (ray diagrams), 10.15 Pressure, 10.19 and 11.10 Electricity, 11.13 Electromagnetism, 10.2/10.4 Motion, 11.9 Heat. Rewrite every equation from Section 6.
Week 7	**Biosphere + remaining Biology**	11.15 Biosphere (the single most examined unit), 11.1 Tissues, 11.2 Photosynthesis, 10.1 Biomolecules, 10.6 Cells, 10.20 Inheritance.
Week 8	**Remaining units**	11.12 Electrochemistry, 11.14 Hydrocarbons, 11.11 Electronics, 11.4 Waves, 10.18 Work-energy, 10.11-10.12 Moments, 10.5 Friction, 11.8, 10.8, 10.9.
Weeks 9-10	**Timed practice**	Sit 2015-2020 papers under exam time (one Paper I + one Paper II every two days). Mark them and list every wrong answer by unit.
Weeks 11-12	**Mock exams**	Sit 2021-2025 as full mocks marked against the official schemes; keep 2025 as the final mock. Re-do every MCQ you got wrong; revise Sections 5-7 daily.

Exam-day technique

- Paper I: about 1.5 minutes per question. Answer the ones you know first, mark the doubtful ones, return to them. Never leave a blank - there is no negative marking.
- Read "false", "not" and "respectively" twice. Many 2015 candidates lost marks by choosing a true statement when the false one was asked.

- Paper II: use the 10-minute reading time to choose your three Part B questions using the template in 1.5.
- Part A: about 25 minutes per question; Part B: about 30 minutes per question; keep 10 minutes to check.
- Show working in every calculation (formula, substitution, answer with unit) - marks are given for each step.
- Write balanced equations with state symbols where asked; label graph axes with quantity and unit; draw ray diagrams with a ruler and arrows.
- Use the exact textbook term: "limiting friction", "upthrust", "sacrificial protection", "ultrafiltration", "eutrophication".

2

MCQs with answers and reviews

Paper I, 2025 to 2015 (newest first)

- Sit the paper first: 40 questions in 60 minutes
- Mark it with the key that follows each paper
- Read the review line for every question you missed
- Unit codes link each question to Sections 5-7

How this section is arranged

Every Paper I is fully retyped, with its diagrams cleaned and placed beside the question. Each paper is followed by an answer grid and a review table that explains why the keyed option is correct and tags the question with its textbook unit, so you can turn straight to the definitions (Section 5) and notes (Section 7) for that unit. For 2015 the percentage of candidates who answered correctly is shown in square brackets.

Paper	Answers
2025 (2026)	Official key + reviews
2024 (2025)	Official key + reviews
2023 (2024)	Official key + reviews
2022 (2023)	Official key + reviews
2021 (2022)	Official key + reviews
2020	Prepared key + reviews
2019	Official key + reviews
2018	Official key + reviews
2017 (new syllabus)	Prepared key + reviews
2017 (old syllabus)	Prepared key + reviews
2016	Prepared key + reviews
2015 (old syllabus)	Official key + reviews

Paper I • 2025 (2026) — QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. All biomolecules carbohydrates, proteins, lipids and nucleic acids contain,

(1) carbon, hydrogen and oxygen. **(2)** carbon, oxygen and nitrogen.
(3) hydrogen, oxygen and nitrogen. **(4)** carbon, hydrogen and phosphorus.

2. An organelle that can be seen when cheek cells are observed under the optical microscope is,

(1) Golgi complex. **(2)** mitochondrion. **(3)** nucleus. **(4)** ribosome.

3. On a block of wood placed on a smooth horizontal table, horizontal, parallel forces act as shown in the diagram. What is the resultant force acting on the object?



(1) 12 N to left **(2)** 12 N to right **(3)** 22 N to left **(4)** 22 N to right

4. The cause for the pain when stung by red ants is the formic acid which they apply on the sting. Application of which of the following on the sting is most effective to relieve the pain?

(1) salt water **(2)** water **(3)** lime water **(4)** vinegar

5. Of the following which statement is true?

(1) All non- flowering plants are gymnosperms.
(2) Flowering plants are also called gymnosperms.
(3) Monocotyledonous and dicotyledonous plants are commonly referred to as angiosperms.
(4) There are two groups of flowering plants as seed plants and seedless plants.

6. A cell, a tissue and an organ in the blood circulatory system respectively are,

(1) neutrophils, blood and blood vessels. **(2)** platelets, blood plasma and blood vessels.
(3) blood capillaries, arteries and heart. **(4)** eusinophils, blood capillaries and heart.

7. Which of the following species contains 10 electrons, 11 protons and 12 neutrons?

(1) $^{24}_{12}Mg^{2+}$ **(2)** $^{23}_{11}Na^{+}$ **(3)** $^{23}_{11}Na$ **(4)** $^{19}_{9}F^{-}$

8. The essential oil methyl jasmonate is the cause for the fragrance of jasmine flowers. Which following method could be used to separate methyl jasmonate industrially from jasmine flowers?

(1) simple distillation **(2)** steam distillation
(3) fractional distillation **(4)** paper chromatography

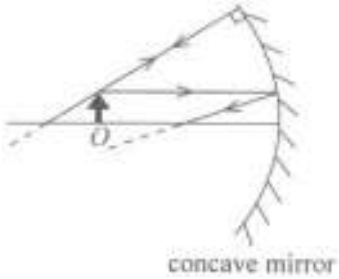
9. Which pair of following disorders is an example for the genetic disorders caused by gene mutation?

(1) haemophilia and red-green colour blindness **(2)** haemophilia and albinism
(3) red-green colour blindness and thalassemia **(4)** albinism and thalassemia

10. Which of the following option correctly indicates a type of an underground stem and an example relevant to it?

(1) rhizome - manioc **(2)** corm - ginger **(3)** bulb - sweet potato **(4)** stem tuber - potato

11. The diagram shows the paths of a pair of rays emitted by an object 'O' placed at a certain point on the principal axis perpendicular to it in front of a concave mirror. The image of this object is,



(1) real, inverted and magnified.
(2) real, inverted and equal to the object in size.
(3) real, upright and reduced.
(4) virtual, upright and magnified.

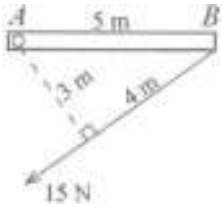
12. A transformer is supplied with a power of 690 W from a supply of 230 V. How much is the current supplied to the coil?

(1) 1 A **(2)** 2 A **(3)** 3 A **(4)** 4 A

13. Which option correctly indicates the nature of radio waves and waves created on a water surface?

	Radio waves	**Waves on a water surface**
(1)	transverse - mechanical	transverse - electromagnetic
(2)	transverse - electromagnetic	transverse - mechanical
(3)	longitudinal - mechanical	longitudinal - mechanical
(4)	longitudinal - electromagnetic	longitudinal - electromagnetic

14. A force of 15 N is applied by a light string tied to the end B of a light rod AB which is pivoted at point A as shown in the diagram. How much is the moment of force acting on the rod?



(1) (15 × 5) N clockwise **(2)** (15 × 5) N anti-clockwise
(3) (15 × 3) N clockwise **(4)** (15 × 3) N anti-clockwise

15. X, Y and Z are three successive elements in the periodic table and X is a noble gas. As which of the following species is Z most likely to exist in its compounds?

(1) Z^{+} **(2)** Z^{2+} **(3)** Z **(4)** Z^{-}

16. Four rules relating to electromagnetism and electromagnetic induction are given below.

A – Maxwell's corkscrew rule
B – Right hand rule
C – Fleming's left hand rule
D – Fleming's right hand rule

Of these, the two rules that can be used to find the direction of the magnetic field around a conductor carrying an electric current are,

(1) A and B. **(2)** A and C. **(3)** B and C. **(4)** B and D.

17. Consider the following statements.

A – An unbalanced force does not act on an object at rest freely suspended by a string.
B – An unbalanced force acts on an object moving with a uniform velocity.
C – The force exerted on the table by an object kept at rest on a horizontal table is equal to the force exerted by the table on the object in the opposite direction.

Of the above, the true statement/statements is/are,

(1) only A. **(2)** only A and B. **(3)** only A and C. **(4)** only B and C.

18. Which of the following option is true about the muscle tissue shown in the figure?



(1) uninucleate, has cross striations, is not fatigued whatever
(2) multinucleate, no cross striations, is not fatigued whatever
(3) uninucleate, no cross striations, is fatigued on excessive action
(4) uninucleate, has cross striations, is fatigued on excessive action

19. Of the following factors essential for photosynthesis, which factor **cannot** be tested in the school laboratory?

(1) water **(2)** chlorophyll **(3)** light **(4)** carbon dioxide

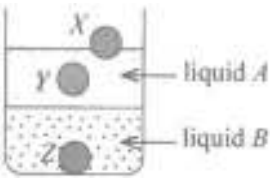
20. The hydrocarbon with molecular formula C_5H_{12},

(1) is an alkene.
(2) is a component of biogas.
(3) can be polymerised.
(4) forms 6 moles of water on complete combustion of one mole.

21. The main reason for the easy flow of electrons across the p-n junction of a forward biased diode is,

(1) high energy in the electrons. **(2)** very low value of the potential barrier.
(3) that the depletion region is very narrow. **(4)** that the doping level is very low.

22. There are two immiscible liquids A and B whose densities are ρ_A and ρ_B respectively. Three solid spheres X, Y and Z equal in radius and with densities ρ_X, ρ_Y and ρ_Z respectively are in the liquids as shown in the diagram. What is the correct statement about them?



(1) $\rho_A < \rho_B$ and $\rho_X = \rho_Y < \rho_Z$ **(2)** $\rho_A < \rho_B$ and $\rho_X < \rho_Y < \rho_Z$
(3) $\rho_A = \rho_X = \rho_Y$ and $\rho_B < \rho_Z$ **(4)** $\rho_A = \rho_Y < \rho_X$ and $\rho_B = \rho_Z$

23. u, v and w are three metals lying above hydrogen in the activity series. The method proposed by a group of students to compare their activity was taking a piece from each metal, reacting them with hydrochloric acid separately and comparing the volumes of hydrogen gas liberated within a fixed short period. Which of the following factors is **not** essential to be kept constant during the experiment?

(1) surface area of the metals
(2) mass of the metals
(3) temperature of the reaction mixture
(4) acid concentration of the reaction mixture

24. During inspiration,

(1) intercostal muscles and the muscles in the diaphragm relax.
(2) intercostal muscles relax while muscles in the diaphragm contract.
(3) intercostal muscles contract while muscles in the diaphragm relax.
(4) intercostal muscles and muscles in the diaphragm contract.

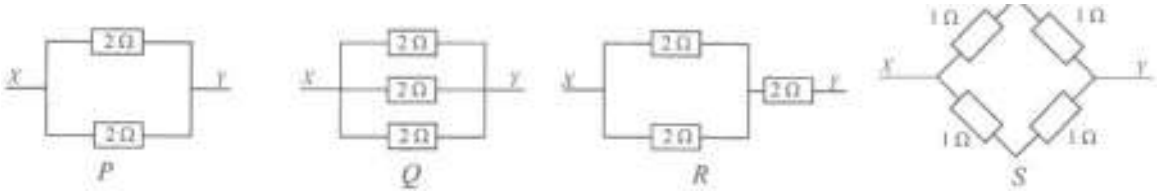
25. Consider the following statements about amoeba.

A – Reproduction occurs by binary fission.
B – Binary fission occurs only by mitotic division.

Of the above statements,

(1) only statement A is true.
(2) only statement B is true.
(3) both statements A and B are true.
(4) both statements A and B are false.

26. Of P, Q, R and S, in which pair of resistor systems is the value of the equivalent resistance the same between X and Y?



(1) P and Q **(2)** P and S **(3)** Q and R **(4)** R and S

27. Two metals Q and R react as indicated by the following equations.

$$Q(s) + H_2SO_4(aq) \rightarrow QSO_4(aq) + H_2(g)$$
$$R(s) + H_2SO_4(aq) \rightarrow RSO_4(aq) + H_2(g)$$
$$R(s) + QSO_4(aq) \rightarrow \text{no reaction}$$

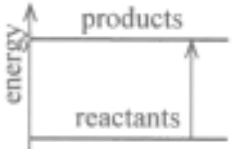
Which of the following can be Q and R respectively?

(1) Cu and Zn **(2)** Zn and Mg **(3)** Mg and Cu **(4)** Mg and Zn

28. A gas jar filled with a gas X was inverted and placed vertically in a beaker of water. Then, it was seen that the water level inside the gas jar rises rapidly. Gas X can be,

(1) Ne. **(2)** N_2. **(3)** CO_2. **(4)** NH_3.

29. Which of the following is most likely to be the change represented by the energy level diagram given?



(1) dissolving of glucose in water
(2) combustion of the hydrocarbon, methane
(3) reaction between zinc and hydrochloric acid
(4) neutralization between sodium hydroxide and hydrochloric acid

30. The heart beat of a person whose head was injured by an accident became irregular and respiration occurred without a control. He happened to vomit also. Thus, it can be inferred that in his brain,

(1) cerebellum is damaged. **(2)** medulla oblongata (brain stem) is damaged.
(3) left cerebral hemisphere is damaged. **(4)** right cerebral hemisphere is damaged.

31. The magnetic train operated in Japan is lifted a bit up above the rails after it acquires an adequate speed and made to run forward. What is the main advantage obtained by this modern technological strategy?

(1) minimizing train maintenance activities
(2) minimizing the wear of the rails
(3) minimizing air resistance acting on the train
(4) running the train under minimal friction

32. Two reactions used to prepare the gases H_2 and CO_2 in the laboratory are given below.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

What is the mass of $CaCO_3$ that should be reacted to obtain an amount of moles of CO_2 gas which is equal to the maximum amount of moles of H_2 gas obtainable from 32g of zinc (Zn)? (H = 1; C = 12; O = 16; Ca = 40; Zn = 64)

(1) 22 g **(2)** 44 g **(3)** 50 g **(4)** 100 g

33. In the form of a thin layer, metal X is applied on the iron sheet A and metal Y is applied on the iron sheet B. A small scratch was made at the centre of both sheets. Later, rusting has spread rapidly on A, but B has not been subjected to a considerable damage. The metals X and Y respectively can be,

(1) Sn and Zn. **(2)** Zn and Sn. **(3)** Cu and Ag. **(4)** Ag and Cu.

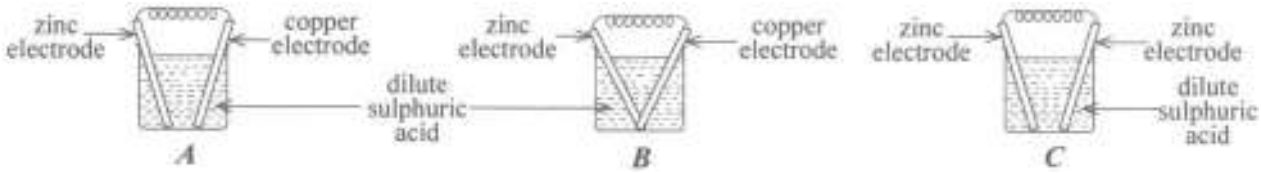
34. 600 g of water at temperature 80°C were added to a vessel containing 200 g of water at 0°C. What is the final temperature of the mixture? (specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$; assume that the vessel does not absorb heat.)

(1) 53°C **(2)** 60°C **(3)** 66°C **(4)** 70°C

35. The areas of cross section of the pistons of a hydraulic jack are × m^2 and 4x m^2. How much is the force exerted on the larger piston when a force of 50 N is applied on the smaller piston?

(1) 50 N **(2)** 100 N **(3)** 150 N **(4)** 200 N

36. A, B and C are three sets of simple cells.



In the external circuits of the cells A, B and C above, an electric current flows only in,

(1) A. **(2)** B. **(3)** A and B. **(4)** A and C.

37. Which of the following is a disease which **cannot** be either controlled or prevented by changing the life style?

(1) diabetes **(2)** gastritis
(3) chronic kidney disease **(4)** haemophilia

38. In which phase of the growth curve of population does the number of organisms in the population reach its carrying capacity?

(1) first phase **(2)** second phase **(3)** third phase **(4)** fourth phase

39. Which of the following statements is true about the ecological pyramids?

(1) Number pyramids are always upright.
(2) In a biomass pyramid, omnivores can exist only as secondary consumers.
(3) Heavy metals accumulate most in the highest level of a biomass pyramid.
(4) Biomagnification is the incorporation of a higher amount of energy in the higher trophic levels of an energy pyramid.

40. As a student says, nitrogenous nutrients in a soil decrease after a flood due to following reasons.

A – occurrence of denitrification
B – percolation deeper into soil (leaching)
C – getting washed away from the surface soil
D – decomposition of organic matter

Of these only,

(1) A, B and C are true. **(2)** A, B and D are true. **(3)** A, C and D are true. **(4)** B, C and D are true.

2025 (2026) — answer key and reviews

Source of answers: Official marking scheme 2025(2026).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	1/2	21	3	31	4
2	3	12	3	22	2	32	3
3	2	13	2	23	2	33	1
4	3	14	All	24	4	34	2
5	3	15	2	25	3	35	4
6	1	16	1	26	2	36	1
7	2	17	3	27	4	37	4
8	2	18	1	28	4	38	4
9	4	19	1	29	1	39	3
10	4	20	4	30	2	40	1

Q	Ans	Unit	Why this is the answer	Textbook
1	1	10.1 Chemical basis of life	All four biomolecule classes are built on carbon, hydrogen and oxygen; N and P occur only in some (proteins, nucleic acids).	G10 Part I p. 1
2	3	10.6 Plant and animal cells	With a light microscope only large organelles are visible; in cheek cells the stained nucleus is clearly seen.	G10 Part I p. 111
3	2	10.9 Resultant force	Add forces along one line: 24 N to the right minus (5 N + 7 N) to the left = 12 N to the right.	G10 Part I p. 167
4	3	11.7 Acids, bases and salts	Formic acid is neutralised by a weak base; lime water ($Ca(OH)_2$) relieves the sting. Vinegar is an acid.	G11 Part I p. 201
5	3	10.13 The world of life (classification and nomenclature)	Angiosperms (flowering plants) are divided into monocots and dicots; ferns are non-flowering but not gymnosperms.	G10 Part II p. 11
6	1	10.8 Characteristics of organisms	Neutrophil = a single cell; blood = a (connective) tissue; blood vessels = organs of the circulatory system.	G10 Part I p. 143
7	2	10.3 Structure of matter	11 protons = sodium; 11 + 12 = mass number 23; 10 electrons means it has lost one electron: Na^+ (23/11).	G10 Part I p. 55
8	2	11.3 Mixtures	Essential oils are volatile and decompose at high temperature, so they are separated by steam distillation.	G11 Part I p. 66
9	4	10.20 Inheritance	Albinism and thalassaemia arise from mutations in autosomal genes; colour blindness and haemophilia are sex-linked.	G10 Part II p. 185
10	4	10.14 Continuity of life (reproduction)	Potato is a stem tuber (has nodes and 'eyes'). Ginger is a rhizome; manioc and sweet potato are root tubers.	G10 Part II p. 29

Q	Ans	Unit	Why this is the answer	Textbook
11	1/2	11.5 Geometrical optics	Both options were accepted by the examiners; the object lies near the centre of curvature, giving a real, inverted image.	G11 Part I p. 115
12	3	11.13 Electromagnetism and electromagnetic induction	P = VI, so I = P/V = 690 W / 230 V = 3 A.	G11 Part II p. 146
13	2	11.4 Waves and their applications	Radio waves are transverse electromagnetic waves; water-surface waves are treated as transverse mechanical waves.	G11 Part I p. 73
14	All	10.11 Turning effect of a force	All answers accepted by the examiners (diagram ambiguity). Remember: moment = force × perpendicular distance from pivot.	G10 Part I p. 200
15	2	10.3 Structure of matter	X is a noble gas, so Z is two places later: a Group 2 metal that loses two electrons to form Z^{2+}.	G10 Part I p. 82
16	1	11.13 Electromagnetism and electromagnetic induction	Maxwell's corkscrew rule and the right-hand grip rule give the field direction around a current-carrying wire.	G11 Part II p. 119
17	3	10.4 Newton's laws of motion	A: forces on a hanging body at rest are balanced. C: Newton's third law (action = reaction). B is false: uniform velocity means zero net force.	G10 Part I p. 97
18	1	11.1 Living tissues	Cardiac muscle: uninucleate, branched with cross striations, and never fatigues.	G11 Part I p. 14
19	1	11.2 Photosynthesis	Water cannot be removed from a plant without killing it, so its need cannot be tested in a school experiment.	G11 Part I p. 26
20	4	11.14 Hydrocarbons and their derivatives	One mole of a hydrocarbon with 12 H atoms gives 6 mol H_2O on complete combustion (2 H per water molecule).	G11 Part II p. 154
21	3	11.11 Electronics	In forward bias the depletion region becomes very narrow, so electrons cross the junction easily (official answer).	G11 Part II p. 56
22	2	10.15 Hydrostatic pressure and its applications	Floating height compares densities: the sphere sinking lower is denser; read the positions of X, Y and Z against the two liquids.	G10 Part II p. 83
23	2	10.16 Changes in matter	For a fair test keep surface area, temperature and acid concentration the same; equal mass is not essential.	G10 Part II p. 103
24	4	11.6 Biological processes in the human body	During inspiration both the external intercostal muscles and the diaphragm muscles contract, enlarging the thorax.	G11 Part I p. 152
25	3	10.13 The world of life (classification and nomenclature)	Amoeba reproduces asexually by binary fission, which involves mitotic division of the nucleus.	G10 Part II p. 9
26	2	10.19 Current electricity	Work out each combination (series adds; parallel uses $1/R = 1/R_1 + 1/R_2$): P and S give the same total.	G10 Part II p. 163
27	4	10.16 Changes in matter	Both Q and R displace hydrogen from acid, but R cannot displace Q, so Q is more reactive: Mg (Q) and Zn (R).	G10 Part II p. 99
28	4	10.16 Changes in matter	Ammonia is extremely soluble in water, so water rushes into the jar.	G10 Part II p. 104
29	1	11.8 Heat changes associated with chemical reactions	Products above reactants = endothermic. Dissolving glucose absorbs heat; the other three are exothermic.	G11 Part I p. 203
30	2	11.6 Biological processes in the human body	Medulla oblongata controls heartbeat, breathing and vomiting reflexes; damage disturbs all three.	G11 Part I p. 175
31	4	11.13 Electromagnetism and electromagnetic induction	Magnetic levitation removes wheel-rail contact, so the train runs with minimal friction.	G11 Part II p. 124
32	3	10.16 Changes in matter	32 g Zn = 0.5 mol, giving 0.5 mol H_2. 0.5 mol CO_2 needs 0.5 mol $CaCO_3$ = 0.5 × 100 = 50 g.	G10 Part II p. 94

Q	Ans	Unit	Why this is the answer	Textbook
33	1	11.12 Electrochemistry	Tin (less reactive than iron) speeds rusting once scratched; zinc (more reactive) gives sacrificial protection.	G11 Part II p. 111
34	2	11.9 Heat	Heat lost = heat gained: 600(80 - T) = 200(T - 0), so T = 48000/800 = 60 °C.	G11 Part II p. 11
35	4	10.15 Hydrostatic pressure and its applications	Pressure is transmitted equally: $F_2 = F_1$ x A2/A1 = 50 N x 4 = 200 N.	G10 Part II p. 69
36	1	11.12 Electrochemistry	A simple cell needs two different metals in an electrolyte; only set A (zinc and copper) produces a current.	G11 Part II p. 82
37	4	11.15 Biosphere	Haemophilia is an inherited (genetic) disorder; lifestyle change cannot prevent it.	G11 Part II p. 200
38	4	11.15 Biosphere	In the final (fourth) phase of the growth curve the population levels off at the carrying capacity.	G11 Part II p. 170
39	3	11.15 Biosphere	Heavy metals are not broken down, so they biomagnify and are most concentrated at the top trophic level.	G11 Part II p. 174
40	1	11.15 Biosphere	Floods cause denitrification (waterlogging), leaching and surface wash-off; decomposition adds nitrogen.	G11 Part II p. 179

Paper I • 2024 (2025)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. To which of the following tissues does the cell type stone cells belong?
(1) meristematic **(2)** parenchyma **(3)** collenchyma **(4)** sclerenchyma

2. Of the following pairs, the pair of vector quantities is,
(1) force and mass. **(2)** pressure and acceleration.
(3) speed and work. **(4)** velocity and displacement.

3. Which of the following is the element that acts as an intrinsic semiconductor at the room temperature?
(1) Cu **(2)** Al **(3)** Si **(4)** Fe

4. Which of the following indicates the symbols of the elements zinc, sodium and silver respectively?
(1) Sn, S, Si **(2)** Zn, Na, Si **(3)** Zn, Na, Ag **(4)** Sn, Zn, S

5. Select the option that correctly indicates the scientific name of plant mango.
(1) Mangifera indica (2) *Mangifera indica* (3) mangifera indica (4) *mangifera indica*

6. Which organelle of the cell transmits the hereditory characteristics from generation to generation?
(1) mitochondria **(2)** nucleus **(3)** Golgi bodies **(4)** ribosomes

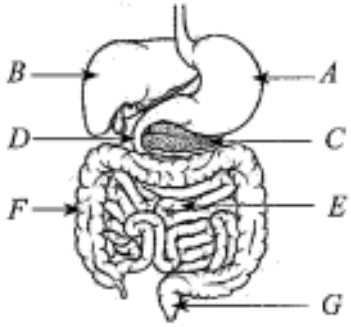
7. From which of the following structures in the ovaries of the female reproductive system an ovum is released?
(1) corpus luteum **(2)** corpus albicans **(3)** graffian follicle **(4)** primary follicle

8. Cutting a yam with a well sharpened knife is easier. The reason for this is,
(1) the ability to apply a greater force.
(2) the ability to apply a greater pressure.
(3) lessening the friction between the yam and the knife.
(4) lessening the weight of the knife during sharpening.

9. The formula of the compound formed by the element X with oxygen is XO while the formula of the compound formed by the element Y with sodium is NaY. What is the formula of the compound formed by the combination of X and Y?
(1) XY **(2)** X_2Y **(3)** XY_2 **(4)** XY_4

▸ *Question numbers 10 and 11 are based on the following sketch of the human digestive system.*

10. Which of the following options indicates the path the food passes through from A to G in this system respectively?



(1) B, C, D **(2)** C, D, E **(3)** D, E, F **(4)** D, C, E

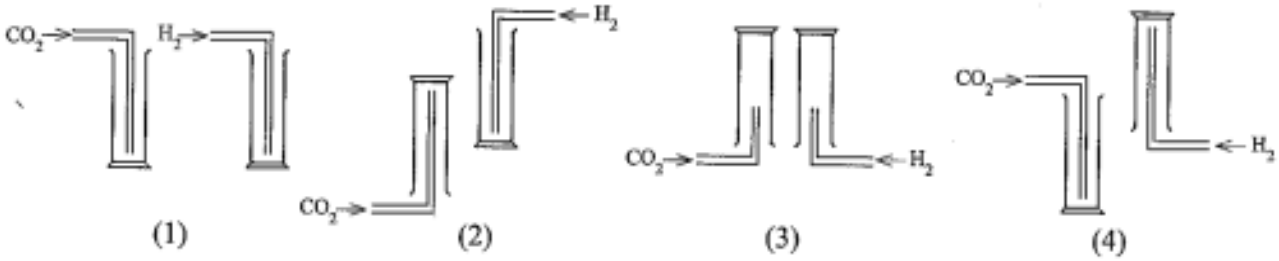
11. If a little food is taken out from the sites A and D and pH papers were put into them separately, the pH values which correspond with the colour change occurring in them respectively would be,

(1) 3.5 and 7.5 **(2)** 3.5 and 4.0 **(3)** 7.5 and 3.5 **(4)** 7.5 and 8.5

12. Which of the following is the **false** statement about the resistance of a metallic conductor?

(1) It depends on the temperature.
(2) It is directly proportional to the length.
(3) It is inversely proportional to the area of cross section.
(4) It depends on the potential difference across it.

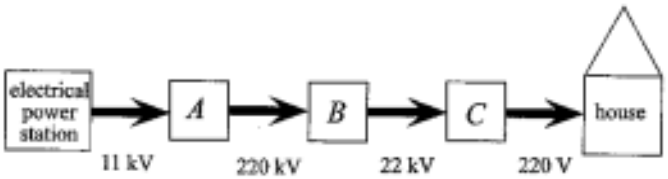
13. Which of the following is the correct way of positioning the delivery tubes to collect two samples of the gases carbon dioxide and hydrogen into gas jars?



14. Which of the following is **not** a property of synthetic linear polymers?

(1) easily biodegradable **(2)** combustible
(3) resistant to acids **(4)** electrical insulators

15. This block diagram indicates some main stages of a route of transmitting electricity from an electrical power station to houses. What is the option that gives the transformer types indicated as A, B and C in it respectively?

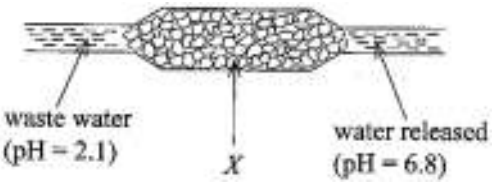


(1) step-up, step-down, step-down **(2)** step-up, step-up, step-up
(3) step-down, step-up, step-up **(4)** step-down, step-down, step-up

16. Which chamber of the human heart has the thickest walls?

(1) left atrium **(2)** right atrium **(3)** left ventricle **(4)** right ventricle

17. The waste water released by a factory was passed through a packing of a solid substance X as shown in the figure before emptying into the environment. Which of the following statement can be true about the waste water and X?



(1) Waste water is acidic and X is sand. **(2)** Waste water is basic and X is sand.
(3) Waste water is acidic and X is limestone. **(4)** Waste water is basic and X is limestone.

18. When the cap of a bottle of soda water is opened, carbon dioxide gas bubbles are liberated. More over, carbon dioxide gas bubbles are liberated faster when a bottle of soda water kept outside a refrigerator is opened than when a bottle of soda water kept inside a refrigerator is opened. According to these observations, under which of the following conditions could it be concluded that the solubility of carbon dioxide in water increases?

(1) higher pressure and higher temperature **(2)** higher pressure and lower temperature
(3) lower pressure and higher temperature **(4)** lower pressure and lower temperature

19. Which of the following statement is true about the image formed by a plane mirror?

(1) The image is formed on the side of the object itself.
(2) The size of the image depends on the size of the mirror.
(3) The image is laterally inverted.
(4) The image distance depends on the geometrical shape of the mirror.

20. A telecommunication satellite is orbited at a height of 36 000 km from the level of the Earth. What is the time taken in seconds for a radio wave sent by a transmitting station on the Earth to reach the satellite? (Speed of radio waves in air is 3.0×10^8 m s^{-1}.)

(1) $36000 / (3.0 \times 10^8)$ **(2)** $(3.0 \times 10^8) / 36000$
(3) $(3.0 \times 10^8) / (3.6 \times 10^7)$ **(4)** $(3.6 \times 10^7) / (3.0 \times 10^8)$

21. When a small amount of Benedict solution is added to a certain food extract and heated, no colour change occurred. When a little of dilute sulphuric acid is added to it and heated, the solution turned orange. The nutrient contained in this food extract would be,

(1) glucose. **(2)** sucrose. **(3)** fat. **(4)** protein.

22. Consider the following characteristics possessed by a living species.

A – An organized nucleus is absent.
B – can be destroyed by antibiotics
C – can be either pathogenic or autotrophic

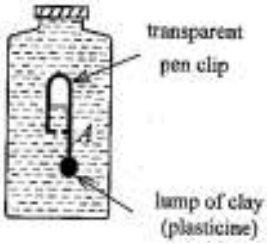
Of these, the characteristics owned by the organisms belonging to domain bacteria are,

(1) only A and B. **(2)** only A and C. **(3)** only B and C. **(4)** all A, B and C.

23. The metals P and Q react with dilute acids liberating hydrogen gas while the metal R does not liberate hydrogen with dilute acids. P cannot displace Q from a solution of a salt of Q. What is the sequential order in which the metals P, Q and R are placed in the activity series?

(1) P, Q, R **(2)** Q, P, R **(3)** P, R, Q **(4)** R, P, Q

24. An arrangement named A has been introduced into a well stoppered plastic bottle filled with water so that it floats immersed. When the bottle is squeezed at its middle the arrangement A moves down the bottle. The reason for this is,



(1) increase in the pressure of water. **(2)** increase in the weight of arrangement A.
(3) decrease in the upthrust exerted on A. **(4)** decrease in the volume of water.

25. Given below are three statements relating to motion of waves.

A – Transverse waves travel in a direction perpendicular to the direction of the vibration of particles in the medium.
B – Longitudinal waves can travel in free space (vacuum).
C – Electromagnetic waves travel at the same speed in any medium.

The correct statement/s of the above is/are,

(1) only A. **(2)** only B. **(3)** only A and B. **(4)** only B and C.

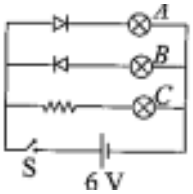
26. Of the two solutions A and B, no colour change occurred when a few drops of phenolphthalein was added to solution A. When equal volumes of solutions of A and B of equal concentration were mixed and allowed to react, an aqueous solution of C was obtained and its pH was 7. The solutions A, B and C respectively could be,

(1) HCl, NaOH and NaCl. **(2)** HCl, NaCl and NaOH. **(3)** NaOH, HCl and NaCl. **(4)** NaOH, NaCl and HCl.

27. The carbohydrate products first formed during photosynthesis, stored temporarily in chloroplasts and translocated through the phloem respectively are,

(1) monosaccharides, disaccharides and polysaccharides.
(2) monosaccharides, polysaccharides and disaccharides.
(3) disaccharides, polysaccharides and monosaccharides.
(4) polysaccharides, monosaccharides and disaccharides.

28. When the switch S is closed in this circuit,



(1) bulbs A and B light. **(2)** bulbs B and C light. **(3)** bulbs A and C light. **(4)** all the bulbs light.

29. The number of autosomes and the sex chromosome that can be present in a human ovum respectively are,

(1) 22 and Y. **(2)** 22 and X. **(3)** 23 and Y. **(4)** 23 and X.

30. What is the option which correctly indicates how the curvature of the diaphragm and the volume of the thoracic cavity change when inspiration occurs in the respiratory process of a human?

	curvature of the diaphragm	**volume of the thoracic cavity**
(1)	increases	increases
(2)	increases	decreases
(3)	decreases	increases
(4)	decreases	decreases

31. The power of an electric heater is 1 000 W. The amount of electrical energy spent when this heater operated for a period of 2 hours was,

(1) 0.5 kW h. **(2)** 2 kW h. **(3)** 500 kW h. **(4)** 2 000 kW h.

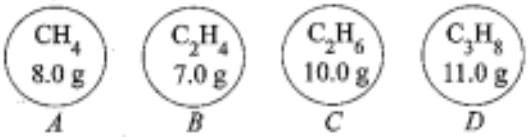
32. Which of the following metals can be used for cathodic protection of iron?

(1) Ag **(2)** Cu **(3)** Sn **(4)** Zn

33. The force exerted vertically upwards on a rocket of mass m due to combustion of fuel is R. If g is the acceleration due to gravity, the acceleration with which the rocket moves is,

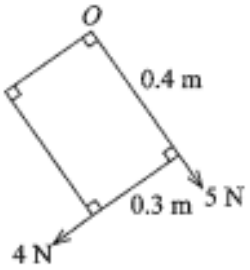
(1) (R − mg) / m **(2)** R / m **(3)** (R − m) / mg **(4)** R / mg

34. Given in the figure are masses of four gaseous hydrocarbons. In which of them equal number of molecules are contained? (C=12, H = 1)



(1) A and B **(2)** A and C **(3)** B and D **(4)** C and D

35. A light, rectangular lamina 0.4 m × 0.3 m is pivoted at point O and two forces 5 N and 4 N are applied on it as shown in the diagram. What is the moment of force on the lamina around the point O?

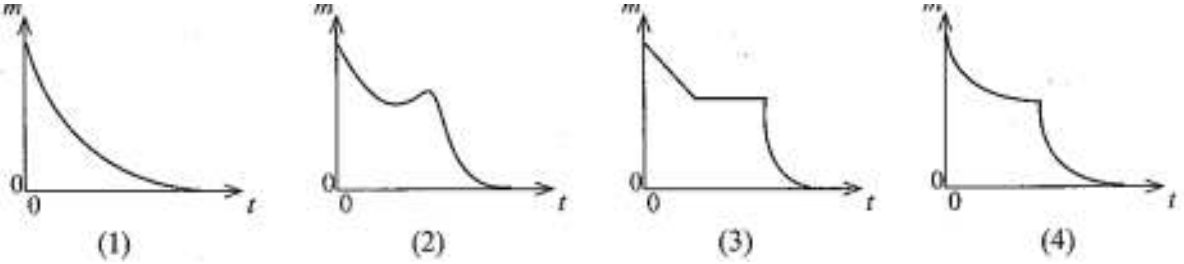


(1) 1.6 N m anticlockwise **(2)** 1.6 N m clockwise
(3) 1.5 N m anticlockwise **(4)** 1.5 N m clockwise

36. The boiling points of hydrogen chloride and water are -85 °C and 100 °C respectively. Which of the following statements explains the cause for this difference?

(1) The intermolecular forces among hydrogen chloride molecules are weaker than the intermolecular forces among water molecules.
(2) The relative molecular mass of hydrogen chloride is greater than the relative molecular mass of water.
(3) The covalent bonds among the atoms are stronger in water than those in hydrogen chloride.
(4) Water molecules are polar whereas hydrogen chloride molecules are non-polar.

37. A sheet of zinc suspended on a spring balance is immersed in a hydrochloride acid solution bringing them to react. Some time after the beginning of the reaction another quantity of the acid solution was added into the reaction mixture. If the spring balance reading (m) was plotted against time (t), which of the following graphs is most likely to be obtained?



38. Of the following, which one is the **false** statement?

(1) Acid rains occur due to release of chlorofluorocarbons to the atmosphere.
(2) Greenhouse effect is necessary to maintain life.
(3) Greenhouse effect affects global warming.
(4) Oxides of nitrogen affect depletion of the ozone layer.

39. Which of the following disaster conditions has the minimum influence of humans?

(1) occurrence of tsunami **(2)** occurrence of photochemical smog
(3) spread of invasive alien plants **(4)** invasion of settlements by wild animals

40. In a traditional tank (wewa), what is the structure that prevents the erosion of the tank bund?

(1) bisokotuwa **(2)** ralapanawa **(3)** out spill **(4)** wew thaulla

2024 (2025) — answer key and reviews

Source of answers: Official marking scheme 2024(2025).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	4	11	1	21	2	31	2
2	4	12	4	22	4	32	4
3	3	13	4	23	2	33	1
4	3	14	1	24	3	34	3
5	2	15	1	25	1	35	2
6	2	16	3	26	1	36	1
7	3	17	3	27	2	37	4
8	2	18	2	28	3	38	1
9	3	19	3	29	2	39	1
10	3	20	4	30	3	40	2

Q	Ans	Unit	Why this is the answer	Textbook
1	4*	11.1 Living tissues	Stone cells (sclereids) are sclerenchyma cells with thick lignified walls. (*The examiners accepted all answers for this item.)	G11 Part I p. 7
2	4	10.2 Motion in a straight line	Vectors have magnitude and direction: velocity and displacement. Mass, speed, work and pressure are scalars.	G10 Part I p. 47
3	3	11.11 Electronics	Pure silicon is the intrinsic semiconductor; Cu, Al and Fe are metallic conductors.	G11 Part II p. 53
4	3	10.3 Structure of matter	Zinc = Zn, sodium = Na (natrium), silver = Ag (argentum).	G10 Part I p. 81
5	2	10.13 The world of life (classification and nomenclature)	Binomial name: genus with a capital letter, species in lower case, printed in italics (or each word underlined separately when hand-written): Mangifera indica.	G10 Part II p. 24
6	2	10.6 Plant and animal cells	The nucleus carries the chromosomes (DNA) that pass hereditary characteristics to the next generation.	G10 Part I p. 119
7	3	10.14 Continuity of life (reproduction)	At ovulation the mature Graafian follicle bursts and releases the ovum; it then becomes the corpus luteum.	G10 Part II p. 51
8	2	10.15 Hydrostatic pressure and its applications	A sharp edge has a tiny contact area, so the same force produces a much greater pressure (P = F/A).	G10 Part II p. 64
9	3	10.3 Structure of matter	XO shows X is 2+; NaY shows Y is 1-. Balancing charges gives XY_2.	G10 Part I p. 82
10	3	11.6 Biological processes in the human body	Follow the labelled alimentary canal from the mouth: the parts in order are D, E then F (official key).	G11 Part I p. 143
11	1	11.6 Biological processes in the human body	Site A (stomach) is acidic, about pH 3.5, because of HCl in gastric juice; site D (small intestine) is slightly alkaline, about pH 7.5 (bile and pancreatic juice).	G11 Part I p. 146
12	4	10.19 Current electricity	Resistance depends on length, area, material and temperature, not on the potential difference applied.	G10 Part II p. 152
13	4	10.16 Changes in matter	CO_2 is denser than air (upward displacement of air: tube to the bottom); H_2 is lighter (downward displacement of air: jar inverted).	G10 Part II p. 104
14	1	11.14 Hydrocarbons and their derivatives	Synthetic polymers such as polythene are NOT easily biodegradable, which is why they pollute.	G11 Part II p. 163
15	1	11.13 Electromagnetism and electromagnetic induction	Generator voltage is stepped up to 220 kV for transmission, then stepped down to 22 kV and finally to 230 V.	G11 Part II p. 145
16	3	11.6 Biological processes in the human body	The left ventricle pumps blood to the whole body (systemic circulation), so it has the thickest muscular wall.	G11 Part I p. 166

Q	Ans	Unit	Why this is the answer	Textbook
17	3	11.7 Acids, bases and salts	The pH rises from 2.1 (acidic) to 6.8, so X neutralises acid: limestone ($CaCO_3$).	G11 Part I p. 196
18	2	11.3 Mixtures	Gas is more soluble at higher pressure (sealed bottle) and lower temperature (refrigerator).	G11 Part I p. 39
19	3	11.5 Geometrical optics	A plane-mirror image is virtual, same size, as far behind as the object is in front, and laterally inverted.	G11 Part I p. 107
20	4	11.4 Waves and their applications	time = distance/speed = 3.6×10^7 m / 3.0×10^8 m s^{-1}.	G11 Part I p. 86
21	2	10.1 Chemical basis of life	Sucrose is a non-reducing sugar: Benedict's test is negative until acid hydrolysis produces glucose and fructose.	G10 Part I p. 6
22	4	10.13 The world of life (classification and nomenclature)	Bacteria are prokaryotes (no organised nucleus), are killed by antibiotics, and include pathogens and autotrophs.	G10 Part II p. 4
23	2	10.16 Changes in matter	Q is more reactive than P (P cannot displace Q); R is below hydrogen. Order: Q, P, R.	G10 Part II p. 99
24	3	10.15 Hydrostatic pressure and its applications	Squeezing raises pressure, compressing the air in A; its displaced volume falls, so upthrust falls and it sinks (Cartesian diver).	G10 Part II p. 82
25	1	11.4 Waves and their applications	Only A is true. Longitudinal (mechanical) waves need a medium; EM waves travel at different speeds in different media.	G11 Part I p. 74
26	1	11.7 Acids, bases and salts	A shows no colour with phenolphthalein, so it is acidic (HCl); B is NaOH; equal amounts give neutral NaCl (pH 7).	G11 Part I p. 197
27	2	11.2 Photosynthesis	Glucose (monosaccharide) is made first, stored temporarily as starch (polysaccharide) and transported as sucrose (disaccharide).	G11 Part I p. 22
28	3	11.11 Electronics	Trace the current through the diode directions: only the branches with forward-biased diodes carry current (A and C).	G11 Part II p. 60
29	2*	10.20 Inheritance	An ovum is haploid: 22 autosomes + one X chromosome. (*All answers were accepted by the examiners.)	G10 Part II p. 183
30	3	11.6 Biological processes in the human body	At inspiration the diaphragm contracts and flattens (curvature decreases) and the thoracic volume increases.	G11 Part I p. 152
31	2	11.10 Power and energy of electric appliances	Energy = power × time = 1 kW x 2 h = 2 kWh.	G11 Part II p. 47
32	4	11.12 Electrochemistry	Zinc is more reactive than iron and corrodes sacrificially, protecting the iron.	G11 Part II p. 85
33	1	10.4 Newton's laws of motion	Net force = R - mg, so acceleration a = (R - mg)/m.	G10 Part I p. 89
34	3	10.7 Quantification of elements and compounds	Equal numbers of molecules mean equal numbers of moles: mass / Mr is the same for B and D.	G10 Part I p. 132
35	2	10.11 Turning effect of a force	Add the moments of the 5 N and 4 N forces about O (force × perpendicular distance); the net turning effect is 1.6 N m clockwise.	G10 Part I p. 194
36	1	10.10 Chemical bonds	Water has strong hydrogen bonds between molecules, far stronger than the forces between HCl molecules.	G10 Part I p. 183
37	4	10.17 Rate of reactions	Mass of zinc falls as it reacts; the rate slows, then speeds up again when fresh acid is added.	G10 Part II p. 117
38	1	11.15 Biosphere	Acid rain is caused by oxides of sulphur and nitrogen, not CFCs (CFCs deplete ozone).	G11 Part II p. 184
39	1	11.15 Biosphere	A tsunami is a natural event caused by undersea earthquakes; the others are strongly human-influenced.	G11 Part II p. 206
40	2	11.15 Biosphere	The ralapanawa (wave-breaker) protects the bund from erosion by waves. Bisokotuwa is the sluice valve-pit.	G11 Part II p. 204

Paper I • 2023 (2024)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Urea which is an excretory product is produced in

(1) kidneys. **(2)** liver. **(3)** urinary bladder. **(4)** nephrons.

2. What is the unit of power?

(1) W s **(2)** $W\ s^{-1}$ **(3)** J s **(4)** $J\ s^{-1}$

3. The formula of an isopropyl alcohol molecule is $(CH_3)_2CHOH$. What is the number of atoms in this molecule?

(1) 8 **(2)** 10 **(3)** 11 **(4)** 12

4. What is the tissue that transports food produced in plant leaves throughout the plant body?

(1) xylem **(2)** phloem **(3)** cambium **(4)** sclerenchyma

5. When two objects are rubbed together and one of them gets positively charged, transferred to the other are

(1) electrons. **(2)** protons.
(3) neutrons. **(4)** electrons and protons.

6. Which of the following includes an acidic oxide, an amphoteric oxide and a basic oxide in respective order?

(1) SO_3, Al_2O_3, SiO_2 **(2)** SO_3, Al_2O_3, MgO **(3)** CO_2, SiO_2, MgO **(4)** SiO_2, CO_2, Al_2O_3

7. In a plant cell ..... can be called a non-living structure.

(1) cell wall **(2)** plasma membrane **(3)** ribosomes **(4)** Golgi body

8. Another morphological feature of a plant bearing the leaves with the venation shown in the diagram is



(1) presence of a tap root system. **(2)** having a branched stem.
(3) having one cotyledon in the seed. **(4)** bearing tetramerous or pentamerous flowers.

9. Which of the following statements on electromagnetic waves is **false**?

(1) They transmit energy.
(2) They travel with a speed of 3×10^8 m s^{-1} in vacuum.
(3) Frequency is less in a material medium than in vacuum.
(4) Speed is less in a material medium than in vacuum.

10. Which of the following statements is true about ionic compounds?

(1) They conduct electricity in the solid state.
(2) All dissolve well in water.
(3) Boiling points and melting points take high values.
(4) They do not conduct electricity in the fused state.

11. Following symptoms are seen in a person suffering from a disease in the respiratory system.

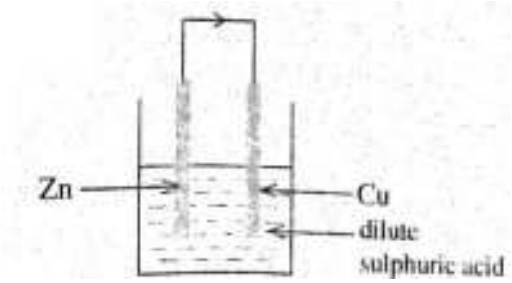
- release of blood with cough
- loss in body weight
- high fatigue

This person would have contracted

(1) pneumonia. **(2)** bronchitis. **(3)** tuberculosis. **(4)** silicosis.

▸ *Questions 12 and 13 are based on the figure given below.*

12. In the direction shown by the arrow, which of the following flow(s) in the external circuit?



(1) conventional current **(2)** electrons **(3)** Zn^{2+} ions **(4)** Cu^{2+} ions

13. What is the cathodic reaction taking place in the above cell?

(1) $Zn^{2+}(aq) + 2e \rightarrow Zn(s)$ **(2)** $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$

(3) $2H^{+}(aq) + 2e \rightarrow H_2(g)$ **(4)** $4OH^{-}(aq) + 4e \rightarrow O_2(g) + 2H_2O(l)$

14. Consider the following statements regarding refraction of light.

A – Light refracts only when it travels from a rarer medium to a denser medium.
B – Reason for the refraction is the difference in the speed of light in the two media.
C – Frequency of light changes during refraction.

Of the above, true statement(s) is/are

(1) only A. **(2)** only B. **(3)** only A and C. **(4)** only B and C.

15. The acceleration due to gravity on the Earth is 10 m s^{-2}. On the moon its value is 1/6th the value on the Earth. What is the weight of an object on the moon if it weighs 60 N on the Earth?

(1) 10 N **(2)** 60 N **(3)** 100 N **(4)** 360 N

16. Of the following characteristics, what are the characteristics common only to Aves and Mammalia belonging to the vertebrate animal group?

A – warm bloodedness
B – skin covered with hair
C – bony internal skeleton
D – four chambered heart

(1) A and B **(2)** A and D **(3)** B and C **(4)** C and D

17. Which of the following is **false** about metals?

(1) Majority of the elements are metals.
(2) All metals conduct electricity.
(3) Metal atoms lose electrons and form positive ions.
(4) All metals react with acids and liberate hydrogen.

18. When a few drops of methyl orange were added to a certain solution, it turned red. Which of the following is most likely to be the pH value of that solution?

(1) 2 **(2)** 7 **(3)** 12 **(4)** 14

19. It takes four seconds for an ultrasonic wave sent by a ship to the bottom of the sea to be reflected and come back to the ship. If the depth to the bottom of the sea is 2880 m, what is the speed of the ultrasonic wave in sea water?

(1) 720 m s^{-1} **(2)** 1440 m s^{-1} **(3)** 2880 m s^{-1} **(4)** 3700 m s^{-1}

20. Given below are some properties of a gas.
- can be burnt easily
- density is less than that of air
- slightly soluble in water

This gas is

(1) hydrogen. **(2)** nitrogen. **(3)** oxygen. **(4)** carbon dioxide.

21. What is the part belonging to the central nervous system which controls the rate of heart beat?

(1) cerebrum **(2)** cerebellum **(3)** spinal cord **(4)** medulla oblongata

22. Consider the following statements about the resistance of a conductor.

A – depends on the potential difference between the two ends of the conductor
B – directly proportional to the length of the conductor
C – depends on the current flowing through the conductor

Of the above, the true statement(s) is/are,

(1) only A. **(2)** only B. **(3)** only A and B. **(4)** only A and C.

23. What is the amount of moles of calcium carbonate in 10 g of calcium carbonate? ($CaCO_3$ = 100)

(1) 0.01 **(2)** 0.1 **(3)** 1 **(4)** 10

24. Select the correct statement about carbohydrates.

(1) All carbohydrates are water-soluble.
(2) All carbohydrates are crystalline.
(3) In carbohydrates, ratio between C and H is 1 : 2.
(4) Glucose is the structural unit of carbohydrates.

25. The figure on the right shows a bimetal strip made of two metals A and B. Of these, the metal expanding more is A while the metal expanding less is B. In which of the following ways does the shape of the bimetal strip change when its temperature is increased?



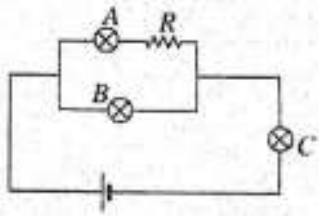
26. If an object made up of a solid substance is to float in a liquid,

(1) the density of the solid substance should be less than the density of the liquid.
(2) the mass of the solid object should be equal to the mass of the liquid displaced.
(3) weight of the solid object should be equal to the weight of the liquid volume displaced by it.
(4) weight of the solid object should be less than the upthrust acting on it.

27. Of the offspring produced by the interbreeding of two organisms with the genotype Tt, the numbers of the genotypes and the phenotypes differing from one another respectively are

(1) 2 and 1. **(2)** 3 and 2. **(3)** 4 and 2. **(4)** 4 and 3.

28. The figure indicates how three identical bulbs A, B and C and a resistor R are connected in a circuit. Which statement correctly indicates the relationship among the brightness of the bulbs A, B and C?



(1) A < B < C **(2)** A = B = C **(3)** A = B < C **(4)** A < C < B

29. Indicated below is the reaction between haematite and carbon monoxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

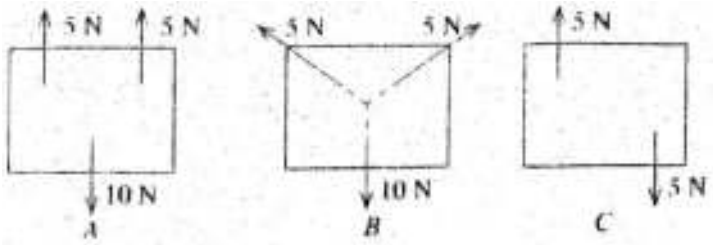
What is the mass of Fe that can be produced using one mole of Fe_2O_3? (Fe = 56)

(1) 28 g **(2)** 56 g **(3)** 112 g **(4)** 168 g

30. The amount of platelets in the blood of a person subjected to a viral infection has decreased below the normal value. As a result of it, in his body,

(1) transport of oxygen becomes faster.
(2) production of antibodies is suppressed.
(3) clotting of blood does not occur properly.
(4) transport of hormones becomes slower.

31. Figures A, B and C show how coplanar forces are applied on three rectangular sheets.



Of the above, the sheet(s) in equilibrium is/are

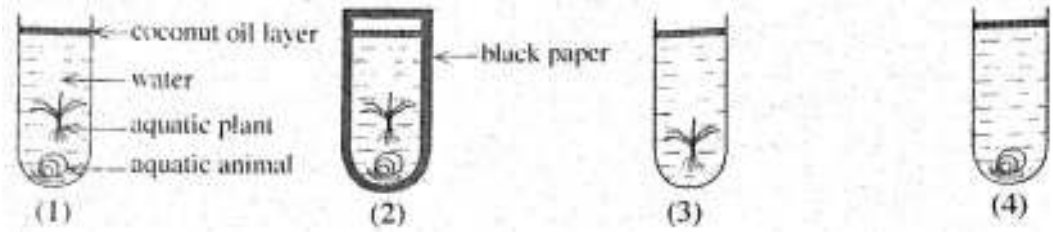
(1) only A. **(2)** only B. **(3)** only A and C. **(4)** all A, B and C.

32. **A** – Catalysts increase the rate of a chemical reaction.
B – At the end of the reaction, the chemical composition of the catalyst changes.

Of the above,

(1) both the statements A and B are true.
(2) statement A is true while statement B is false.
(3) both the statements A and B are false.
(4) statement A is false while statement B is true.

33. The set ups (1), (2), (3) and (4) shown in the figures were prepared by adding equal volumes of water with equal concentration of carbon dioxide to four identical test tubes. In which set up will there be the **lowest** carbon dioxide concentration after exposing these four set ups for three hours to identical conditions of light?



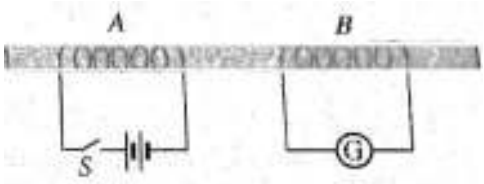
34. Consider the following statements on polymers.

A – have a very high relative molecular mass
B – small molecules contributing to make them are known as repeating units
C – can be classified as artificial and natural based on origin

Of these, the true statement(s) is/are,

(1) only A. **(2)** only B. **(3)** only A and C. **(4)** only B and C.

35. The figure illustrates how two insulated copper coils A and B are wound around a soft iron core. Which of the following statement is true about this arrangement?



(1) The moment the switch S is closed, a current flows in A while no current flows in B.
(2) When the switch S is kept continuously closed, a current flows in A and a current flows in B too.
(3) Only the moment the switch S is closed, a current flows in B.
(4) Only the moment the switch S is opened and is closed, a current flows in B.

36. Of the following statements on the velocity-time graphs, which one is **false**?
(1) The area covered by the graph gives the displacement of the object.
(2) The graph starts from the origin for the objects starting their motion from the state of rest.
(3) The gradient of the graph is zero in a motion where the velocity varies with time.
(4) The gradient of the graph gives the acceleration / deceleration.

37. What is the pollutant that contributes to the abnormal growth of algae population in oceanic ecosystems?
(1) heavy metals **(2)** sulphate **(3)** nuclear waste **(4)** phosphate

38. During the discussions held with a few adults living in coastal areas, they stated that at present, they witness an increase in the number of outbreaks of storms occurring per year and their severity while coastal erosion occurs largely. Which of the following environmental phenomenon contributes most to this condition?
(1) global warming **(2)** greenhouse effect
(3) ozone layer depletion **(4)** eutrophication

39. The environmental pyramids always indicated in an upright way are,
(1) biomass pyramids. **(2)** number pyramids.
(3) energy pyramids. **(4)** energy pyramids and biomass pyramids.

40. Which of the following practices is an example for the principle of recycling?
(1) making door mats from the Denim trousers no more in use
(2) younger brother wearing the clothes used by his elder brother
(3) using the same cloth bag to carry foodstuffs bought day-to-day
(4) restitching and wearing a clothe whose stitches have gone undone

2023 (2024) — answer key and reviews

Source of answers: Official marking scheme 2023(2024).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	2	11	3	21	4	31	1
2	4	12	2	22	2	32	2
3	4	13	3	23	2	33	3
4	2	14	2	24	4	34	3
5	1	15	1	25	4	35	4
6	2	16	2	26	3/2	36	3
7	1	17	4	27	2	37	4
8	3	18	1	28	1	38	1
9	3	19	2	29	3	39	3
10	3	20	1	30	3	40	1

Q	Ans	Unit	Why this is the answer	Textbook
1	2	11.6 Biological processes in the human body	Urea is made in the liver from excess amino acids (deamination); the kidneys only excrete it.	G11 Part I p. 158
2	4	10.18 Work, energy and power	Power = work/time, so its unit is J s^{-1} (= watt).	G10 Part II p. 136
3	4	10.3 Structure of matter	$(CH_3)_2CHOH = C_3H_8O$: 3 C + 8 H + 1 O = 12 atoms.	G10 Part I p. 75
4	2	11.1 Living tissues	Phloem translocates food (mainly sucrose) from the leaves to all parts of the plant; xylem carries water.	G11 Part I p. 9
5	1	10.19 Current electricity	Only electrons move during charging by friction; the object that loses electrons becomes positive.	G10 Part II p. 141
6	2	10.3 Structure of matter	SO_2 is acidic (non-metal oxide), Al_2O_3 is amphoteric, MgO is basic (metal oxide).	G10 Part I p. 73
7	1	10.6 Plant and animal cells	The cellulose cell wall is secreted by the cell and is non-living.	G10 Part I p. 113
8	3	10.13 The world of life (classification and nomenclature)	The leaf shows parallel venation, a monocot feature; monocots also have one cotyledon in the seed.	G10 Part II p. 14
9	3*	11.4 Waves and their applications	Frequency does not change when EM waves enter a medium, so (3) is false. (*All answers were accepted by the examiners.)	G11 Part I p. 81
10	3	10.10 Chemical bonds	Ionic compounds have strong electrostatic lattices, so high melting and boiling points. They conduct only when molten or dissolved.	G10 Part I p. 185
11	3	11.6 Biological processes in the human body	Coughing blood, weight loss and fatigue are classic signs of tuberculosis.	G11 Part I p. 156
12	2	11.12 Electrochemistry	In the external circuit of a cell, electrons flow from the zinc (anode) to the copper (cathode).	G11 Part II p. 83
13	3	11.12 Electrochemistry	At the copper cathode of a simple Zn/Cu/dilute H_2SO_4 cell, H^+ ions are reduced: $2H^+ + 2e^- \rightarrow H_2$.	G11 Part II p. 94
14	2	11.5 Geometrical optics	Refraction is caused by the change of speed between media. It occurs in both directions and frequency stays constant.	G11 Part I p. 120
15	1	10.4 Newton's laws of motion	Weight on the Moon = 60 N / 6 = 10 N (mass does not change).	G10 Part I p. 95
16	2	10.13 The world of life (classification and nomenclature)	Birds and mammals are the only warm-blooded vertebrates with a four-chambered heart; hair is only in mammals.	G10 Part II p. 23
17	4	10.3 Structure of matter	False: metals below hydrogen (Cu, Ag, Au) do not liberate H_2 from dilute acids.	G10 Part I p. 66

Q	Ans	Unit	Why this is the answer	Textbook
18	1	11.7 Acids, bases and salts	Methyl orange turns red in acidic solution (pH below about 3), so pH 2.	G11 Part I p. 196
19	2	11.4 Waves and their applications	The wave travels to the bottom and back: speed = 2 × 2880 m / 4 s = 1440 m s^{-1}.	G11 Part I p. 97
20	1	10.16 Changes in matter	Combustible, lighter than air and only slightly soluble in water: hydrogen.	G10 Part II p. 103
21	4	11.6 Biological processes in the human body	The medulla oblongata controls involuntary actions such as heart rate and breathing.	G11 Part I p. 176
22	2	10.19 Current electricity	Resistance is directly proportional to length (B). It does not depend on p.d. or current.	G10 Part II p. 151
23	2	10.7 Quantification of elements and compounds	Moles = mass / Mr = 10 g / 100 g mol^{-1} = 0.1 mol.	G10 Part I p. 132
24	4*	10.1 Chemical basis of life	Glucose is the structural unit (monomer) of starch, glycogen and cellulose. (*All answers accepted.)	G10 Part I p. 5
25	4	11.9 Heat	The metal that expands more (A) ends up on the outside (convex side) of the curve when heated.	G11 Part II p. 19
26	3/2	10.15 Hydrostatic pressure and its applications	Both (3) and (2) accepted. A body floats when its weight equals the upthrust, i.e. the weight of liquid it displaces.	G10 Part II p. 83
27	2	10.20 Inheritance	Tt x Tt gives TT, Tt, tt (3 genotypes) and 2 phenotypes (dominant and recessive).	G10 Part II p. 185
28	1	10.19 Current electricity	Bulbs in parallel or series share current differently; trace the circuit: brightness order A < B < C (official key).	G10 Part II p. 155
29	3	10.7 Quantification of elements and compounds	Fe_2O_3 contains 2 mol Fe: 2 × 56 = 112 g of iron per mole of Fe_2O_3.	G10 Part I p. 131
30	3	11.6 Biological processes in the human body	Platelets are needed for blood clotting; low platelet count (e.g. dengue) leads to poor clotting.	G11 Part I p. 165
31	1	10.12 Equilibrium of forces	A body is in equilibrium only when the resultant force (and moment) is zero; only sheet A satisfies this.	G10 Part I p. 210
32	2	10.17 Rate of reactions	Catalysts speed up reactions (A true) but are chemically unchanged at the end (B false).	G10 Part II p. 121
33	3	11.2 Photosynthesis	With light, the plant alone uses CO_2 for photosynthesis and no animal adds CO_2, so set-up (3) has the least.	G11 Part I p. 22
34	3	11.14 Hydrocarbons and their derivatives	Polymers have very high Mr (A) and are natural or synthetic (C). The small molecules are monomers, not repeating units.	G11 Part II p. 160
35	4	11.13 Electromagnetism and electromagnetic induction	Current is induced in coil B only while the magnetic flux changes, i.e. at the moments S is closed or opened.	G11 Part II p. 136
36	3	10.2 Motion in a straight line	False statement: in a velocity-time graph the gradient is zero only when velocity is constant.	G10 Part I p. 37
37	4	11.15 Biosphere	Phosphate (and nitrate) from fertilisers and detergents cause eutrophication and algal blooms.	G11 Part II p. 194
38	1	11.15 Biosphere	More frequent, stronger storms and coastal erosion (sea-level rise) are effects of global warming.	G11 Part II p. 191
39	3*	11.15 Biosphere	Energy pyramids are always upright. (*All answers were accepted by the examiners.)	G11 Part II p. 176
40	1	11.15 Biosphere	Recycling turns used material into a new product (denim to door mats); reuse and repair are different R's.	G11 Part II p. 208

Paper I • 2022 (2023)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. What is the organ that mainly performs nitrogenous excretion of human?
(1) kidneys **(2)** lungs **(3)** skin **(4)** liver

2. The unit of pressure is,
(1) N m^{-1}. **(2)** N m^{-2}. **(3)** N m. **(4)** N m^{2}.

3. What is the type of biomolecules in which hydrogen and oxygen atoms are combined in the ratio of 2 : 1?
(1) carbohydrates **(2)** lipids **(3)** proteins **(4)** nucleic acids

4. Select the correct statement given about atoms.
(1) The nucleus of all the atoms of every element contains neutrons.
(2) In every atom, the number of neutrons and the number of protons in the nucleus are equal.
(3) The atomic numbers of two atoms of different elements can be equal.
(4) There may be atoms with different mass numbers in the same element.

5. Of the following plant tissues, which is a complex, permanent tissue?
(1) parenchyma **(2)** collenchyma **(3)** sclerenchyma **(4)** xylem

6. What is the particle that contributes to the flow of an electric current through a metallic conductor?
(1) electron **(2)** proton **(3)** neutron **(4)** metal ion

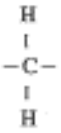
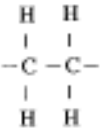
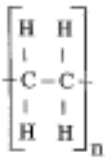
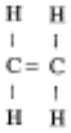
▸ *Questions 7 and 8 are based on the following chemical equation.* $M(s) + ZnSO_4(aq) \rightarrow MSO_4(aq) + Zn(s)$

7. In the above chemical equation, the metal indicated as M could be,
(1) Cu. **(2)** Fe. **(3)** Mg. **(4)** Pb.

8. What is the type of reaction to which the above chemical equation belongs?
(1) combination **(2)** decomposition **(3)** single displacement **(4)** double displacement

9. The kingdoms to which only heterotrophs belong are,
(1) fungi and protista. **(2)** protista and plantae.
(3) plantae and animalia. **(4)** fungi and animalia.

10. Of the following structures, select the repeating unit of polythene.

(1)  (2)  (3)  (4) 

11. Which is the phenomenon that **cannot** be explained by total internal reflection?
(1) travelling of light through optical fibres
(2) making diamond shiny by cutting and polishing
(3) formation of a rainbow by dispersion of white light into colours
(4) turning a ray of light by 90° by a rectangular prism

12. Which of the following is a change that occurs after the process of fertilization of a flower?
(1) ovary turning into the pericarp **(2)** ovules turning into seeds
(3) sepals turning into the seed coat **(4)** integument turning into the pericarp

13. Which of the following is **not** a characteristic of the smooth muscle tissue?

(1) cells being uninucleate **(2)** having cross striations
(3) cells are spindle shaped **(4)** acting involuntarily

14. Consider the following statements given about mechanical waves.

A – The frequency of the wave changes on entering from one medium into another.
B – The speed of the wave does not depend on its frequency.
C – The speed of the wave depends on the medium through which it travels.

Of the above, true statement/s is/are,

(1) only A. **(2)** only B. **(3)** only A and C. **(4)** only B and C.

15. Given below are some information regarding a certain element.

- It comes second in the order of abundance of elements in the Earth's crust.
- Shows semi-conductor properties.
- Shows metallic properties as well as non- metallic properties.

This element is,

(1) aluminium. **(2)** silicon. **(3)** boron. **(4)** phosphorus.

16. A group of students counted the number of animals in a unit area of an ecosystem. Those numbers are given below.

Animal species	**butterfly**	**spider**	**snail**	**earthworm**	**leech**	**centipede**	**gecko**
Number	2	1	3	1	2	1	1

What is the number of animals belonging to phylum Annelida in the relevant area?

(1) 1 **(2)** 3 **(3)** 4 **(4)** 6

17. Of the following compounds, what is the compound in which the percentage of oxygen by mass is 50%? (H = 1, C = 12, N = 14, O = 16, Mg = 24, Ca = 40)

(1) NH_4OH **(2)** $Ca(OH)_2$ **(3)** CH_3OH **(4)** $MgCO_3$

18. What is the advantage of using the handle fixed to a door in the occasions of opening and closing it?

(1) adequacy of applying a low moment of force **(2)** being able to execute a greater rotation
(3) adequacy of applying a smaller force **(4)** reduction of the amount of work done

19. In the male reproductive system, sperms are produced in the,

(1) testes. **(2)** penis. **(3)** prostrate gland. **(4)** seminal vesicles.

20. What is the statement that is true with respect to all the molecules given below?

CO_2, NH_3, H_2O

(1) The electron octet of the central atom of the molecules is complete.
(2) Only single bonds occur among the atoms of the molecules.
(3) Lone pairs of electrons are present on the central atom of the molecules.
(4) The molecules exist only as gases at room temperature.

21. Consider the following statements given about heat transfer.

A – Sea breeze and land breeze occur due to conduction.
B – Heat reaches the Earth from the Sun by radiation.
C – When a metal spoon is put into a hot cup of tea it is heated by convection.

Of the above, true statement/s is/are,

(1) only A. **(2)** only B. **(3)** only A and C. **(4)** only B and C.

22. A function of the hormone adrenaline is,

(1) preparing body to respond in emergencies.
(2) controlling the rate of metabolic activities in the body.
(3) stimulating the growth of bones.
(4) stimulating the spermatogenesis of males.

23. What is the amount of moles of O_2 in 64 g of oxygen? (O = 16)

(1) 1 **(2)** 2 **(3)** 3 **(4)** 4

24. In a transformer, the voltage supplied to the primary coil is 120 V while the voltage received from the secondary coil is 12 V. If the current flowing through the primary coil is 2 A, what is the current flowing through the secondary coil?

(1) 0.2 A **(2)** 2 A **(3)** 10 A **(4)** 20 A

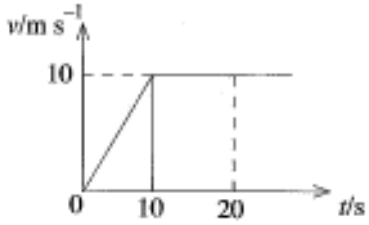
25. Consider the following statements given with regard to anaerobic respiration.

A – Lactic acid is produced during the anaerobic respiration taking place in animal cells.
B – The amount of energy produced in anaerobic respiration is higher than that in aerobic respiration.
C – A part of energy produced during anaerobic respiration is stored as ATP.

Of the above, the true statements are,

(1) only A and B. **(2)** only A and C. **(3)** only B and C. **(4)** all A, B and C.

26. Indicated here is the velocity-time graph for the motion of a certain object. What is the displacement of the object from the beginning to 20 s?



(1) 50 m **(2)** 100 m **(3)** 150 m **(4)** 200 m

27. Consider the following statements.

A – In chemical industries, catalysts are used to obtain a higher yield in a shorter period of time.
B – Catalysts increase as well as decrease the rate of chemical reactions.

Of the above statements,

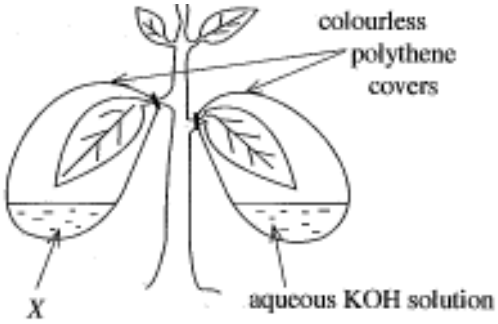
(1) both A and B are true. **(2)** A is true while B is false.
(3) both A and B are false. **(4)** A is false while B is true.

28. Which of the following phenomena agrees most with Newton's third law of motion?

(1) A ball falling down from a higher level bouncing after touching the ground.
(2) The velocity of a fruit falling from a tree reaching the maximum value when it comes closer to the ground.
(3) Flinging of passengers forward when brakes are suddenly applied to a running bus.
(4) Changing the direction of a moving football by kicking it.

▸ *Questions 29 and 30 below are based on the figure given.*

29. The need of which factor for photosynthesis is expected to be tested by this set up?



(1) water **(2)** light **(3)** chlorophyll **(4)** carbon dioxide

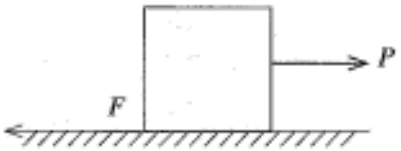
30. What is the substance labelled X in the above figure?

(1) water **(2)** lime water **(3)** iodine solution **(4)** ethyl alcohol

31. What is the mass of $C_6H_{12}O_6$ required to prepare 1 dm^3 of a 0.1 mol dm^{-3} glucose solution? (H = 1, C = 12, O = 16)

(1) 0.18 g **(2)** 1.8 g **(3)** 18 g **(4)** 180 g

32. The figure shows how a horizontal force P is applied on an object placed on a plane. When the value of P is gradually increased from zero, the frictional force (F) acting on the object,



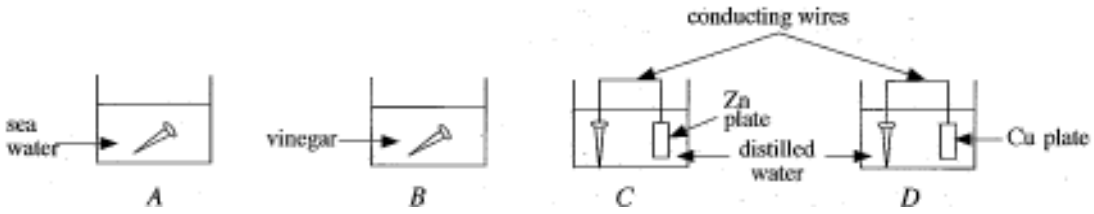
(1) takes a constant value continuously from the beginning.

(2) increases gradually from zero to a maximum value.

(3) increases gradually from zero to a maximum value and then decreases gradually.

(4) increases gradually from zero to a maximum value, then decreases slightly and takes a constant value.

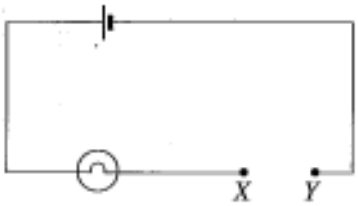
33. Arrangements A, B, C and D set up by a student in the laboratory using four clean, iron nails to study about corrosion of iron are as follows.



When observed after a few days, the nail in which arrangement has corroded least?

(1) A **(2)** B **(3)** C **(4)** D

34. By connecting a conducting wire between X and Y in the circuit shown in the figure, the bulb in it can be lighted. In three instances, three wires made of the same metal were connected between X and Y as given below and the brightness of the bulb was measured.



A – connecting a thin long wire
B – connecting a thick short wire
C – connecting a thin short wire

Accordingly, what is the order in which the brightness of the bulb **increases**?

(1) A , B , C **(2)** A , C , B **(3)** B , A , C **(4)** C , B , A

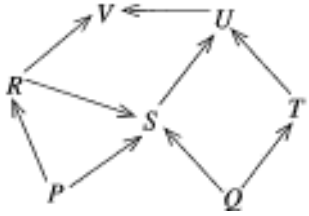
35. In a water barometer, the vertical height of the water column is 10 m. What is the atmospheric pressure at that instant? (Density of water = 1000 kg m^{-3}, Acceleration due to gravity = 10 m s^{-2})

(1) 1.0×10^2 Pa **(2)** 1.0×10^3 Pa **(3)** 1.0×10^4 Pa **(4)** 1.0×10^5 Pa

36. What is the chemical compound that ionises completely in aqueous solution and releases H^+ ions?

(1) CH_3COOH **(2)** H_3PO_4 **(3)** H_2CO_3 **(4)** HNO_3

37. A food web that can be seen in a terrestrial ecosystem is shown in the figure. What is the **most correct** inference that can be made based on this food web?



(1) R is a herbivore. **(2)** U is a carnivore. **(3)** S is an ominivore. **(4)** V is an ominivore.

38. Of the following, which option indicates the courses of action relevant to sustainable use of resources and use of renewable energy resources respectively?

(1) waste management and production of electricity by wind power
(2) reforestation and production of electricity by coal
(3) converting marshlands into cultivable lands and production of electricity by solar energy
(4) minimizing food mile and production of electricity by mineral oil

39. Which option indicates the chemical species affecting the environmental crises, ozone layer depletion, acid rains and eutrophication respectively?

(1) CFC, NO_2, CO_3^{2-} **(2)** CFC, SO_2, NO_3^- **(3)** NO_2, CO_2, PO_4^{3-} **(4)** NO, SO_2, SO_4^{2-}

40. Select the pair with inversely proportional relationship.

(1) concentration of greenhouse gases - atmospheric temperature
(2) food mile - carbon footprint
(3) deforestation - desertification
(4) emergence of invasive species - biodiversity

2022 (2023) — answer key and reviews

Source of answers: Official marking scheme 2022(2023).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	3	21	2	31	3
2	2	12	2	22	1	32	4
3	1	13	2	23	2	33	3
4	4	14	4	24	4	34	2
5	4	15	2	25	2	35	4
6	1	16	2	26	3	36	4
7	3	17	3	27	2	37	3
8	3	18	3	28	1	38	1
9	4	19	1	29	4	39	2
10	2	20	1	30	1	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	1	11.6 Biological processes in the human body	The kidneys remove nitrogenous waste (urea) from blood; the liver makes urea but does not excrete it.	G11 Part I p. 158
2	2	10.15 Hydrostatic pressure and its applications	Pressure = force/area, unit N m^{-2} (pascal).	G10 Part II p. 63
3	1	10.1 Chemical basis of life	Carbohydrates have the general formula Cx(H2O)y: H and O in a 2:1 ratio, as in water.	G10 Part I p. 2
4	4	10.3 Structure of matter	Isotopes: atoms of one element can have different numbers of neutrons, hence different mass numbers.	G10 Part I p. 61
5	4	11.1 Living tissues	Xylem contains several cell types (vessels, tracheids, fibres, parenchyma), so it is a complex permanent tissue.	G11 Part I p. 8
6	1	10.19 Current electricity	Current in a metal is a flow of free (delocalised) electrons.	G10 Part II p. 144
7	3	10.16 Changes in matter	M must be above zinc in the activity series to displace it: magnesium.	G10 Part II p. 99
8	3	10.16 Changes in matter	One element displaces another from its compound: single displacement.	G10 Part II p. 90
9	4	10.13 The world of life (classification and nomenclature)	Fungi and animals are entirely heterotrophic; plants and many protists photosynthesise.	G10 Part II p. 6
10	2	11.14 Hydrocarbons and their derivatives	Polythene is made from ethene; its repeating unit is $-CH_2-CH_2^-$ (structure 2).	G11 Part II p. 160
11	3	11.5 Geometrical optics	A rainbow forms by dispersion and refraction, not total internal reflection; the others use TIR.	G11 Part I p. 125
12	2	10.14 Continuity of life (reproduction)	After fertilisation the ovules become seeds and the ovary becomes the fruit wall.	G10 Part II p. 42
13	2	11.1 Living tissues	Smooth muscle has no cross striations; it is uninucleate, spindle-shaped and involuntary.	G11 Part I p. 13
14	4	11.4 Waves and their applications	B and C are true. Frequency does not change when a wave enters another medium (A false).	G11 Part I p. 80
15	2	10.3 Structure of matter	Silicon: second most abundant element in the crust, a metalloid and a semiconductor.	G10 Part I p. 72
16	2	10.13 The world of life (classification and nomenclature)	Annelids are the segmented worms: earthworm (1) + leech (2) = 3.	G10 Part II p. 16

Q	Ans	Unit	Why this is the answer	Textbook
17	3	10.7 Quantification of elements and compounds	CH_3OH: Mr = 32, oxygen = 16, so 16/32 = 50%.	G10 Part I p. 124
18	3	10.11 Turning effect of a force	A handle far from the hinge increases the perpendicular distance, so a smaller force gives the needed moment.	G10 Part I p. 190
19	1	10.14 Continuity of life (reproduction)	Sperms are produced in the seminiferous tubules of the testes.	G10 Part II p. 49
20	1	10.10 Chemical bonds	In the molecules shown the central atom has a complete octet (check each Lewis structure).	G10 Part I p. 179
21	2	11.9 Heat	Only B: radiation carries heat from the Sun. Sea/land breezes are convection; a spoon heats by conduction.	G11 Part II p. 25
22	1	11.6 Biological processes in the human body	Adrenaline prepares the body for 'fight or flight' in emergencies.	G11 Part I p. 178
23	2	10.7 Quantification of elements and compounds	Moles of O_2 = 64 g / 32 g mol^{-1} = 2 mol.	G10 Part I p. 135
24	4	11.13 Electromagnetism and electromagnetic induction	Ideal transformer: VpIp = VsIs, so Is = 120 × 2 / 12 = 20 A.	G11 Part II p. 146
25	2	11.6 Biological processes in the human body	A and C true. Anaerobic respiration releases LESS energy than aerobic (B false).	G11 Part I p. 155
26	3	10.2 Motion in a straight line	Displacement = area under the velocity-time graph; calculate trapezium area = 150 m.	G10 Part I p. 41
27	2	10.17 Rate of reactions	Catalysts give faster product formation (A true) but do not slow reactions (B false at O/L).	G10 Part II p. 121
28	1	10.4 Newton's laws of motion	A ball bounces because the ground pushes back on it with an equal and opposite force (action-reaction).	G10 Part I p. 97
29	4	11.2 Photosynthesis	KOH absorbs carbon dioxide, so the set-up tests whether CO_2 is needed for photosynthesis.	G11 Part I p. 25
30	1	11.2 Photosynthesis	X is water in the control set-up (official key), so only the absence of CO_2 differs.	G11 Part I p. 26
31	3	11.3 Mixtures	0.1 mol of glucose (Mr 180) = 0.1 × 180 = 18 g in 1 dm^3.	G11 Part I p. 46
32	4	10.5 Friction	Static friction rises with P up to limiting friction, then drops slightly to a constant dynamic friction.	G10 Part I p. 109
33	3	11.12 Electrochemistry	Iron corrodes least in arrangement C, where it is protected (e.g. connected to a more reactive metal / no electrolyte).	G11 Part II p. 110
34	2	10.19 Current electricity	R is proportional to length and inversely to area: thin long (A) is dimmest, thin short (C) next, thick short (B) brightest.	G10 Part II p. 155
35	4	10.15 Hydrostatic pressure and its applications	$P = h \rho g = 10 \times 1000 \times 10 = 1.0 \times 10^5$ Pa.	G10 Part II p. 76
36	4	11.7 Acids, bases and salts	Nitric acid is a strong acid and ionises completely; the others are weak acids.	G11 Part I p. 191
37	3	11.15 Biosphere	Read the food web: S eats both plants and animals, so it is an omnivore.	G11 Part II p. 172
38	1	11.15 Biosphere	Waste management conserves resources and wind power is renewable.	G11 Part II p. 209
39	2	11.15 Biosphere	Ozone depletion - CFC; acid rain - SO_2; eutrophication - nitrate/phosphate ions.	G11 Part II p. 192
40	4	11.15 Biosphere	As invasive species spread, native biodiversity falls (inverse relationship).	G11 Part II p. 196

Paper I • 2021 (2022)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. To which of the following organizational level does the human heart belong?

(1) cell **(2)** tissue **(3)** organ **(4)** system

2. The hydrocarbons contained in LP gas as its major components are

(1) methane and ethane. **(2)** propane and butane. **(3)** butane and pentane. **(4)** propane and pentane.

3. What is the unit of the amount of work?

(1) kg m s^{-1} **(2)** kg m s^{-2} **(3)** kg m^{-1} s^{-1} **(4)** kg m^2 s^{-2}

4. Which of the following is **not** a characteristic of the cardiac muscle tissue?

(1) cells being mononuclear **(2)** occurrence of intercalated discs
(3) cells being branched **(4)** acting voluntarily

5. A seed observed by a student during a field study is shown in the diagram. This seed is dispersed by



(1) animals. **(2)** water. **(3)** wind. **(4)** explosion.

6. Which of the following quantity increases uniformly in an object moving with a constant acceleration?

(1) distance **(2)** displacement **(3)** velocity **(4)** retardation

7. Which of the following is equal in $^{40}_{19}K$ and $^{40}_{20}Ca$ atoms?

(1) number of electrons **(2)** number of neutrons
(3) sum of the number of electrons and protons **(4)** sum of the number of protons and neutrons

8. Which property of water causes water to be used as a cooling agent to remove excessive heat generated in an automobile engine?

(1) having a high specific heat capacity **(2)** having a high boiling point
(3) being a colourless liquid **(4)** having a high density

9. In the process of digestion of food, bile necessary for the emulsification of lipids is produced in the

(1) gall bladder. **(2)** liver. **(3)** duodenum. **(4)** pancreas.

10. What is the essential element for the production of thyroxine hormone in the thyroid gland?

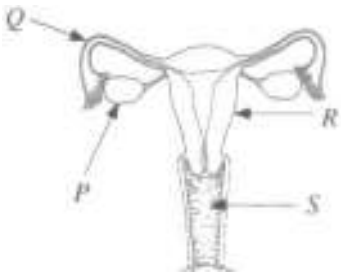
(1) sodium **(2)** phosphorus **(3)** calcium **(4)** iodine

11. How much is the mass of NaCl contained in 100 cm^3 of a sodium chloride solution of concentration 1.0 mol dm^{-3}? (Na = 23, Cl = 35.5)

(1) 585 g **(2)** 58.5 g **(3)** 5.85 g **(4)** 0.585 g

▸ *Questions 12 and 13 are based on the female reproductive system given in the diagram.*

12.



R and S respectively represent

(1) uterus and vagina.
(2) uterus and fallopian tube.
(3) ovary and vagina.
(4) ovary and fallopian tube.

13. An ovum fertilizes with a sperm in

(1) P. **(2)** Q. **(3)** R. **(4)** S.

14. The image of a real object produced by a convex mirror is always

(1) real and smaller than the object.
(2) real and larger than the object.
(3) virtual and smaller than the object.
(4) virtual and larger than the object.

15. What is the increasing order of pH of four solutions of HCl, CH_3COOH, NaOH and NH_3 of equal concentration?

(1) $HCl < CH_3COOH < NaOH < NH_3$
(2) $HCl < CH_3COOH < NH_3 < NaOH$
(3) $CH_3COOH < HCl < NaOH < NH_3$
(4) $CH_3COOH < HCl < NH_3 < NaOH$

16. What is the number of CO_2 molecules in 22 g of carbon dioxide? (C = 12, O = 16, Avagadro constant = 6.022×10^{23} mol^{-1})

(1) $22/44 \times 6.022 \times 10^{23}$
(2) $44/22 \times 6.022 \times 10^{23}$
(3) $(6.022 \times 10^{23})/(44 \times 22)$
(4) $44 \times 22 \times 6.022 \times 10^{23}$

17. The chemical formula of the chemical fertilizer urea is $CO(NH_2)_2$. Select the correct statement about urea.

(1) Urea possesses the properties of the constituent elements.
(2) A molecule of urea has two carbon atoms.
(3) A molecule of urea has four hydrogen atoms.
(4) The total number of atoms in a urea molecule is seven.

18. Which option contains only the components that are found in the glomerular filtrate but not in urine of a healthy person?

(1) glucose, amino acids **(2)** water, glucose **(3)** urea, amino acids **(4)** water, urea

19. A jack fruit of mass 10 kg is falling freely from a height of 5 m of a jack tree. What is the velocity acquired by the fruit when it touches the ground? (Acceleration due to gravity is 10 m s^{-2}. Assume that the resistance of air is negligibly small.)

(1) 5 m s^{-1} **(2)** 10 m s^{-1} **(3)** 50 m s^{-1} **(4)** 100 m s^{-1}

20. Select the correct statement regarding the circulation of blood in humans.

(1) Always arteries contain oxygenated blood.
(2) When circulated once through the body, blood goes twice through lungs.
(3) Left ventricle acts as the pump of systemic blood circulation.
(4) Always veins circulate blood away from the heart.

21. A few ways of connecting four resistors of equal magnitude are shown below. Of them, which one has the lowest equivalent resistance?



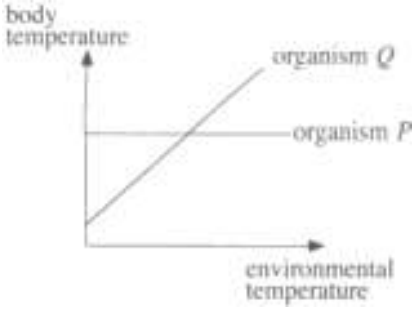
22. Consider the following organs.

A – skin
B – kidneys
C – pancreas

Of these, those that contribute to maintain homoeostasis of the body is/are

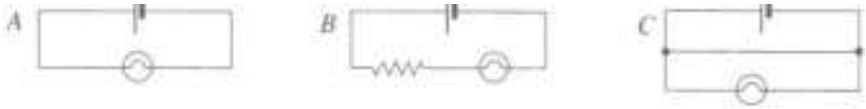
(1) only A. **(2)** only A and B. **(3)** only B and C. **(4)** all A, B and C.

23. The graphs P and Q respectively indicate how the body temperature of the two organisms P and Q varies with the temperature of the environment. The organisms P and Q respectively can be



(1) ox and bat. **(2)** fowl and tortoise. **(3)** elephant and duck. **(4)** frog and Thilapia.

24. In which order does the brightness of the bulb decrease in the circuits A, B and C?



(1) A > B > C **(2)** A > C > B **(3)** B > C > A **(4)** C > A > B

25. Some information regarding an element are as follows.

- Has several allotropic forms.
- One allotropic form conducts electricity.

This element is

(1) carbon. **(2)** oxygen. **(3)** sulphur. **(4)** iron.

26. Some functions of the human brain are given below.

A – reception of senses
B – maintaining the balance of the body
C – controlling the rate of heart beat

Of the above, cerebellum controls

(1) only A. **(2)** only B. **(3)** only A and B. **(4)** only B and C.

27. Consider the following statements.

A – The rate of a reaction increases when the temperature increases.
B – The kinetic energy of reactant particles increases when the temperature increases.

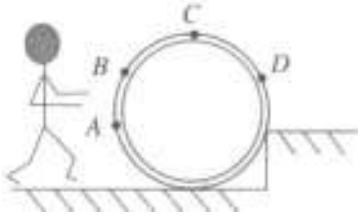
Of these

(1) both statements A and B are true.
(2) statement A is true and statement B is false.
(3) both statements A and B are false.
(4) statement A is false and statement B is true.

28. Which of the following phenomena **cannot be** explained by the Archimedes principle?

(1) a ship cruising in the sea sinking more when entering a river
(2) a balloon filled with helium gas moving upwards through air
(3) floating of sunk orange seeds in a glass of orange juice when dissolving sugar
(4) lifting a large mass by a hydraulic jack by applying a small force

29. The diagram shows a cross section of a cylindrical concrete ring kept on a flight of steps. Indicated as A, B, C and D are four points at which force can be applied by a man to roll it to the upper level. What is the point at which force can be applied on the cylinder in a suitable direction to roll it up with a lowest force?



(1) A **(2)** B **(3)** C **(4)** D

30. When thin iron wool is heated, it instantly burns. But though an iron nail is heated till red hot, it does not undergo a considerable change. What conclusion can be drawn from these observations?

(1) Iron wool acts as a catalyst.
(2) Iron wool and iron nail undergo reactions different from each other.
(3) The composition of iron wool and iron nail is different from each other.
(4) The rate of a reaction depends on the physical nature of the reactants.

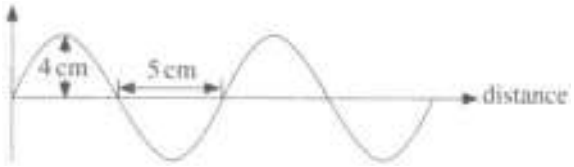
31. In 2011, the number of elephants in Sri Lanka was 5879. What is the most suitable biospherical organizational level to denominate that number of elephants?

(1) species **(2)** population **(3)** community **(4)** eco-system

32. Select the correct option with regard to an npn transistor.

	Base	**Emitter**	**Collector**
(1)	p	n	n
(2)	n	p	n
(3)	p	n	p
(4)	n	n	p

33. The situation of transverse wave travelling on the surface of water at a certain moment is shown in the figure. The amplitude and the wave length of this wave respectively are

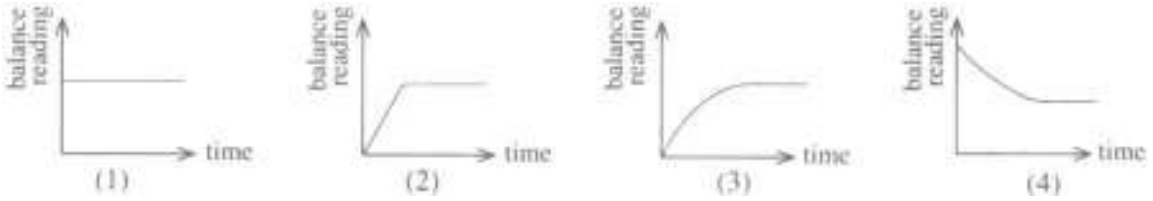


(1) 4 cm and 5 cm. **(2)** 4 cm and 10 cm. **(3)** 5 cm and 4 cm. **(4)** 8 cm and 10 cm.

34. Which of the following statements is **false** about electroplating of iron?

(1) An aqueous solution of a compound of the metal that is electroplated should be the electrolyte.
(2) The electrolyte should be in high concentration for quality electroplating.
(3) Iron should be made the cathode of the electrolytic cell.
(4) The current used should be a direct current.

35. A conical flask containing aqueous hydrochloric acid is kept on a sensitive balance. Pieces of limestone were added to it in excess. Which of the following graphs indicates how the balance reading varies against time after the addition of limestone?



36. The number of turns in the primary coil and the secondary coil of a transformer are N_P and N_S respectively. The voltage difference of the primary coil is V_P and the voltage difference of the secondary coil is V_S. What is the correct relationship between the numbers of turns and the voltage differences?

(1) $V_P/V_S = N_P/N_S$ **(2)** $V_S/V_P = N_P/N_S$ **(3)** $V_SV_P = N_SN_P$ **(4)** $V_SN_S = 1/(V_PN_P)$

▸ Questions 37 to 40 are based on the information given in the following table. Information relating to the method of obtaining energy, lighting devices and cooking equipment used in four houses A, B, C and D are given below.

37.

House	Method of obtaining energy	Lighting device	Cooking equipment
A	solar cells	CFL bulbs	LP gas cooker
B	national electric grid	filament bulbs	electric heater/cooker
C	electricity generator	fluorescent lamps	kerosene stove
D	biogas unit	biogas lamps	firewood hearth

For the energy obtaining method of which house is only a **non-renewable** energy source used?

(1) A **(2)** B **(3)** C **(4)** D

38. Which houses use the lighting devices that largely contribute to pollute soil and water when improperly disposed to the environment?

(1) A and C **(2)** A and D **(3)** B and C **(4)** B and D

39. Which house uses the cooking equipment that minimally contributes to pollute air inside the house?

(1) A **(2)** B **(3)** C **(4)** D

40. What is the house that has taken most practical solutions to the electricity and fuel crisis?

(1) A **(2)** B **(3)** C **(4)** D

2021 (2022) — answer key and reviews

Source of answers: Official marking scheme 2021(2022).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	3	11	3	21	4	31	2
2	2	12	1	22	4	32	1
3	4	13	2	23	2	33	2
4	4	14	3	24	1	34	2
5	3	15	2	25	1	35	4
6	3	16	1	26	2	36	1
7	4	17	3	27	1	37	3
8	1	18	1	28	4	38	1
9	2	19	2	29	1/2	39	2
10	4	20	3	30	4	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	3	10.8 Characteristics of organisms	The heart is made of several tissues working together, so it is an organ.	G10 Part I p. 143
2	2	11.14 Hydrocarbons and their derivatives	LP gas is liquefied propane and butane.	G11 Part II p. 155
3	4	10.18 Work, energy and power	Work = force × distance: (kg m s^{-2})(m) = kg m^2 s^{-2} (joule).	G10 Part II p. 126
4	4	11.1 Living tissues	Cardiac muscle is involuntary; it is uninucleate, branched and has intercalated discs.	G11 Part I p. 14
5	3	10.14 Continuity of life (reproduction)	The seed shown has wing-like / hairy structures, an adaptation for wind dispersal.	G10 Part II p. 43
6	3	10.2 Motion in a straight line	Constant acceleration means velocity changes by equal amounts in equal times.	G10 Part I p. 33
7	4	10.3 Structure of matter	Both have mass number 40: protons + neutrons are equal (K has 19 p, 21 n; Ca has 20 p, 20 n).	G10 Part I p. 55
8	1	11.9 Heat	Water's high specific heat capacity lets it absorb a lot of heat for a small temperature rise.	G11 Part II p. 11
9	2	11.6 Biological processes in the human body	Bile is produced in the liver and only stored in the gall bladder.	G11 Part I p. 147
10	4	10.1 Chemical basis of life	Thyroxine contains iodine; its deficiency causes goitre.	G10 Part I p. 2
11	3	11.3 Mixtures	Moles = 1.0 × 0.100 dm^3 = 0.1 mol; mass = 0.1 × 58.5 = 5.85 g.	G11 Part I p. 51
12	1	10.14 Continuity of life (reproduction)	In the diagram R and S are the uterus and the vagina (official key).	G10 Part II p. 57
13	2	10.14 Continuity of life (reproduction)	Fertilisation takes place in the fallopian tube (oviduct), labelled Q.	G10 Part II p. 51
14	3	11.5 Geometrical optics	A convex mirror always forms a virtual, upright, diminished image.	G11 Part I p. 118
15	2	11.7 Acids, bases and salts	Increasing pH: strong acid HCl < weak acid CH_3COOH < weak base NH_3 < strong base NaOH.	G11 Part I p. 201
16	1	10.7 Quantification of elements and compounds	22 g CO_2 = 22/44 = 0.5 mol = 0.5 × 6.022 × 10^{23} molecules.	G10 Part I p. 134

Q	Ans	Unit	Why this is the answer	Textbook
17	3	10.7 Quantification of elements and compounds	Urea $CO(NH_2)_2$ has 1 C, 1 O, 2 N and 4 H (8 atoms). A compound does not show its elements' properties.	G10 Part I p. 127
18	1	11.6 Biological processes in the human body	Glucose and amino acids are filtered but fully reabsorbed, so they are absent from normal urine.	G11 Part I p. 160
19	2	10.2 Motion in a straight line	$v^2 = 2gh = 2 \times 10 \times 5 = 100$, so $v = 10\ m\ s^{-1}$.	G10 Part I p. 44
20	3	11.6 Biological processes in the human body	The left ventricle pumps blood into the systemic circulation. Blood passes through the lungs once per circuit.	G11 Part I p. 168
21	4	10.19 Current electricity	Resistors all in parallel give the lowest equivalent resistance.	G10 Part II p. 162
22	4	11.6 Biological processes in the human body	Skin (temperature), kidneys (water/salts) and pancreas (blood sugar) all help homeostasis.	G11 Part I p. 180
23	2	10.13 The world of life (classification and nomenclature)	P has a constant body temperature (homoeotherm, fowl); Q follows the environment (poikilotherm, tortoise).	G10 Part II p. 22
24	1	10.19 Current electricity	A single bulb (A) is brightest; a resistor in series (B) reduces current; the shorted/shared bulb in C is dimmest.	G10 Part II p. 155
25	1	10.3 Structure of matter	Carbon has allotropes (diamond, graphite, fullerene); graphite conducts electricity.	G10 Part I p. 71
26	2	11.6 Biological processes in the human body	The cerebellum maintains balance and coordinates movement; the medulla controls heart rate.	G11 Part I p. 176
27	1	10.17 Rate of reactions	Higher temperature raises particles' kinetic energy, increasing collisions and reaction rate. Both true.	G10 Part II p. 121
28	4	10.15 Hydrostatic pressure and its applications	A hydraulic jack works by Pascal's principle (transmission of pressure), not Archimedes' principle.	G10 Part II p. 69
29	1/2	10.11 Turning effect of a force	Both accepted: the force should give the largest moment about the step edge, i.e. applied at the point farthest from the pivot.	G10 Part I p. 194
30	4	10.17 Rate of reactions	Iron wool has a much larger surface area, so it reacts faster: rate depends on physical nature of reactants.	G10 Part II p. 117
31	2	11.15 Biosphere	All individuals of one species living in an area at one time form a population.	G11 Part II p. 168
32	1	11.11 Electronics	An npn transistor: emitter and collector are n-type, base is p-type.	G11 Part II p. 68
33	2	11.4 Waves and their applications	Amplitude = maximum displacement (4 cm); wavelength = distance of one complete wave (10 cm).	G11 Part I p. 79
34	2	11.12 Electrochemistry	False: quality plating needs a dilute (low-concentration) electrolyte and a small current.	G11 Part II p. 99
35	4	10.17 Rate of reactions	CO_2 escapes from the flask, so the balance reading falls quickly at first, then levels off when the reaction stops (graph 4).	G10 Part II p. 117
36	1	11.13 Electromagnetism and electromagnetic induction	For a transformer Vp/Vs = Np/Ns.	G11 Part II p. 146
37	3	11.15 Biosphere	An electricity generator runs on petrol or diesel, a non-renewable fossil fuel.	G11 Part II p. 182
38	1	11.15 Biosphere	CFL and fluorescent lamps contain mercury, which pollutes soil and water if dumped.	G11 Part II p. 183
39	2	11.15 Biosphere	An electric cooker produces no smoke or fumes inside the house.	G11 Part II p. 210

Q	Ans	Unit	Why this is the answer	Textbook
40	4	11.10 Power and energy of electric appliances	House D uses biogas for lighting and cooking: renewable and locally produced.	G11 Part II p. 41

Paper I • 2020

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. The fundamental structural and functional unit of life is the

(1) cell. **(2)** tissue. **(3)** organ. **(4)** system.

2. What is the pair of subatomic particles which attract each other?

(1) electrons and neutrons
(2) electrons and protons
(3) protons and neutrons
(4) electrons and electrons

3. The unit of momentum is

(1) kg m s^{-1}. **(2)** kg m s^{-2}. **(3)** kg m^{-1} s^{-1}. **(4)** kg m^2 s^{-2}.

4. The figures A, B and C below indicate three types of muscle tissues.



A, B and C above respectively are

(1) smooth muscle, cardiac muscle and skeletal muscle tissues.
(2) skeletal muscle, smooth muscle and cardiac muscle tissues.
(3) smooth muscle, skeletal muscle and cardiac muscle tissues.
(4) cardiac muscle, skeletal muscle and smooth muscle tissues.

5. Which of the following is the molecule with highest number of covalent bonds?

(1) O_2 **(2)** N_2 **(3)** NH_3 **(4)** CO_2

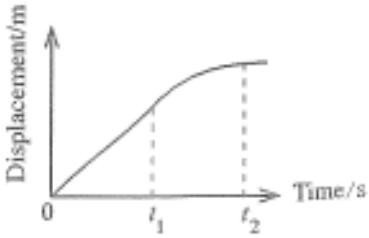
6. Heat is transmitted from the Sun to the Earth by

(1) radiation.
(2) conduction.
(3) convection.
(4) radiation and convection.

7. As was extracted by a student from an environmental pyramid, that ecosystem has one producer, eight primary consumers and twenty three secondary consumers. The student has extracted this information from a

(1) upright number pyramid.
(2) inverted number pyramid.
(3) upright biomass pyramid.
(4) inverted biomass pyramid.

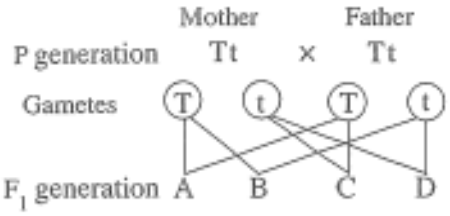
8. Here is shown the displacement-time graph of the motion of an object. During the time intervals from 0 to t_1 and t_1 to t_2, the nature of the motion of the object respectively is,



(1) a uniform velocity and an acceleration.
(2) a uniform velocity and a retardation.
(3) a uniform acceleration and a retardation.
(4) a uniform retardation and an acceleration.

▸ Questions 9 and 10 are based on the following information and the illustration. Production of haemoglobin is disturbed by thalassemia, an inherited disease caused by the gene mutation in a somatic chromosome. With regard to the production of haemoglobin naturally, the dominant gene is T while the mutant recessive gene is t. A, B, C, and D indicate the F_1 generation.

9.



A thalassemia patient belonging to the F_1 generation is

(1) A. **(2)** B. **(3)** C. **(4)** D.

10. The ratio among the thalassemia patients, healthy disease carriers and healthy individuals belonging to the F_1 generation is

(1) 1 : 1 : 1. **(2)** 1 : 1 : 2. **(3)** 1 : 2 : 1. **(4)** 2 : 1 : 1.

11. Which statement is always true about the magnitude of displacement of a certain object?

(1) greater than the distance moved
(2) equal to the distance moved
(3) lesser than the distance moved
(4) either equal to or less than the distance moved

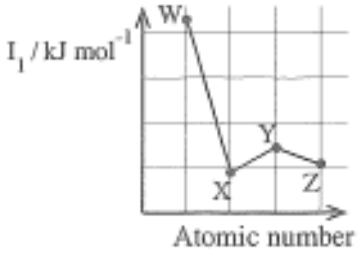
12. The electronic configurations of the atoms of two elements X and Y are 2, 8, 1 and 2, 8, 7 respectively. Of the following statements about the pair of those elements, which statement is **false**?

(1) located in the same period in the Periodic Table
(2) located in the same group in the Periodic Table
(3) chemically combine forming ionic bonds
(4) combine and form the compound with the chemical formula XY

13. What is the number of O_2 molecules contained in 64 g of oxygen gas? (O = 16)

(1) 6.022×10^{23} **(2)** $2 \times 6.022 \times 10^{23}$ **(3)** $4 \times 6.022 \times 10^{23}$ **(4)** $64 \times 6.022 \times 10^{23}$

14. W, X, Y and Z are four elements consecutively placed in the Periodic Table with atomic numbers below 20. The graph indicates how their first ionisation energy (I_1) varies against the atomic number. In which group of the Periodic Table is Y placed?



(1) I **(2)** II **(3)** III **(4)** IV

15. The substances acting as the main components providing energy for the functioning of the human body are

(1) proteins and lipids.
(2) proteins and vitamins.
(3) carbohydrates and lipids.
(4) carbohydrates and proteins.

16. A person's glucose level in the blood has increased above the optimum level. Which of the following food items should he consume minimally?

(1) meat
(2) milk
(3) green gram (mung/payaru)
(4) bread

17. Select the **false** statement about nucleic acids.

(1) building unit is called nucleotide
(2) a natural polymer
(3) store hereditory information
(4) contain the elements C, H, O and N only

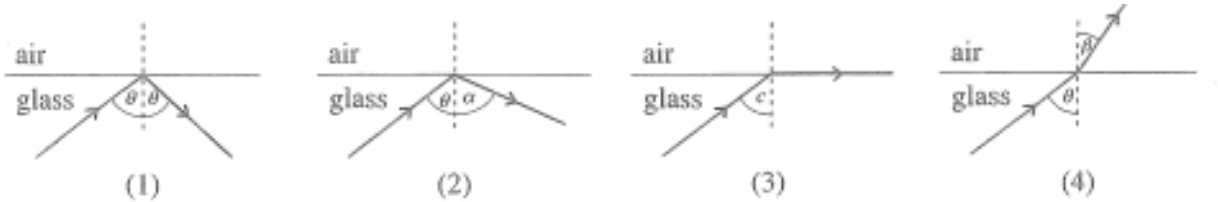
18. Examples for the seeds/fruits dispersed by water, wind and explosive mechanism respectively are

(1) Ceylon almond (kottamba/kaththappu), hora and mango.
(2) lotus, castor (endaru/amanakku) and rubber.
(3) coconut, milkweed (vara/erukkalai) and rubber.
(4) jack, cotton and okra (bandakka/vendi).

19. Which of the following **does not** pass into the foetus from the mother through the umbilical cord?

(1) blood **(2)** nutrients **(3)** oxygen **(4)** pathogens

20. What is the ray diagram which illustrates the phenomenon of total internal reflection?



21. An athlete finishing a running event suffered from a cramp in his leg. What is the chemical compound which is produced in muscle cells causing the cramp?

(1) carbon dioxide **(2)** ethyl alcohol **(3)** lactic acid **(4)** acetic acid

22. A warm-blooded (homoeothermic) animal and a cold-blood (poikilothermic) animal respectively are

(1) pigeon and frog. **(2)** bear and rat.
(3) rat snake and whale. **(4)** crocodile and tortoise.

23. Which arrangement can be used to obtain a voltage of 3 V from two dry cells each with an electromotive force of 1.5 V?



24. What is the metal that reacts with hot water but not with cold water?

(1) sodium **(2)** magnesium **(3)** aluminium **(4)** calcium

25. What is the correct statement about the Covid-19 virus?

(1) can be observed by the optical microscope
(2) carries out metabolic activities
(3) bears a nucleus with DNA
(4) shows living as well as non-living characteristics

26. When salt is extracted from sea water in a saltern, what is the compound that precipitates along with NaCl?

(1) Na_2SO_4 **(2)** $MgCl_2$ **(3)** $CaCO_3$ **(4)** $CaSO_4$

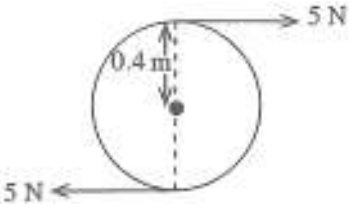
27. The maximum upthrust exerted by water on a certain object is less than the weight of the object. Then, the object will

(1) float on the water surface. **(2)** float partly immersed in water.
(3) float fully immersed in water. **(4)** sink fully in water.

28. What is the part common to the human digestive system and the human respiratory system?

(1) mouth **(2)** oesophagus **(3)** pharynx **(4)** larynx

29. The figure shows how a couple of forces is applied to rotate a wheel of 0.4 m radius. How much is the moment of this couple?



(1) 5 × 0.4 N m **(2)** 5 × 0.8 N m **(3)** 5 × 5 × 0.4 N m **(4)** 5 × 5 × 0.8 N m

30. What is the mole fraction of O_2 in a mixture containing 96 g of oxygen gas (O_2) and 56 g of nitrogen gas (N_2)? (N = 14, O = 16)

(1) 1/5 **(2)** 2/5 **(3)** 3/5 **(4)** 4/5

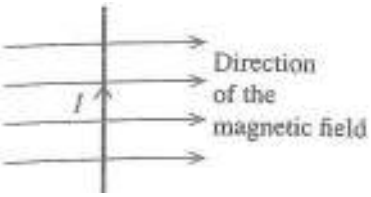
31. Given below are four ways by which zinc metal and hydrochloric acid were reacted at room temperature. In which way is hydrogen gas liberated with the highest speed?

(1) zinc granules + dilute hydrochloric
(2) zinc granules + concentrated hydrochloric
(3) zinc powder + dilute hydrochloric
(4) zinc powder + concentrated hydrochloric

32. Between a strong acid and a strong base,

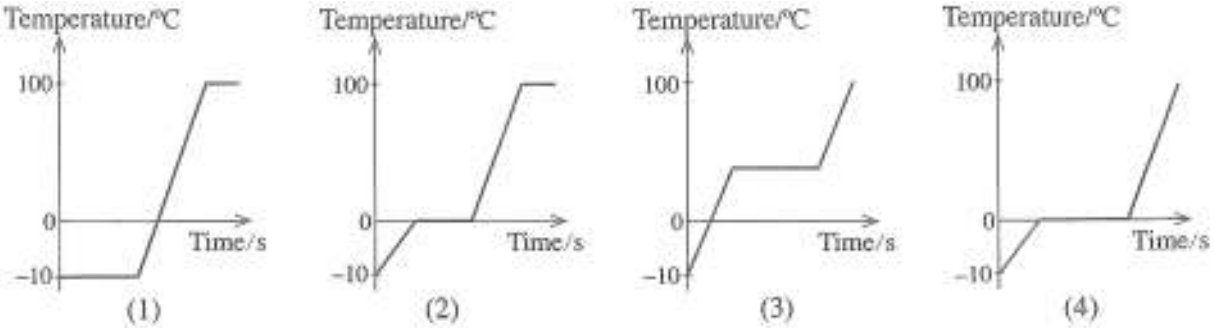
(1) an exothermic neutralization reaction occurs.
(2) an endothermic neutralization reaction occurs.
(3) an exothermic combination reaction occurs.
(4) an endothermic combination reaction occurs.

33. A conductor carrying an electric current I, is kept perpendicular to a magnetic filed as shown in the diagram. Horizontal lines indicate the direction of the magnetic field. The direction of the force acting on the conductor is



(1) toward the left on the plane of the paper.
(2) toward the right on the plane of the paper.
(3) into the plane of the paper perpendicular to the plane.
(4) out of the plane of the paper perpendicular to the plane.

34. Under normal atmospheric pressure, a pure block of ice at temperature −10 °C was heated at a uniform rate until it was turned into liquid water and then for some time after the water started to boil. Which graph correctly indicates the variation of the temperature of the system with time?



35. Consider the following statements presented regarding natural rubber.

A – It is a linear polymer.
B – Isoprene is the monomer.
C – There are cross links among the chains.

Of these statements

(1) only A is true.
(2) only A and B are true.
(3) only B and C are true.
(4) only A and C are true.

36. Corrosion of iron can be controlled by keeping iron in contact with the bivalent metal M. What is the half reaction to which the metal M is subjected here?

(1) $M(s) \rightarrow M^{2+}(aq) + 2e$
(2) $M^{2+}(aq) \rightarrow M(s) + 2e$
(3) $M^{2+}(aq) + 2e \rightarrow M(s)$
(4) $M(s) \rightarrow M^{+}(aq) + e$

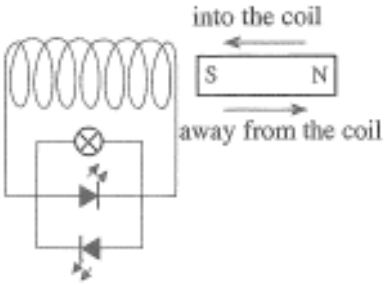
37. A 4 N force and a 3 N force are applied on an object at the same instance. Consider the following statements given about the magnitude of the resultant obtainable at that occasion.

A – The maximum magnitude of the resultant obtainable is 7 N.
B – The minimum magnitude of the resultant obtainable is 1 N.
C – The magnitude of the resultant obtainable is always 5 N.

Of the above, the correct statement(s) is / are

(1) only A.
(2) only B.
(3) only C.
(4) only A and B.

38. A strong bar magnet is moved into and away from an insulated wire coil with a large number of turns as illustrated by the diagram. What is the correct observation about the instances of movement of the magnet?



(1) In both instances, both the bulb and two LEDs light simultaneously.
(2) In both instances, the bulb lights and only one LED lights.
(3) The bulb and one LED light only when moved into the coil.
(4) The bulb and one LED light only when moved away from the coil.

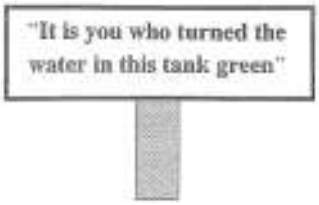
39. Consider the following statements.

A – Biomagnification occurs along a food chain.
B – Toxic chemical pollutants concentrate more in the upper trophic levels of a food chain.

Of the above statements,

(1) both A and B are true.
(2) A is true while B is false.
(3) A is false while B is true.
(4) both A and B are false.

40. A statement displayed on a board near a tank is shown in the figure. Which of the following human activities in connection with the tank would have contributed most to the change mentioned on the board?



(1) clearing the area above the tank
(2) increase in algae population due to fishing
(3) accumulation of oil and grease due to vehicle wash
(4) addition of faecal and excretory matter to the water

2020 — answer key and reviews

Source of answers: Prepared answer key (no official 2020 scheme in the collection); checked against the textbooks and an annotated copy.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	4	21	3	31	4
2	2	12	2	22	1	32	1
3	1	13	2	23	3	33	3
4	3	14	2	24	2	34	2
5	4	15	3	25	4	35	2
6	1	16	4	26	2	36	1
7	2	17	4	27	4	37	4
8	2	18	3	28	3	38	2
9	4	19	1	29	2	39	1
10	3	20	1	30	3	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	1	10.6 Plant and animal cells	The cell is the basic structural and functional unit of all living things.	G10 Part I p. 110
2	2	10.3 Structure of matter	Opposite charges attract: negative electrons and positive protons.	G10 Part I p. 52
3	1	10.4 Newton's laws of motion	Momentum = mass × velocity: kg m s^{-1}.	G10 Part I p. 93
4	3	11.1 Living tissues	A: spindle-shaped, no striations = smooth; B: long striated multinucleate fibres = skeletal; C: branched = cardiac.	G11 Part I p. 13
5	4	10.10 Chemical bonds	O=C=O has two double bonds = 4 covalent bonds; N_2 has 3, NH_3 has 3, O_2 has 2.	G10 Part I p. 182
6	1	11.9 Heat	Space is a vacuum, so heat reaches Earth only by radiation.	G11 Part II p. 26
7	2	11.15 Biosphere	1 producer, 8 primary and 23 secondary consumers: numbers increase upwards, an inverted number pyramid.	G11 Part II p. 175
8	2	10.2 Motion in a straight line	Straight line from 0 to t1 = uniform velocity; flattening curve from t1 to t2 = slowing down (retardation).	G10 Part I p. 49
9	4	10.20 Inheritance	A patient has two recessive genes (tt); D receives t from both parents.	G10 Part II p. 185
10	3	10.20 Inheritance	Tt x Tt gives 1 TT : 2 Tt : 1 tt; ratio patients : carriers : healthy = 1 : 2 : 1.	G10 Part II p. 185
11	4	10.2 Motion in a straight line	Displacement is the straight-line distance, so it is equal to or less than the path distance.	G10 Part I p. 23

Q	Ans	Unit	Why this is the answer	Textbook
12	2	10.10 Chemical bonds	X (2,8,1) is Na in Group 1; Y (2,8,7) is Cl in Group 17. They are in the same period, not the same group.	G10 Part I p. 187
13	2	10.7 Quantification of elements and compounds	64 g O_2 = 2 mol = 2 × 6.022 × 10^{23} molecules.	G10 Part I p. 134
14	2	10.3 Structure of matter	W (very high I_1) is a noble gas, X drops to Group I, Y rises to Group II, then Z falls slightly at Group III.	G10 Part I p. 82
15	3	10.1 Chemical basis of life	Carbohydrates and lipids are the main energy sources; proteins are mainly for growth and repair.	G10 Part I p. 8
16	4	10.1 Chemical basis of life	Bread is rich in starch, which is digested to glucose; a person with high blood glucose should limit it.	G10 Part I p. 5
17	4	10.1 Chemical basis of life	False: nucleic acids contain phosphorus as well as C, H, O and N.	G10 Part I p. 11
18	3	10.14 Continuity of life (reproduction)	Coconut (fibrous, floats: water), milkweed (hairs: wind), rubber (explosive pods).	G10 Part II p. 44
19	1	10.14 Continuity of life (reproduction)	Maternal and foetal blood do not mix in the placenta; only substances diffuse across.	G10 Part II p. 57
20	1	11.5 Geometrical optics	Total internal reflection: light in the denser medium (glass) at an angle greater than the critical angle reflects completely.	G11 Part I p. 125
21	3	11.6 Biological processes in the human body	Anaerobic respiration in overworked muscle produces lactic acid, causing cramp.	G11 Part I p. 155
22	1	10.13 The world of life (classification and nomenclature)	Birds (pigeon) are warm-blooded; amphibians (frog) are cold-blooded.	G10 Part II p. 22
23	3	10.19 Current electricity	Cells joined in series (positive to negative) add their e.m.f.s: 1.5 V + 1.5 V = 3 V.	G10 Part II p. 144
24	2	10.16 Changes in matter	Magnesium reacts slowly with cold water but readily with hot water/steam; Na and Ca react with cold water.	G10 Part II p. 96
25	4	10.8 Characteristics of organisms	Viruses show non-living features (crystallise, no metabolism outside cells) and living features (reproduce in host cells).	G10 Part I p. 139
26	2	11.3 Mixtures	Magnesium chloride crystallises with the salt in the final tank (making salt damp); $CaSO_4$ and $CaCO_3$ separate earlier.	G11 Part I p. 65
27	4	10.15 Hydrostatic pressure and its applications	If the maximum upthrust is less than the weight, the object cannot float and sinks.	G10 Part II p. 82
28	3	11.6 Biological processes in the human body	The pharynx carries both food (to the oesophagus) and air (to the larynx).	G11 Part I p. 145
29	2	10.11 Turning effect of a force	Moment of a couple = one force × perpendicular distance between them = 5 N x 0.8 m.	G10 Part I p. 198
30	3	11.3 Mixtures	O_2: 96/32 = 3 mol; N_2: 56/28 = 2 mol; mole fraction of O_2 = 3/5.	G11 Part I p. 43
31	4	10.17 Rate of reactions	Rate is fastest with the largest surface area (powder) and highest concentration.	G10 Part II p. 117
32	1	11.7 Acids, bases and salts	Neutralisation always releases heat (exothermic).	G11 Part I p. 201
33	3	11.13 Electromagnetism and electromagnetic induction	Fleming's left-hand rule with field to the right and current upwards gives a force into the paper.	G11 Part II p. 122
34	2	11.9 Heat	Temperature rises to 0 °C, stays constant while melting, rises to 100 °C, then stays constant while boiling.	G11 Part II p. 14

Q	Ans	Unit	Why this is the answer	Textbook
35	2	11.14 Hydrocarbons and their derivatives	Natural rubber is a linear polymer of isoprene; cross-links form only after vulcanisation.	G11 Part II p. 164
36	1	11.12 Electrochemistry	M is more reactive than iron and is oxidised instead: $M(s) \rightarrow M^{2+}(aq) + 2e^{-}$ (sacrificial protection).	G11 Part II p. 111
37	4	10.9 Resultant force	Same direction: 4 + 3 = 7 N (max); opposite: 4 - 3 = 1 N (min). 5 N only when perpendicular.	G10 Part I p. 167
38	2	11.13 Electromagnetism and electromagnetic induction	Current reverses when the magnet moves in and out; the bulb lights both times but each LED conducts in only one direction.	G11 Part II p. 149
39	1	11.15 Biosphere	Persistent toxins pass along food chains (biomagnification) and are most concentrated at the top.	G11 Part II p. 177
40	4	11.15 Biosphere	Faecal and excretory matter adds nutrients that cause algal growth (eutrophication), turning the water green.	G11 Part II p. 194

Paper I • 2019

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Liver is a

(1) cell. **(2)** tissue. **(3)** organ. **(4)** system.

2. To maintain the balance of which following cycle is biological fixation important?

(1) carbon cycle **(2)** nitrogen cycle **(3)** phosphorus cycle **(4)** water cycle

3. Which following quantity is a vector?

(1) displacement **(2)** distance **(3)** pressure **(4)** work

4. Which following molecule is composed of the highest number of atoms?

(1) CH_3CHO **(2)** CCl_4 **(3)** H_2SO_4 **(4)** $CO(NH_2)_2$

5. A rough sketch drawn by a student by observing an underground stem during a field study is shown below. To which type of underground stems does this belong?



(1) rhizome **(2)** corm **(3)** bulb **(4)** stem tuber

6. Which of the following structure - function pairs indicates the correct relationship?

	Structure	Function
(1)	blood platelets	production of antibodies
(2)	white blood cells	transport of oxygen
(3)	red blood cells	phagocytosis
(4)	blood plasma	transport of hormones

7. The relative atomic mass of iron is 56. Thus, which of the following statements is the correct statement?

(1) The mass of an iron atom is 56 g.
(2) A mole of iron contains 56 iron atoms.
(3) The mass of 6.022×10^{23} iron atoms is 56 g.
(4) The mass of 56 iron atoms is 6.022×10^{23} g.

8. Which of the following molecules is made of two covalent bonds?

(1) Cl_2 **(2)** CH_4 **(3)** HCl **(4)** H_2O

9. Coordination of movements and equilibrium of the human body are maintained by the

(1) cerebellum. **(2)** cerebrum. **(3)** medulla oblongata. **(4)** spinal cord.

10. Consider the following statements on various processes taking place in a plant.

A – Plants emit carbon dioxide only during night.
B – Plants emit only oxygen during the day time.
C – Gaseous exchange in plant leaves mainly occurs through stomata.
D – Gases entering the plant leaves diffuse into the cells through intercellular spaces.

Of the statements A, B, C and D above, the true statements are,

(1) only A and B. **(2)** only A and D. **(3)** only B and C. **(4)** only C and D.

11. The acceleration due to gravity on the Earth's surface is 10 m s^{-2}. The acceleration due to gravity on the surface of the moon is 1/6 the acceleration due to gravity of the Earth. If the weight of a man on the Earth is 600 N, how much is his weight on the moon?

(1) 60 N **(2)** 100 N **(3)** 360 N **(4)** 600 N

12. The deficiency of which following vitamin causes anaemia?

(1) vitamin A **(2)** vitamin B **(3)** vitamin E **(4)** vitamin K

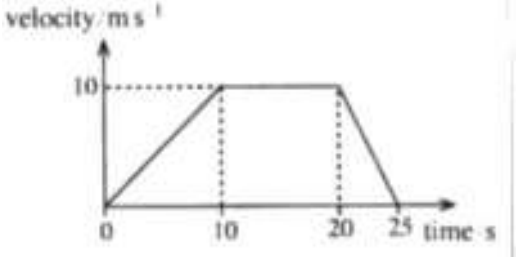
13. In which part of the female reproductive system does fertilization occur in human reproduction?

(1) vagina **(2)** uterus **(3)** fallopian tube **(4)** ovaries

14. What is the mass of glucose required to make 500 cm^3 of a glucose solution of concentration 1.0 mol dm^{-3}? (Relative molecular mass of glucose = 180)

(1) 45 g **(2)** 90 g **(3)** 180 g **(4)** 360 g

15. The movement of an object during 25 seconds is illustrated by the velocity-time graph given. Select the correct statement about the movement of the object.



(1) The retardation of the object is 2 m s^{-2}.
(2) The displacement of the object is zero.
(3) The acceleration of the object is 10 m s^{-2}.
(4) The object has moved 20 seconds at a velocity of 10 m s^{-1}.

16. In which part of the alimentary canal is the enzyme lipase added to food?

(1) duodenum **(2)** stomach **(3)** oesophagus **(4)** large intestine

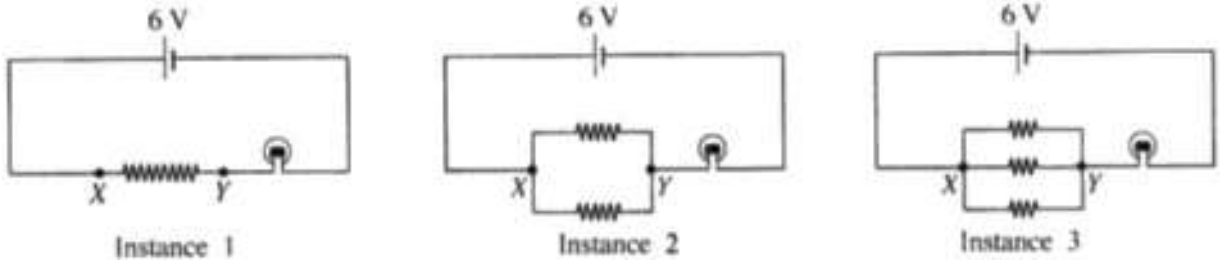
17. Given below is the balanced equation, relating to the decomposition of potassium permanganate ($KMnO_4$).

$$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2 \text{ (on heating)}$$

How much is the amount of moles of potassium permanganate that should be decomposed to produce 3 moles of oxygen gas?

(1) 1 **(2)** 2 **(3)** 4 **(4)** 6

18. There are three wires of equal length with uniform resistance. Illustrated below are three instances in which the three wires are connected between the points X and Y in the same circuit where the first wire is connected as it is, the second wire cut into two equal parts and the third cut into three equal parts. (Assume the voltage of battery stays constant.)



The bulb connected to the circuit lights brightest in

(1) instance 1. **(2)** instance 2. **(3)** instance 3. **(4)** instances 2 and 3.

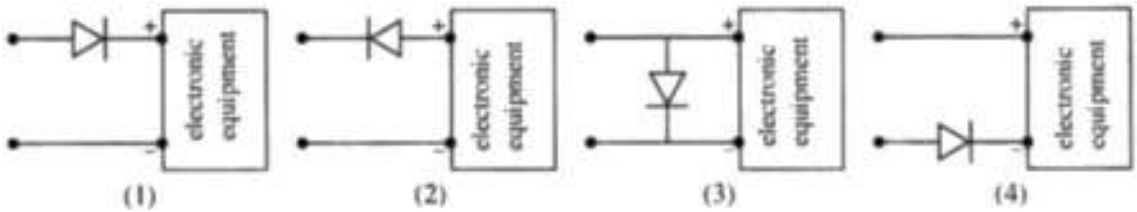
19. Consider the following substances.

A – solid sodium chloride crystals
B – molten sodium chloride
C – aqueous sodium chloride solution

Which of the above conduct electricity?

(1) A and B only **(2)** A and C only **(3)** B and C only **(4)** All A, B and C

20. When supplying electricity to an electronic equipment, it may get damaged if the source of electricity is connected to it with the terminals reversed. Which diagram illustrates correctly how a diode should be connected to it to protect the equipment from such a damage?



21. It was found that an aqueous solution of the compound HA contains H^+ ions, A^- ions, OH^- ions as well as undissociated HA molecules. The pH value of this solution is less than 7. Which of the following statements is true about HA?

(1) HA is a strong acid. **(2)** HA is a weak acid.
(3) HA is a weak base. **(4)** HA is an acidic salt.

22. Several species of animals and the number of animals belonging to each species identified by a group of students in an environmental study are as follows.

Animal species	snail	butterfly	spider	leech	scorpion
Number	5	4	3	2	1

What is the number of animals identified by the students which belong to phylum Arthropoda?

(1) 7 **(2)** 8 **(3)** 9 **(4)** 10

23. The atmospheric pressure at the sea level is 1×10^5 N m^{-2}. The area of the tympanic membrane of a man is about 5×10^{-5} m^2. What is the force exerted by the atmospheric pressure on the tympanic membrane?

(1) 5 N **(2)** 1/5 N **(3)** $1/5 \times 10^{10}$ N **(4)** 5×10^{-10} N

24. The power supplied to the primary coil of a transformer of 100% efficiency is 200 W. If the voltage across its secondary coil is 10 V, what is the current flowing through the secondary coil?

(1) 10 A **(2)** 20 A **(3)** 40 A **(4)** 50 A

25. Which polysaccharide contained in plant cells helps prevent constipation?

(1) starch **(2)** glycogen **(3)** cellulose **(4)** lactose

26. What is the constituent mostly present in the urine of a healthy person?

(1) water **(2)** urea **(3)** uric acid **(4)** salts

27. What is the polymer that contains carbon and hydrogen only as the constituent elements?

(1) vulcanized rubber **(2)** polythene **(3)** teflon **(4)** cellulose

28. What is the equipment that works using the force exerted on a current carrying conductor placed in a magnetic field?

(1) moving coil microphone **(2)** electric bell
(3) transformer **(4)** direct current motor

29. Select the **false** statement from the following statements.

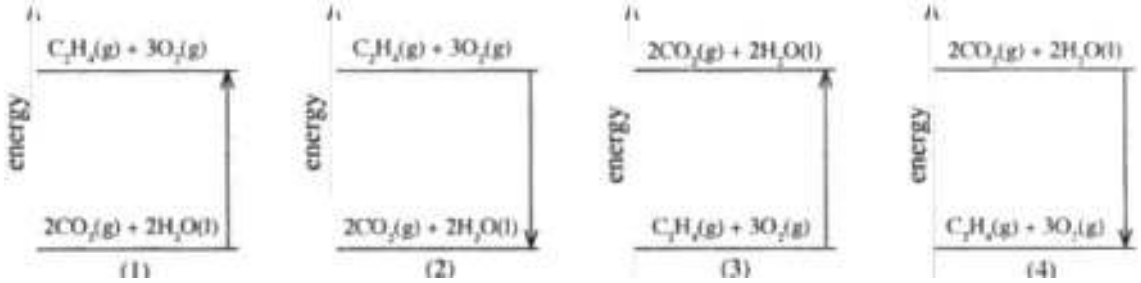
(1) Fractional distillation is used to refine mineral oils.
(2) Steam distillation is used to extract cinnamon oil.
(3) Solvent extraction is used to extract medicinal extracts and potions.
(4) Chromatography is used to separate a mixture of volatile components.

▸ Questions 30 and 31 are based on the following balanced equation relating to the complete combustion of ethene (C_2H_4): $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l) + 1400$ kJ (H = 1, C = 12, O = 16)

30. What is the mass of water formed when one mole of ethene is subjected to complete combustion?

(1) 2 g **(2)** 18 g **(3)** 36 g **(4)** 44 g

31. What is the correct energy level diagram for the complete combustion of ethene?



32. There is a greater chance for a man swimming in the water with gas bubbles at the base of a water fall to drown. What is the reason for this?

(1) increase in the upthrust exerted by water
(2) decrease in the upthrust exerted by water
(3) dissolving of a greater amount of gas in water
(4) decrease in the temperature of water

33. When a sound wave emitted by a loudspeaker propagates through air its

(1) frequency decreases. **(2)** velocity decreases.
(3) wave length decreases. **(4)** amplitude decreases.

34. Why is limestone added to the blast furnace during iron extraction?

(1) to reduce the iron ore to iron
(2) to increase the temperature in the blast furnace
(3) to remove certain impurities in the iron ore
(4) to decrease the melting point of iron

35. Which of the following has the greatest effect on ozone layer depletion?

(1) CFC gases **(2)** NO_2 gas **(3)** CH_4 gas **(4)** CO_2 gas

36. What is the true statement about the $^{20}_{10}Ne$ atom and the $^{23}_{11}Na^+$ ion?

(1) The number of electrons in both is equal.
(2) The number of protons in both is equal.
(3) The number of neutrons in both is equal.
(4) The number of protons in both is greater than the number of neutrons.

37. Which following factor affects the pressure exerted by water on the bottom of a vessel filled with water to a certain height?

(1) volume of water **(2)** shape of the vessel
(3) area of the bottom of the vessel **(4)** vertical height of the water column

38. Which of the following cells are multi-nucleate?

(1) red blood cells **(2)** white blood cells
(3) skeletal muscle cells **(4)** cardiac muscle cells

39. Boiling and evaporation are the two ways by which liquid water moves into the air as water vapour. Of the following statements connected with them, which is **false**?

(1) Temperature remains constant during boiling as well as during evaporation.
(2) Boiling is a visible process while evaporation is an invisible process.
(3) Speed of wind affects evaporation but does not affect boiling.
(4) Temperature of water remains constant during boiling while decreases during evaporation.

40. The aim of shortening the food mileage is to

(1) direct people more to consume native food.
(2) get an opportunity to consume quality food.
(3) create a greater demand for the locally produced food.
(4) minimize the amount of fuel spent during transport of food.

2019 — answer key and reviews

Source of answers: Official marking scheme 2019.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	3	11	2	21	2	31	2
2	2	12	2	22	2	32	2
3	1	13	3	23	1	33	4
4	4	14	2	24	2	34	3
5	1	15	1	25	3	35	1
6	4	16	1	26	1	36	1
7	3	17	4	27	2	37	4
8	4	18	3	28	4	38	3
9	1	19	3	29	4	39	All
10	4	20	1	30	3	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	3	10.8 Characteristics of organisms	The liver is made of several tissues working together: an organ.	G10 Part I p. 143
2	2	11.15 Biosphere	Nitrogen-fixing bacteria convert atmospheric N_2 into compounds plants can use, balancing the nitrogen cycle.	G11 Part II p. 179
3	1	10.2 Motion in a straight line	Displacement has magnitude and direction; distance, pressure and work are scalars.	G10 Part I p. 24
4	4	10.3 Structure of matter	$CO(NH_2)_2$ has 8 atoms; CH_3CHO has 7, CCl_4 has 5, H_2SO_4 has 7.	G10 Part I p. 75
5	1	10.14 Continuity of life (reproduction)	A horizontal underground stem with nodes, scale leaves and adventitious roots is a rhizome (e.g. ginger).	G10 Part II p. 29
6	4	11.6 Biological processes in the human body	Plasma transports hormones. Platelets clot blood, WBCs fight infection, RBCs carry oxygen.	G11 Part I p. 165
7	3	10.7 Quantification of elements and compounds	Ar = 56 means one mole (6.022×10^{23} atoms) of iron has a mass of 56 g.	G10 Part I p. 131
8	4	10.10 Chemical bonds	Water H-O-H has two single covalent bonds.	G10 Part I p. 182
9	1	11.6 Biological processes in the human body	The cerebellum coordinates muscular movement and maintains balance (equilibrium).	G11 Part I p. 176
10	4	11.2 Photosynthesis	C and D: gas exchange is mainly through stomata and gases diffuse through intercellular spaces. Plants respire day and night.	G11 Part I p. 21

Q	Ans	Unit	Why this is the answer	Textbook
11	2	10.4 Newton's laws of motion	Mass = 600/10 = 60 kg; weight on Moon = 60 × 10/6 = 100 N.	G10 Part I p. 95
12	2	10.1 Chemical basis of life	Vitamin B12 (and folic acid) deficiency causes anaemia.	G10 Part I p. 20
13	3	10.14 Continuity of life (reproduction)	Fertilisation occurs in the fallopian tube.	G10 Part II p. 51
14	2	11.3 Mixtures	Moles = 1.0 mol dm^{-3} × 0.5 dm^3 = 0.5 mol; mass = 0.5 × 180 = 90 g.	G11 Part I p. 46
15	1	10.2 Motion in a straight line	Read the slope of the falling part of the v-t graph: deceleration = change in velocity / time = 2 m s^{-2}.	G10 Part I p. 46
16	1	11.6 Biological processes in the human body	Pancreatic lipase is added to food in the duodenum.	G11 Part I p. 147
17	4	10.7 Quantification of elements and compounds	2 $KMnO_4$ give 1 O_2, so 3 mol O_2 need 6 mol $KMnO_4$.	G10 Part I p. 135
18	3	10.19 Current electricity	Cutting into three equal parts joined in parallel gives the smallest resistance, so the bulb is brightest in instance 3.	G10 Part II p. 147
19	3	10.10 Chemical bonds	Ionic NaCl conducts only when ions are free to move: molten (B) or in solution (C).	G10 Part I p. 185
20	1	11.11 Electronics	The diode must be in the circuit so that it conducts only with the correct polarity (forward bias), blocking reversed supply.	G11 Part II p. 63
21	2	11.7 Acids, bases and salts	Both undissociated HA and ions are present, so HA ionises only partly: a weak acid.	G11 Part I p. 191
22	2	10.13 The world of life (classification and nomenclature)	Arthropods (jointed legs): butterfly 4 + spider 3 + scorpion 1 = 8.	G10 Part II p. 18
23	1	10.15 Hydrostatic pressure and its applications	F = P x A = 1 × 10^5 N m^{-2} × 5 × 10^{-5} m^2 = 5 N.	G10 Part II p. 74
24	2	11.13 Electromagnetism and electromagnetic induction	100% efficient: power out = 200 W; I = P/V = 200/10 = 20 A.	G11 Part II p. 146
25	3	10.1 Chemical basis of life	Cellulose (dietary fibre) adds bulk and prevents constipation.	G10 Part I p. 5
26	1	11.6 Biological processes in the human body	Urine is about 95% water; urea is the main dissolved solute.	G11 Part I p. 161
27	2	11.14 Hydrocarbons and their derivatives	Polythene (CH_2-CH_2)n contains only C and H; rubber has S cross-links, Teflon has F, cellulose has O.	G11 Part II p. 164
28	4	11.13 Electromagnetism and electromagnetic induction	A d.c. motor uses the force on a current-carrying conductor in a magnetic field.	G11 Part II p. 120
29	4	11.3 Mixtures	False: chromatography separates small amounts of coloured / dissolved components, not volatile ones (those use distillation).	G11 Part I p. 58
30	3	10.7 Quantification of elements and compounds	1 mol C_2H_4 gives 2 mol H_2O = 2 × 18 = 36 g.	G10 Part I p. 135
31	2	11.8 Heat changes associated with chemical reactions	Combustion is exothermic: products ($2CO_2$ + $2H_2O$) lie below the reactants on the energy diagram.	G11 Part I p. 203

Q	Ans	Unit	Why this is the answer	Textbook
32	2	10.15 Hydrostatic pressure and its applications	Gas bubbles lower the average density of the water, so the upthrust on the swimmer decreases.	G10 Part II p. 76
33	4	11.4 Waves and their applications	As sound spreads, its energy spreads out and the amplitude decreases; frequency stays the same.	G11 Part I p. 93
34	3	10.16 Changes in matter	Limestone decomposes to CaO, which removes sandy impurities (SiO_2) as slag.	G10 Part II p. 101
35	1	11.15 Biosphere	CFCs release chlorine radicals in the stratosphere that destroy ozone.	G11 Part II p. 192
36	1	10.3 Structure of matter	Ne (10 p) and Na^+ (11 p, lost one electron) both have 10 electrons (isoelectronic).	G10 Part I p. 54
37	4	10.15 Hydrostatic pressure and its applications	Liquid pressure depends only on depth (vertical height), density and g, not volume or shape.	G10 Part II p. 66
38	3	11.1 Living tissues	Skeletal muscle fibres are long and multinucleate.	G11 Part I p. 14
39	All	11.9 Heat	All answers were accepted by the examiners for this item.	G11 Part II p. 16
40	4	11.15 Biosphere	Shorter food miles mean less fuel burnt in transport, reducing the carbon footprint.	G11 Part II p. 207

Paper I • 2018

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Which of the following is an example for a plant which does not produce seeds?
(1) Cycas **(2)** Pinus **(3)** Salvinia **(4)** Blue water lily

2. The SI unit of force in fundamental units is,
(1) kg m s^{-2}. **(2)** kg m s^{-1}. **(3)** kg m^2 s^{-1}. **(4)** kg m^{-2} s^{-2}.

3. Which of the following is a homogeneous mixture?
(1) wheat flour + water **(2)** ethyl alcohol + water
(3) coconut oil + water **(4)** clay + water

4. Of the following statements, which is **false** about a silicon npn junction transistor?
(1) It can be used to amplify signals.
(2) It can be used as a switch.
(3) It can be used as a current amplifier.
(4) It can be used to rectify alternating voltages.

5. If an object is to stay in equilibrium under three forces,
(1) the resultant force of two forces should be in the same direction as that of the remaining force.
(2) the resultant force of the three forces should be zero.
(3) the three forces should be coplanar.
(4) the lines of action of the three forces should meet at the same point.

6. In the urine filtration process taking place in kidneys, which of the following is filtered into the glomerulus from blood?
(1) blood cells **(2)** plasma proteins **(3)** glucose **(4)** platelets

7. The typical cell is
(1) the structural and functional unit of life.
(2) the cell that gives origin to some other cell.
(3) the cell that can undergo division.
(4) the constructed cell that contains all the organelles.

8. Which of the following equipments is based on the phenomenon of electromagnetic induction?
(1) Direct current motor **(2)** Loudspeaker
(3) Electric bell **(4)** Moving coil magnetic microphone

9. Of the fruits shown in the following diagrams, which could be a fruit that has suitable adaptations to be dispersed by water?



10. Consider the following statements about catalysts.
A – Catalysts increase as well as decrease reaction rates.
B – Though catalysts take part in the chemical reaction, they are not consumed during the reaction.
C – A small amount of the catalyst is adequate for a large amount of reactants.
Of the above, the true statements are,
(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

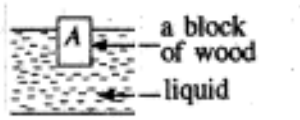
11. Consider the following equation.

$$2C_6H_{12}O_6 \rightleftharpoons C_{12}H_{22}O_{11} + H_2O \ (A = 2C_6H_{12}O_6,\ B = C_{12}H_{22}O_{11})$$

Select the option that gives appropriate examples for A and B in the above equation.

	A	B
(1)	glucose	maltose
(2)	glucose	cellulose
(3)	fructose	starch
(4)	fructose	glycogen

12. When a block of wood A is placed in a liquid, it floats with a part immersed. Which of the following is the true statement in relation to this?



(1) The upthrust exerted by the liquid on A is equal to the total weight of A.

(2) The weight of the liquid displaced by A is equal to the weight of the part of A immersed in the liquid.

(3) The volume of the liquid displaced by A is equal to the total volume of A.

(4) The density of A is equal to the density of the liquid.

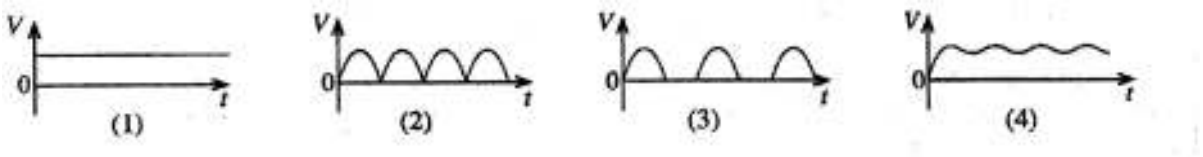
13. Which option correctly indicates the main functions of xylem and phloem tissues in a plant?

	Xylem	Phloem
(1)	Transport of water	Mechanical support
(2)	Mechanical support	Transport of water
(3)	Transport of water	Translocation of food
(4)	Translocation of food	Mechanical support

14. Which of the following oxides does **not** take part in the extraction process of iron?

(1) CaO **(2)** MgO **(3)** CO_2 **(4)** SiO_2

15. An alternating voltage was subjected to full wave rectification followed by smoothing by a capacitor. Which of the following graphs illustrates the variation of the output voltage (V) with time (t)?



16. What is the phenotype ratio obtained, when two organisms with the genotypes Tt and tt were crossed?

(1) 1 : 1 **(2)** 2 : 1 **(3)** 3 : 1 **(4)** 1 : 2 : 1

17. The relative molecular mass of the hormone adrenaline is 183. Thus, X in the relationship 183 = (mass of an adrenaline molecule) / X represents,

(1) mass of a $^{12}_{6}C$ atom. **(2)** 1/12 x mass of a $^{12}_{6}C$ atom.

(3) 12 x mass of a $^{12}_{6}C$ atom. **(4)** 1/12 x molar mass of $^{12}_{6}C$.

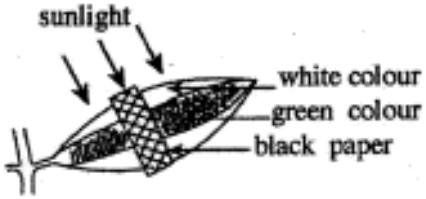
18. Consider the following aqueous solutions of equal concentration.

(a) NaOH (b) NH_4OH (c) CH_3COOH (d) HCl

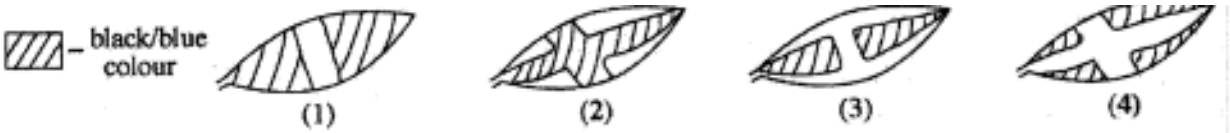
Select the option which indicates the increasing order of their pH correctly.

(1) c < d < b < a **(2)** d < c < b < a **(3)** c < d < a < b **(4)** d < a < b < c

19. A plant leaf with colours white and green, while attached to the plant, was set out as follows and kept in an open place.



After two days, the leaf was detached from the plant and tested for starch. After the test, in which of the following ways would the leaf appear?



20. What is the option that correctly indicates all the species contained in an aqueous solution of hydrochloric acid?

(1) H_2O, H^+, HCl, Cl^- **(2)** H_2O, H^+, OH^-, Cl^- **(3)** H^+, OH^-, HCl, Cl^- **(4)** H_2O, H^+, OH^-, HCl

21. The total number of atoms in one mole of CO_2 molecules is

(1) $6.022 \times 10^{23} \times 3$ **(2)** $6.022 \times 10^{23} \times 2$ **(3)** $6.022 \times 10^{23} \times 1$ **(4)** $6.022 \times 10^{23} \times 1/3$

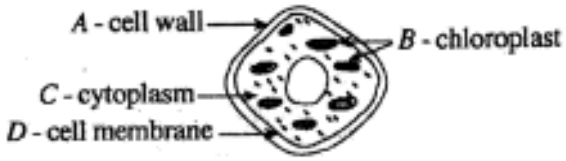
22. Hydrogen sulphide (H_2S) reacts with sulphur dioxide (SO_2) according to the following balanced chemical equation.

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S$$

The amount of moles of sulphur dioxide that reacts with one mole of hydrogen sulphide is

(1) 0.5 **(2)** 1.0 **(3)** 1.5 **(4)** 2.0

23. Given here is a diagram of a plant cell. What are the parts indicated in it that are seen in animal cells as well?



(1) A and B **(2)** A and D **(3)** B and C **(4)** C and D

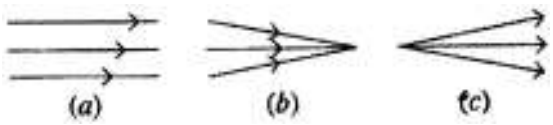
24. Consider the following statements about the compounds, carbon dioxide and sulphur dioxide.

A – They are acidic oxides.
B – They exist as gases under room temperature.
C – They are colourless.

Of the above, the true statements are,

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

25. In the following figure, a, b and c are three beams of light. Using a glass lens, one of these beams can be converted into another type of beam that is shown in the diagram. Which of the following statements correctly indicates this conversion?



(1) 'a' to 'b' using a convex lens. **(2)** 'a' to 'b' using a concave lens.
(3) 'b' to 'a' using a convex lens. **(4)** 'c' to 'a' using a concave lens.

26. Consider an instance where a convex lens is used to read a label with very small letters. Here, the label should be placed,

(1) between the lens and its focus.
(2) on the focus of the lens.
(3) on a point which is away from the lens twice its focal length.
(4) on a point which is away from the lens more than twice its focal length.

27. Some features observed when an animal was examined are as follows:

- Has four pentadactyl limbs
- Has a glandular skin
- Has a broad mouth
- Cold-blooded

This animal could be the

(1) otter. **(2)** crocodile. **(3)** tortoise. **(4)** toad.

28. A tightly stoppered, half-filled bottle of soda water was taken out from a refrigerator and kept outside until it reaches the room temperature. When kept like this, the mole fraction of carbon dioxide,

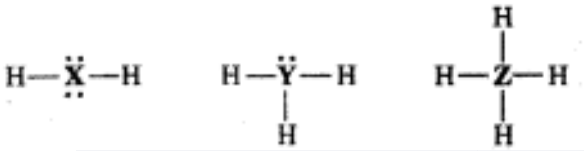


(1) increases in phases both A and B. **(2)** decreases in phases both A and B.
(3) increases in phase A; decreases in phase B. **(4)** decreases in phase A; increases in phase B.

29. In respiration of living organisms, oxygen gas and carbon dioxide gas exchange at the respiratory surface. Accordingly, the respiratory surface of the human is

(1) nasal cavity. **(2)** lungs. **(3)** alveolar wall. **(4)** alveolus.

30. The Lewis structures of the hydrides of the three elements X, Y and Z are given here. Which elements in the table are represented by X, Y and Z?

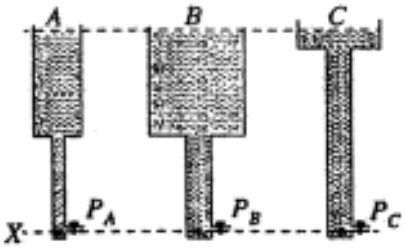


	X	Y	Z
(1)	C	N	O
(2)	O	N	C
(3)	N	O	C
(4)	C	O	N

31. A small glass ball and a big iron ball were dropped on to a porcelain surface from the same height. The porcelain surface cracked at the point at which the iron ball hit it. No such crack was caused by the glass ball. Of the following, greatness of which quantity of the iron ball than that of the glass ball could be the reason for this?

(1) velocity **(2)** volume **(3)** momentum **(4)** acceleration

32. As shown in the figure, water is filled to the same height from level X in three tanks, A, B and C which are different in breadth. Which of the following is correct about the pressures P_A, P_B and P_C of the three tanks at level X?



(1) $P_A > P_B > P_C$ **(2)** $P_C > P_B > P_A$ **(3)** $P_B > P_A = P_C$ **(4)** $P_A = P_B = P_C$

33. The number of electrons and the number of neutrons in the ion indicated by the symbol $^{23}_{11}Na^+$ respectively are,

(1) 11 and 23. **(2)** 10 and 23. **(3)** 10 and 12. **(4)** 11 and 12.

34. What characteristic given below should be studied to distinguish as **living** and **non-living** the specimens; a fertilized egg, a piece of meat, a bean seed obtained before germination and a dry piece of a branch of a plant?

(1) growth **(2)** respiration
(3) reproduction **(4)** cellular organisation

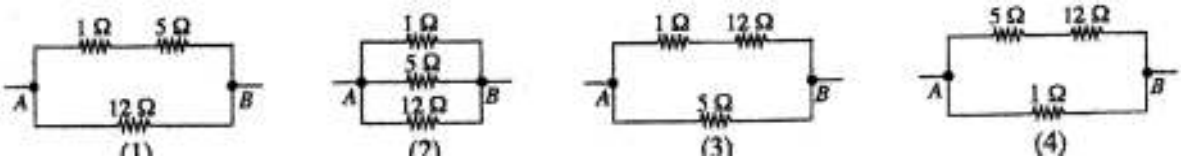
35. An electric lamp bulb of a motor car is labelled 12 V, 0.5 A. Consider the following statements about those values.

A – When an electrical supply of 12 V is given across the bulb, the current flowing through it is 0.5 A.
B – When the bulb operates normally, its power is 12 × 0.5 W.
C – The resistance of the bulb is 12/0.5 Ω.

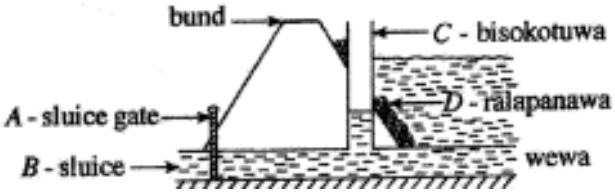
Of the above, the correct statements are,

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

36. Which diagram correctly indicates the connection of 1 Ω, 5 Ω and 12 Ω resistors so that the equivalent resistance between A and B is 4 Ω?



37. The diagram illustrates a cross section across the bund close to the sluice of a wewa (tank). What is the structure constructed to reduce the speed of water flow by reducing pressure, when water is released from the tank?



(1) A **(2)** B **(3)** C **(4)** D

38. Some activities carried out after felling trees in a forest are given below. Among them, which one contributes most to increase the carbon dioxide percentage in the atmosphere in a short period of time?

(1) Growing vegetable crops in the area **(2)** Letting cut down parts decompose naturally
(3) Using parts of timber for constructions **(4)** Burning the parts cut down

39. It has been planned to hold a conference in Sri Lanka in May/June 2019, on a convention/treaty dealing with regulations related to the trade of endangered plants and animals. By what name is that convention/treaty known?

(1) Ramsar **(2)** Montreal **(3)** CITES **(4)** Rio

40. Reduce, Reuse and Recycle are three, out of the principles used in waste/energy management. Which of the following is **not** a suitable example for "Reduce" given here?

(1) Switching off unnecessary electric lamps **(2)** Eating all the food served for self
(3) Closing the unnecessarily opened water taps **(4)** Refraining from using polythene

2018 — answer key and reviews

Source of answers: Official marking scheme 2018.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	3	11	1	21	1	31	3
2	1	12	1	22	1	32	4
3	2	13	3	23	4	33	3
4	4	14	2	24	4	34	2
5	2	15	4	25	1	35	4
6	3	16	1	26	1	36	1
7	4	17	2	27	4	37	3
8	4	18	2	28	3	38	4
9	2	19	3	29	3	39	3
10	2	20	2	30	2	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	3	10.13 The world of life (classification and nomenclature)	Salvinia is an aquatic fern (pteridophyte) and reproduces by spores; Cycas and Pinus are gymnosperms with seeds.	G10 Part II p. 12
2	1	10.4 Newton's laws of motion	F = ma, so newton = kg m s^{-2}.	G10 Part I p. 88
3	2	11.3 Mixtures	Ethyl alcohol and water mix completely in one phase: homogeneous. The others are suspensions or immiscible.	G11 Part I p. 42
4	4	11.11 Electronics	A transistor amplifies and switches; rectification is done by diodes.	G11 Part II p. 69
5	2	10.12 Equilibrium of forces	For equilibrium the resultant of the three forces must be zero.	G10 Part I p. 210
6	3	11.6 Biological processes in the human body	Glucose is small enough to pass into the glomerular filtrate; blood cells, platelets and plasma proteins are too large.	G11 Part I p. 160
7	4	10.6 Plant and animal cells	A 'typical cell' is a model cell constructed to show all the organelles together.	G10 Part I p. 112
8	4	11.13 Electromagnetism and electromagnetic induction	A moving-coil microphone converts sound to current by electromagnetic induction; motors, speakers and bells use the motor effect.	G11 Part II p. 138
9	2	10.14 Continuity of life (reproduction)	The fruit shown with a fibrous/air-filled light covering is adapted to float (water dispersal).	G10 Part II p. 44
10	2	10.17 Rate of reactions	Catalysts are not used up and work in small amounts. At O/L, catalysts only increase rates (A false).	G10 Part II p. 121
11	1	10.1 Chemical basis of life	Two glucose molecules condense (losing water) to form maltose.	G10 Part I p. 4
12	1	10.15 Hydrostatic pressure and its applications	A floating body: upthrust = total weight of the body = weight of liquid displaced.	G10 Part II p. 82

Q	Ans	Unit	Why this is the answer	Textbook
13	3	11.1 Living tissues	Xylem transports water and minerals; phloem translocates food.	G11 Part I p. 9
14	2	10.16 Changes in matter	Blast furnace uses CaO, CO_2 (via CO) and removes SiO_2 as slag; MgO is not involved.	G10 Part II p. 101
15	4	11.11 Electronics	Full-wave rectification plus a smoothing capacitor gives an almost steady d.c. output with small ripples.	G11 Part II p. 62
16	1	10.20 Inheritance	Tt × tt gives Tt : tt = 1 : 1 dominant : recessive phenotypes.	G10 Part II p. 175
17	2	10.7 Quantification of elements and compounds	Relative mass compares with one-twelfth of the mass of a carbon-12 atom.	G10 Part I p. 127
18	2	11.7 Acids, bases and salts	pH increases: strong acid HCl < weak acid CH_3COOH < weak base NH_4OH < strong base NaOH.	G11 Part I p. 201
19	3	11.2 Photosynthesis	Starch forms only in green parts exposed to light; covered and white parts stay negative with iodine.	G11 Part I p. 26
20	2	11.7 Acids, bases and salts	HCl ionises completely in water: H_2O, H^+, OH^- (from water) and Cl^- are present; no HCl molecules.	G11 Part I p. 191
21	1	10.7 Quantification of elements and compounds	Each CO_2 molecule has 3 atoms: $3 \times 6.022 \times 10^{23}$ atoms per mole.	G10 Part I p. 133
22	1	10.7 Quantification of elements and compounds	From the equation $2H_2S : 1SO_2$, one mole of H_2S reacts with 0.5 mol SO_2.	G10 Part I p. 138
23	4	10.6 Plant and animal cells	Animal cells share cytoplasm and cell membrane; cell wall and large vacuole are plant-only.	G10 Part I p. 113
24	4	10.16 Changes in matter	CO_2 and SO_2 are acidic oxides, gases at room temperature and colourless.	G10 Part II p. 107
25	1	11.5 Geometrical optics	A convex lens converges a parallel beam (a) into a converging beam (b).	G11 Part I p. 110
26	1	11.5 Geometrical optics	A magnifying glass: object between the lens and its focus gives a magnified virtual image.	G11 Part I p. 134
27	4	10.13 The world of life (classification and nomenclature)	Broad mouth, moist skin and cold-blooded: an amphibian, the toad.	G10 Part II p. 21
28	3	11.3 Mixtures	Cold soda water holds more CO_2; as it warms the gas leaves solution, changing the CO_2 mole fraction in the two phases in opposite ways (official key).	G11 Part I p. 43
29	3	11.6 Biological processes in the human body	Gas exchange occurs across the thin, moist alveolar wall.	G11 Part I p. 154
30	2	10.10 Chemical bonds	Count bonds and lone pairs on X, Y, Z in the Lewis structures to identify the elements (official key option 2).	G10 Part I p. 179
31	3	10.4 Newton's laws of motion	The heavier iron ball has greater momentum (mass × velocity) at the same speed, so greater impact force.	G10 Part I p. 93
32	4	10.15 Hydrostatic pressure and its applications	Liquid pressure depends only on depth: same height in all tanks gives equal pressure.	G10 Part II p. 66
33	3	10.3 Structure of matter	Na^+ (23/11): 11 p, 12 n, and 10 electrons after losing one.	G10 Part I p. 55
34	2	10.8 Characteristics of organisms	Respiration (gas exchange) happens in a living egg and seed but not in meat or dry wood.	G10 Part I p. 139
35	4	11.10 Power and energy of electric appliances	At 12 V the bulb takes 0.5 A (A); P = VI = 12 × 0.5 W (B); R = V/I = 24 Ω (C).	G11 Part II p. 33
36	1	10.19 Current electricity	Combine the resistors so that series and parallel parts total 4 Ω (e.g. 12 Ω parallel with (1 + 5) Ω gives 4 Ω).	G10 Part II p. 162

Q	Ans	Unit	Why this is the answer	Textbook
37	3	10.15 Hydrostatic pressure and its applications	The bisokotuwa (sluice valve pit) reduces water pressure and speed when water is released.	G10 Part II p. 75
38	4	11.15 Biosphere	Burning releases the stored carbon as CO_2 immediately.	G11 Part II p. 178
39	3	10.20 Inheritance	CITES regulates international trade in endangered plants and animals (CoP_{18} was planned for Colombo in 2019).	G10 Part II p. 173
40	4	11.15 Biosphere	Refraining from polythene is 'refuse', not 'reduce'.	G11 Part II p. 208

Paper I • 2017 (new syllabus)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Which of the following plants is a gymnosperm?
(1) Coconut **(2)** Paddy **(3)** Grass **(4)** Pinus

2. What is the unit of the moment of force?
(1) $J\ s^{-1}$ **(2)** $kg\ m\ s^{-2}$ **(3)** N m **(4)** $N\ m^{-2}$

3. The organ which mainly contributes to nitrogenous excretion in the human is
(1) skin. **(2)** kidney. **(3)** nose. **(4)** lungs.

4. Which of the following substances can be mixed with water to make a heterogeneous mixture?
(1) Copper sulphate **(2)** Ethyl alcohol **(3)** Sugar **(4)** Wheat flour

5. Which of the following organelles releases energy by aerobic respiration?
(1) Nucleus **(2)** Mitochondrion **(3)** Ribosome **(4)** Golgi complex

6. Which of the following oxides is basic?
(1) MgO **(2)** Al_2O_3 **(3)** SO_2 **(4)** SiO_2

7. The animal tissue given in the diagram is



(1) a muscle tissue. **(2)** a nervous tissue.
(3) an epithelial tissue. **(4)** a connective tissue.

8. Which of the following energy transformations takes place in a bicycle dynamo?
(1) Electric energy → Mechanical energy **(2)** Thermal energy → Electric energy
(3) Mechanical energy → Electric energy **(4)** Electric energy → Light energy

9. The biochemical reactions that take place in organisms are catalysed by
(1) hormones. **(2)** enzymes. **(3)** fatty acids. **(4)** water.

10. In which of the following instances, does a couple of forces act?
(1) When a door is opened by pushing
(2) When a nail is unscrewed by a screw driver
(3) When the rope is pulled in opposite directions by two groups in a competition of pulling ropes
(4) When two persons are pushing a box in the same direction, which is kept on the floor

11. The number of electrons and the number of protons in an Al^{3+} ion are respectively, (The atomic number of Al is 13.)
(1) 10, 13 **(2)** 10, 27 **(3)** 13, 13 **(4)** 13, 27

12. What is the standard notation of Tritium?
(1) ${}^{1}_{1}H$ **(2)** ${}^{2}_{1}H$ **(3)** ${}^{3}_{1}H$ **(4)** ${}^{3}_{3}H$

13. Which of the following adaptations is shown by the seeds of Hora/Ennei plant for dispersal by wind?
(1) Possessing wing-like structures **(2)** Presence of hairs
(3) Having air-filled shells **(4)** Consisting of different patterns

14. A certain covalent compound is completely ionized in water. Which of the following could be this compound?
(1) NH_4OH **(2)** HCl **(3)** $CuSO_4$ **(4)** H_2CO_3

15. The endocrine glands that secrete glucagon and calcitonin in human body are respectively,

(1) pancreas and thyroid. **(2)** adrenal and thyroid.
(3) pituitary and adrenal. **(4)** thyroid and pancreas.

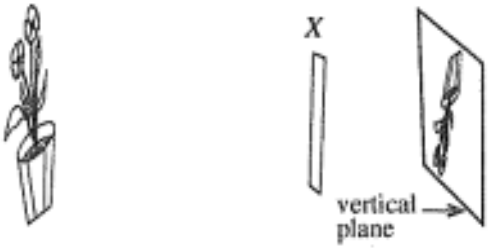
16. Select the option in the table which gives the most suitable extraction method for each of the elements potassium, calcium and lead.

	Potassium	**Calcium**	**Lead**
(1)	Electrolysis	Reduction	Physical method
(2)	Electrolysis	Reduction	Reduction
(3)	Reduction	Electrolysis	Physical method
(4)	Electrolysis	Electrolysis	Reduction

17. On a horizontal ground, the point B is located to the east of A and point C is located to the north of B. An ant has moved from A to C through the straight line paths AB and BC. If AB = 3 m and BC = 4 m, what is the displacement of ant in this motion?

(1) 4 m. **(2)** 5 m. **(3)** 7 m. **(4)** 25 m.

18. A situation where an image of a flower pot taken on to a white vertical plane using an item called X is shown in the figure. Which of the following could be X?



(1) A plane mirror **(2)** A convex mirror **(3)** A concave lens **(4)** A convex lens

19. Which of the following statements is true regarding waves?

(1) Transverse waves propagate with compressions and rarefactions.
(2) The distance between a crest and a trough of a transverse wave is equal to the wave length of that wave.
(3) It is not necessary to have a medium for the propagation of mechanical waves.
(4) Energy is transmitted by the mechanical waves without the transmission of substance.

20. The salts which precipitate in the first tank and third tank, in the production process of salt from sea water are respectively,

(1) $CaCO_3$ and NaCl **(2)** $CaSO_4$ and $MgSO_4$ **(3)** $MgSO_4$ and NaCl **(4)** $CaCO_3$ and $CaSO_4$

21. Select the most efficient food chain among the food chains given below.

(1) Grass → Deer → Tiger
(2) Carrot → Rabbit → Python → Hawk
(3) Grass → Grass hopper → Rat → Cobra → Hawk
(4) Paddy → Rat → Hornbill → Hawk

22. The composition of a glucose solution in terms of mass and volume is 90 g dm^{-3}. What is the concentration of that glucose solution? (Relative molecular mass of glucose is 180)

(1) 0.25 mol dm^{-3} **(2)** 0.50 mol dm^{-3} **(3)** 0.75 mol dm^{-3} **(4)** 2.00 mol dm^{-3}

23. Which of the following is **not** a function of nucleic acids?

(1) Storing genetic information of organisms **(2)** Contributing to protein synthesis
(3) Controlling activities of the cell **(4)** Maintaining body temperature

24. The final products of the reaction of haematite (Fe_2O_3) with carbon monoxide gas in the temperature range of 1000 °C – 1900 °C are

(1) Fe and CO_2 **(2)** FeO and CO_2 **(3)** Fe and O_2 **(4)** FeO and $FeCO_3$

25. Which of the following end products of digestion is **not** absorbed by the blood capillaries of the villi in the small intestine in human?

(1) Amino acids **(2)** Glycerol **(3)** Galactose **(4)** Fructose

26. Which of the following is a function of human cerebellum?

(1) Maintaining the balance of the body **(2)** Performing high mental activities
(3) Perception of visual stimuli **(4)** Control of respiration

27. A situation where a swan of mass 1.3 kg is at still water in a pond is given in the figure. What is the upthrust acting on the swan by water? (Take the value of gravitational acceleration as 10 m s^{-2})



(1) 1.3 N **(2)** 8.7 N **(3)** 10.0 N **(4)** 13.0 N

28. Consider the following chemical reaction.

$$ZnSO_4 + X \rightarrow XSO_4 + Zn$$

Which of the following elements could be X?

(1) Fe **(2)** Al **(3)** Mg **(4)** Cu

29. A saturated solution of sugar was prepared at 80 °C temperature by dissolving a solid sample of sugar which has been made impure by a small amount of table salt. Which of the following measures can be taken to get pure sugar crystals?

(1) Increasing the temperature of the solution **(2)** Cooling the solution
(3) Diluting the solution **(4)** Filtering the solution

30. Consider the instances A, B and C given below.

A – A bat flying at night emitting ultrasound waves of 21 000 Hz.
B – A dolphin preying in the ocean emitting ultrasound waves of 21 000 Hz.
C – A rabbit walking in the jungle emitting ultrasound waves of 21 000 Hz.

If the speeds of sound emitted at the above instances are V_A, V_B and V_C respectively, which of the following relationships is correct?

(1) $V_A < V_B < V_C$ **(2)** $V_B < V_C < V_A$ **(3)** $V_A = V_C < V_B$ **(4)** $V_A = V_B = V_C$

31. An iron nail which was in contact with a metal M was kept in an agar medium which consists of small amounts of sodium chloride, potassium ferricyanide and phenolphthalein. After one hour, only pink colour was seen in the agar medium around the nail. M could be

(1) copper. **(2)** lead. **(3)** stanus. **(4)** aluminium.

32. Consider the following features.

A – Nucleus is present peripherally in the cytoplasm.
B – Having spherical cells with a large central vacuole.
C – No inter cellular spaces

Of the above features, the features of parenchyma tissue are

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

33. On a table, a box is in equilibrium under three coplanar forces of 10, 15 and P Newtons. The resultant of the two forces 10 N and 15 N is 12 N. Consider the statements X, Y and Z regarding the force P.

X – Magnitude of P is 12 N.
Y – P acts in the direction of the resultant force of the two forces 10 N and 15 N.
Z – The line of action of P goes through the intersecting point of the lines of actions of the two forces 10 N and 15 N.

Of the above statements,

(1) only X and Y are true.
(2) only Y and Z are true.
(3) only X and Z are true.
(4) all X, Y and Z are true.

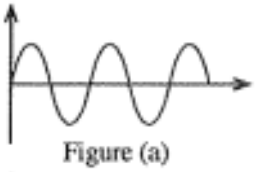
34. An organism has the following features.

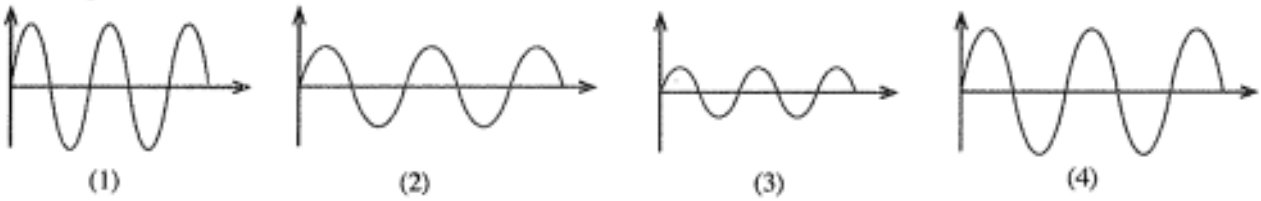
A – Consisting of eukaryotic cells
B – Has the ability to decompose organic matter
C – Presence of chitin in the cell wall

To which kingdom does the above organism belong?

(1) Protista **(2)** Fungi **(3)** Plantae **(4)** Animalia

35. The sound wave obtained by tapping a drum softly was observed in the cathode ray oscilloscope as in figure (a). Which of the following could be the wave form that is obtained, when the drum is tapped with a larger force than the above instance?

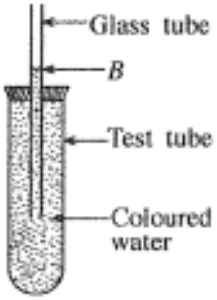

Figure (a)


(1) (2) (3) (4)

36. A child of mass 40 kg walked along a staircase from the first floor to the third floor of a building which is 9 m high from the first floor. The time taken by the child for this entire motion is 2 minutes. What is his rate of doing work? (Take the acceleration due to gravity as 10 m s^{-2})

(1) 30 W **(2)** 400 W **(3)** 1 800 W **(4)** 3 600 W

37. Test tube with the glass tube given in the figure is immersed in a vessel with water and heated for a small period of time.



Three statements regarding the observations of this experiment are given below.

X – The water level in the glass tube rises up gradually from B and stops.
Y – The water level in the glass tube drops down gradually from B and stops.
Z – The water level in the glass tube drops down from B and then rises up and exceeds the level B.

Of the above statements,

(1) X is true.
(2) Y is true.
(3) Z is true.
(4) all X, Y and Z are false.

38. The information relevant to the motion of an object in a straight line is given below.

Time/s	0	1	2	3	4	5	6
Displacement/m	0	4	8	10	14	16	18

Which of the following statements is correct, according to the above information?

(1) The object has moved at a uniform velocity during the total period of time.
(2) The mean velocity of the object is 3 m s^{-1} during the entire motion.
(3) The object has come again to the starting position.
(4) The total distance travelled by the object is 70 m.

39. A straight conductor AB which carries current I is kept in a magnetic field. The direction of magnetic field is perpendicular to the direction of flow of current through the conductor.

Consider the changes done separately in situations X and Y given below.

Situation X : Increasing current upto 2I without changing the magnetic field

Situation Y : Decreasing the strength of magnetic field while keeping the current through AB as I.

Which of the following statements is correct regarding the magnetic force that acts on AB in the two situations?

(1) Magnetic force increases only in situation X
(2) Magnetic force increases only in situation Y
(3) Magnetic force increases in both situations X and Y
(4) Magnetic force decreases in both situations X and Y

40. Consider the following activities.

A – Minimization of food mile
B – Energy management
C – Use of traditional knowledge and technology

The important activities for the sustainable development of Sri Lanka are

(1) A and B only. **(2)** B and C only. **(3)** A and C only. **(4)** all A, B and C.

2017 (new syllabus) — answer key and reviews

Source of answers: Prepared answer key (no official 2017 scheme in the collection); worked from the Grade 10/11 textbooks.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	4	11	1	21	1	31	4
2	3	12	3	22	2	32	1
3	2	13	1	23	4	33	3
4	4	14	2	24	1	34	2
5	2	15	1	25	2	35	4
6	1	16	4	26	1	36	1
7	3	17	2	27	4	37	3
8	3	18	4	28	3	38	2
9	2	19	4	29	2	39	1
10	2	20	1	30	3	40	4

Q	Ans	Unit	Why this is the answer	Textbook
1	4	10.13 The world of life (classification and nomenclature)	Pinus bears naked seeds in cones: a gymnosperm. Coconut, paddy and grass are flowering plants.	G10 Part II p. 11
2	3	10.11 Turning effect of a force	Moment = force × perpendicular distance: N m.	G10 Part I p. 200

Q	Ans	Unit	Why this is the answer	Textbook
3	2	11.6 Biological processes in the human body	The kidneys excrete urea, the main nitrogenous waste.	G11 Part I p. 158
4	4	11.3 Mixtures	Wheat flour does not dissolve; it forms a suspension (heterogeneous). The others dissolve.	G11 Part I p. 34
5	2	10.6 Plant and animal cells	Aerobic respiration occurs in mitochondria, releasing energy as ATP.	G10 Part I p. 122
6	1	10.3 Structure of matter	Metal oxides such as MgO are basic; Al_2O_3 is amphoteric, SO_2 and SiO_2 are acidic.	G10 Part I p. 73
7	3	11.1 Living tissues	A single layer of closely packed column-shaped cells on a base: epithelial tissue.	G11 Part I p. 11
8	3	11.13 Electromagnetism and electromagnetic induction	A dynamo converts the mechanical (kinetic) energy of the wheel into electrical energy.	G11 Part II p. 139
9	2	10.1 Chemical basis of life	Enzymes are biological catalysts.	G10 Part I p. 8
10	2	10.11 Turning effect of a force	A screwdriver turns by two equal, opposite, parallel forces on its handle: a couple.	G10 Part I p. 198
11	1	10.3 Structure of matter	Al has 13 protons; Al^{3+} has lost 3 electrons, leaving 10.	G10 Part I p. 54
12	3	10.3 Structure of matter	Tritium is hydrogen with mass number 3: 3/1 H (1 proton, 2 neutrons).	G10 Part I p. 55
13	1	10.14 Continuity of life (reproduction)	Hora (Dipterocarpus) seeds have wing-like sepals for wind dispersal.	G10 Part II p. 43
14	2	10.10 Chemical bonds	HCl is a covalent molecule that ionises completely in water (strong acid). $CuSO_4$ is ionic.	G10 Part I p. 185
15	1	11.6 Biological processes in the human body	Glucagon comes from the pancreas (islets); calcitonin from the thyroid.	G11 Part I p. 180
16	4	10.16 Changes in matter	Very reactive K and Ca are extracted by electrolysis of fused compounds; lead is reduced with carbon.	G10 Part II p. 100
17	2	10.2 Motion in a straight line	Displacement is the straight line A to C: $\text{sqrt}(3^2 + 4^2) = 5$ m.	G10 Part I p. 23
18	4	11.5 Geometrical optics	Only a convex lens can form a real image on a screen; mirrors here and concave lenses give virtual images.	G11 Part I p. 134
19	4	11.4 Waves and their applications	Mechanical waves transfer energy without carrying the medium along. Transverse waves have crests/troughs, not compressions.	G11 Part I p. 74
20	1	11.3 Mixtures	In the saltern $CaCO_3$ deposits first (first tank) and NaCl crystallises in the third (small) tank.	G11 Part I p. 65
21	1	11.15 Biosphere	Energy is lost at each trophic level; the shortest chain (grass → deer → tiger) is most efficient.	G11 Part II p. 177
22	2	11.3 Mixtures	90 g / 180 g mol^{-1} = 0.5 mol per dm^3.	G11 Part I p. 51
23	4	10.1 Chemical basis of life	Nucleic acids store genetic information and direct protein synthesis; they do not maintain body temperature.	G10 Part I p. 12
24	1	10.16 Changes in matter	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$.	G10 Part II p. 94
25	2	11.6 Biological processes in the human body	Fatty acids and glycerol enter the lacteals (lymph), not the blood capillaries.	G11 Part I p. 148
26	1	11.6 Biological processes in the human body	The cerebellum maintains balance and coordinates movement.	G11 Part I p. 176
27	4	10.15 Hydrostatic pressure and its applications	A floating swan: upthrust = weight = 1.3 kg × 10 m s^{-2} = 13.0 N.	G10 Part II p. 82

Q	Ans	Unit	Why this is the answer	Textbook
28	3	10.16 Changes in matter	X forms XSO_4 (divalent) and is above zinc in the activity series: magnesium.	G10 Part II p. 99
29	2	11.3 Mixtures	Sugar is far more soluble when hot; cooling the saturated solution crystallises sugar while the small amount of salt stays dissolved.	G11 Part I p. 56
30	3	11.4 Waves and their applications	Sound travels at the same speed in air for the bat and rabbit, and faster in water for the dolphin: VA = VC < VB.	G11 Part I p. 96
31	4	11.12 Electrochemistry	Pink colour (OH^- from phenolphthalein) without blue (no Fe^{2+}) shows iron is protected; M is more reactive: aluminium.	G11 Part II p. 108
32	1	11.1 Living tissues	Parenchyma: thin-walled, spherical cells with a large vacuole and peripheral nucleus. It does have intercellular spaces.	G11 Part I p. 5
33	3	10.12 Equilibrium of forces	P balances the other two: equal magnitude (12 N) opposite to their resultant, and concurrent with them (X and Z true).	G10 Part I p. 210
34	2	10.13 The world of life (classification and nomenclature)	Eukaryotic, decomposer, chitin in the cell wall: Kingdom Fungi.	G10 Part II p. 7
35	4	11.4 Waves and their applications	A louder sound has larger amplitude but the same frequency (same number of waves on the screen).	G11 Part I p. 93
36	1	10.18 Work, energy and power	Power = mgh / t = 40 × 10 × 9 / 120 s = 30 W.	G10 Part II p. 136
37	3	11.9 Heat	The glass expands first so the level drops, then the water expands more and rises above B.	G11 Part II p. 20
38	2	10.2 Motion in a straight line	Mean velocity = 18 m / 6 s = 3 m s^{-1}. Velocity is not uniform (the steps vary).	G10 Part I p. 35
39	1	11.13 Electromagnetism and electromagnetic induction	F = BIL: doubling I increases the force; weakening B decreases it.	G11 Part II p. 120
40	4	11.15 Biosphere	Reducing food miles, managing energy and using traditional knowledge all support sustainable development.	G11 Part II p. 201

Paper I • 2017 (old syllabus)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Which of the following plants has leaves with reticulated venation?

(1) Chillies **(2)** Coconut **(3)** Paddy **(4)** Bamboo

2. Some features of the body of an animal are given below.

A – Presence of chaetae
B – Body comprises of three layers
C – Presence of bilateral symmetry

This animal having the above features belong to phylum,

(1) Coelenterata. **(2)** Annelida. **(3)** Mollusca. **(4)** Arthropoda.

3. Which of the following is a warm-blooded animal?

(1) Crocodile **(2)** Toad **(3)** Tortoise **(4)** Kingfisher

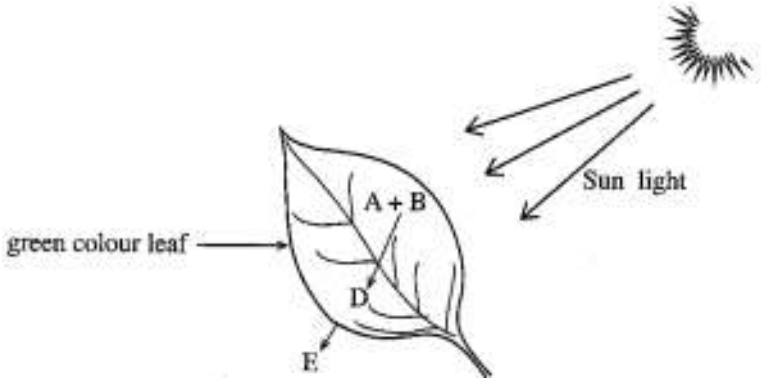
4. The largest organelle, present in an animal cell is

(1) Nucleus. **(2)** Ribosome. **(3)** Golgi bodies. **(4)** Mitochondrion.

5. Which of the following diseases can be prevented by the vaccine B.C.G.?

(1) Pneumonia **(2)** Laryngitis **(3)** Tuberculosis **(4)** Bronchitis

6. The information related to a biological process that takes place in a plant is given in the diagram. According to the diagram, A, B, D and E are, respectively,



(1) CO_2, H_2O, $C_6H_{12}O_6$ and O_2 **(2)** O_2, H_2O, $C_6H_{12}O_6$ and CO_2
(3) H_2O, $C_6H_{12}O_6$, CO_2 and O_2 **(4)** CO_2, $C_6H_{12}O_6$, O_2 and H_2O

7. Past pupils of a school decided to donate blood to a teacher who had undergone an urgent surgery. If her blood group is A, the persons belonging to which of the following blood groups can donate blood?

(1) A and AB **(2)** B and AB **(3)** A and O **(4)** AB and O

8. Saman can see close-by objects clearly. But he cannot see the distant objects clearly. Select the option that gives the defect of his vision and the remedy that must be taken to overcome the defect.

(1) Long sight, wearing spectacles with convex lenses
(2) Long sight, wearing spectacles with concave lenses
(3) Short sight, wearing spectacles with convex lenses
(4) Short sight, wearing spectacles with concave lenses

9. A diagram relevant to a reflex arc is given below.

Skin → [A] → spinal code → [B] → muscles

A and B are, respectively,

(1) sensory neurone and motor neurone. **(2)** sensory neurone and intermediate neurone.
(3) motor neurone and sensory neurone. **(4)** intermediate neurone and motor neurone.

10. Which of the following seeds is dispersed by explosive mechanism?

(1) Orchid **(2)** Balsam **(3)** Thuththiri **(4)** Vara

11. Which of the following is **not** a hereditary disease in humans?

(1) Haemophilia **(2)** Colour blindness **(3)** Thalassemia **(4)** Gonorrhoea

12. Consider the following hormones.

A - Glucogon B - Cortisol C - Insulin D - Adrenalin

The hormones which mainly contribute in maintaining the glucose level in the blood at optimum-level are

(1) A and B. **(2)** A and C. **(3)** B and C. **(4)** A and D.

13. The element **X** belongs to the group three in the periodic table.

The chemical formula of sulphate of **X** is

(1) XSO_4 **(2)** X_2SO_4 **(3)** $X_2(SO_4)_3$ **(4)** $X_3(SO_4)_2$

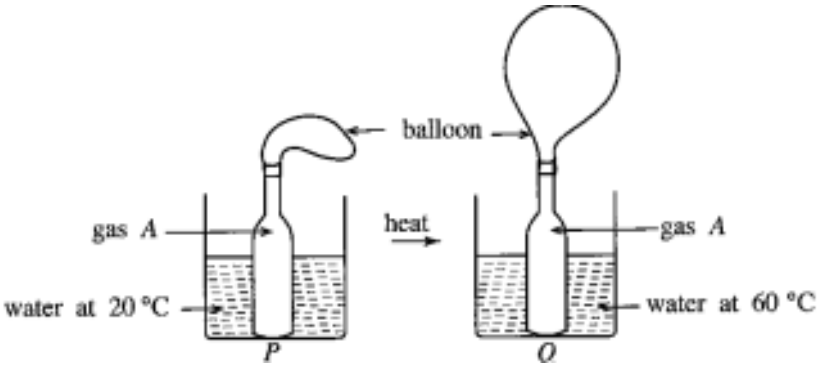
14. Which of the following is an oxide having covalent bonds?

(1) MgO **(2)** Na_2O **(3)** CaO **(4)** SiO_2

15. Which of the following equipment must be used to measure correctly 26.0 cm^3 of a sodium chloride solution?

(1) Measuring cylinder **(2)** Pipette **(3)** Burette **(4)** Volumetric flask

16. Consider the statements ①, ② and ③ related to the situations P and Q shown in the following figures.



① - The volume of gas A in situation Q increased due to increase in the temperature.

② - The pressure inside the balloon in situation P is greater than that of situation Q.

③ - The gas A obeys Charles' law in situations P and Q.

Of the above statements,

(1) ① and ② are true. **(2)** ② and ③ are true.

(3) ① and ③ are true. **(4)** all ①, ② and ③ are false.

17. In the production process of rubber, the anticoagulant used to kill bacteria in latex is

(1) sodium sulphite. **(2)** ammonia solution.

(3) formaldehyde (formalin). **(4)** sodium carbonate

18. Which of the following metals reacts vigorously with cold water?

(1) Na **(2)** Cu **(3)** Mg **(4)** Pb

19. Select the option which gives two metals that are extracted by reduction method?

(1) Na and Cu **(2)** Cu and Pb **(3)** Na and Pb **(4)** Mg and Cu

20. Which of the following is an example for a sedimentary rock?

(1) Gneiss **(2)** Granite **(3)** Marble **(4)** Mud stone

21. Which of the following gives the number of water molecules in 36 g of water? (H = 1, O = 16)

(1) ½ × 6.022 × 10^{23} **(2)** 6.022 × 10^{23} **(3)** 2 × 6.022 × 10^{23} **(4)** 36 × 6.022 × 10^{23}

22. It was necessary to use Halon fire extinguisher to extinguish the fire that has broken out in a building. Accordingly, which of the following could have been the cause for the fire?

(1) Oil **(2)** Plastics **(3)** Electric equipment **(4)** Timber

23. An electrolytic cell must be designed to electroplate copper on an iron key. The anode, cathode and electrolyte which should be used in this cell are, respectively,

(1) key, a copper strip and a copper sulphate solution.
(2) a copper strip, key and diluted sulphuric acid.
(3) a copper strip, key and a copper sulphate solution.
(4) key, a copper strip and diluted sulphuric acid.

24. Which of the following is a neutralization reaction?

(1) $Mg + 2HCl \rightarrow MgCl_2 + H_2$ **(2)** $CaO + H_2O \rightarrow Ca(OH)_2$
(3) $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$ **(4)** $2Na + 2H_2O \rightarrow 2NaOH + H_2$

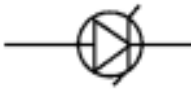
25. Select the option which gives a vector quantity and a scalar quantity respectively.

(1) momentum, force **(2)** momentum, time
(3) distance, time **(4)** velocity, acceleration

26. The temperature of an object is 300 K. This temperature in Celsius is

(1) 27. **(2)** 30. **(3)** 273. **(4)** 573.

27. The symbol given below represents,

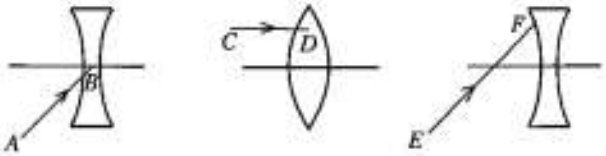


(1) an optical diode. **(2)** a Zener diode. **(3)** a NOT gate. **(4)** an OR gate.

28. Which of the following is **not** a characteristic of electromagnetic waves?

(1) Can propagate in vacuum **(2)** Having a charge
(3) Being transverse waves **(4)** Obey laws of reflection

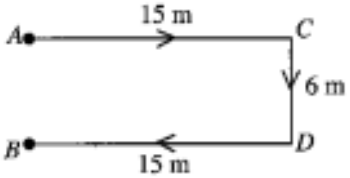
29. Consider the light rays AB, CD and EF incident on the lenses given in the following figures.



Select the option which gives the light ray/rays which does/do **not** undergo refraction.

(1) AB **(2)** CD **(3)** AB and EF **(4)** CD and EF

30. A child moved from the position A on one side of a road to the position B of the opposite side along the path given in the figure. CD shows the region of yellow lines. The displacement of the child in the motion from A to B is



(1) 6 m. **(2)** 15 m. **(3)** 30 m. **(4)** 36 m.

31. The heat required to increase the temperature of 1 kg of water by 1 °C is 4 200 J. What is the heat required to increase the temperature of 10 kg of water by 50 °C?

(1) 21 000 J **(2)** 42 000 J **(3)** 210 000 J **(4)** 2 100 000 J

32. Consider the following optical instruments.

A – Simple microscope
B – Compound microscope
C – Astronomical telescope

The instruments which consist of two convex lenses are

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

33. The mass of an object is 2 kg. When it moves at the velocity of 4 m s^{-1} its momentum is

(1) 2 kg m s^{-1} **(2)** 6 kg m s^{-1} **(3)** 8 kg m s^{-1} **(4)** 16 kg m s^{-1}

34. Consider the facts given below regarding a capacitor.

A – Area of the plates of the capacitor
B – Distance between the plates of the capacitor
C – The nature of the dielectric substance in between the plates of the capacitor

Of the above facts, the facts that affect the capacity of the capacitor are

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

35. In which of the following instances can a p-type semi conductor be made?

(1) Doping a small amount of phosphorus with germanium
(2) Doping a small amount of arsenic with silicon
(3) Doping a small amount of aluminium with germanium
(4) Doping a small amount of silicon with germanium

36. A coin is kept at the bottom of a water basin as shown in the figure. When the coin is viewed from above the water surface, what is the apparent depth of the coin? (The refractive index of water is 1.3)



(1) 2.0 cm **(2)** 2.6 cm **(3)** 13.0 cm **(4)** 20.0 cm

37. What is the gas that rapidly increased in the atmosphere in the year 2016, due to human activities and elnino phenomenon?

(1) N_2 **(2)** CO_2 **(3)** NH_3 **(4)** SO_2

38. What is the theme of the World Science Day in the year 2017?

(1) Science for global understanding **(2)** Science for sustainable development
(3) Science for peace and development **(4)** Science for technology and researches

39. Which of the following items have been completely prohibited from producing, using and selling in Sri Lanka from 01st September 2017?

(1) Plastic bottles **(2)** Polystyrene boxes **(3)** Rubber lids **(4)** Metal lids

40. Consider the following activities regarding waste management.

A – Food scraps are used for the consumption of farm animals.
B – Recycling the items such as polythene and plastic.
C – The broken instruments consisting heavy metals are deposited in the ground.

Of the above activities, the environment friendly activities are

(1) only A and B. **(2)** only B and C. **(3)** only A and C. **(4)** all A, B and C.

2017 (old syllabus) — answer key and reviews

Source of answers: Prepared answer key (old-syllabus 2017 paper; no official scheme in the collection).

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	4	21	3	31	4
2	2	12	2	22	3	32	2
3	4	13	4	23	3	33	3
4	1	14	4	24	3	34	4
5	3	15	3	25	2	35	3
6	1	16	3	26	1	36	4
7	3	17	2	27	1	37	2
8	4	18	1	28	2	38	1
9	1	19	2	29	3	39	2
10	2	20	4	30	1	40	1

Q	Ans	Unit	Why this is the answer	Textbook
1	1	10.13 The world of life (classification and nomenclature)	Chillies is a dicot with net (reticulate) venation; coconut, paddy and bamboo are monocots (parallel venation).	G10 Part II p. 14
2	2	10.13 The world of life (classification and nomenclature)	Chaetae (bristles), three body layers and bilateral symmetry: Annelida (e.g. earthworm).	G10 Part II p. 16
3	4	10.13 The world of life (classification and nomenclature)	Birds such as the kingfisher are warm-blooded; reptiles and amphibians are cold-blooded.	G10 Part II p. 22
4	1	10.6 Plant and animal cells	The nucleus is the largest organelle in an animal cell.	G10 Part I p. 115
5	3	11.6 Biological processes in the human body	BCG vaccine protects against tuberculosis.	G11 Part I p. 156
6	1	11.2 Photosynthesis	Photosynthesis: CO_2 (A) and H_2O (B) enter, glucose (D) is made and O_2 (E) is released.	G11 Part I p. 22
7	3	11.6 Biological processes in the human body	Group A recipients can receive A or O blood (O is the universal donor).	G11 Part I p. 186
8	4	11.5 Geometrical optics	Seeing near but not far = short sight (myopia), corrected by a concave (diverging) lens.	G11 Part I p. 126
9	1	11.6 Biological processes in the human body	Impulses go from receptor (skin) by the sensory neurone (A) to the spinal cord, then by the motor neurone (B) to muscle.	G11 Part I p. 177
10	2	10.14 Continuity of life (reproduction)	Balsam pods burst open and fling out seeds (explosive mechanism).	G10 Part II p. 44
11	4	10.20 Inheritance	Gonorrhoea is a bacterial sexually transmitted disease, not inherited.	G10 Part II p. 172
12	2	11.6 Biological processes in the human body	Glucagon raises and insulin lowers blood glucose, keeping it at the optimum level.	G11 Part I p. 181
13	4	10.3 Structure of matter	Group 3 element forms X^{3+}; sulphate is SO_4^{2-}; formula $X_2(SO_4)_3$.	G10 Part I p. 59
14	4	10.10 Chemical bonds	SiO_2 is a covalent (giant molecular) oxide; the others are ionic metal oxides.	G10 Part I p. 185
15	3	11.3 Mixtures	A burette measures any variable volume accurately to 0.1 cm^3.	G11 Part I p. 47
16	3	11.9 Heat	Heating increases the gas volume (1) at constant (atmospheric) pressure, obeying Charles' law (3).	G11 Part II p. 17

Q	Ans	Unit	Why this is the answer	Textbook
17	2	11.14 Hydrocarbons and their derivatives	Ammonia solution prevents coagulation and kills bacteria in latex.	G11 Part II p. 164
18	1	10.16 Changes in matter	Sodium reacts vigorously with cold water.	G10 Part II p. 96
19	2	10.16 Changes in matter	Moderately reactive / less reactive metals (Cu, Pb) are extracted by reduction; Na and Mg by electrolysis.	G10 Part II p. 100
20	4	10.17 Rate of reactions	Mudstone forms from compacted sediment; gneiss and marble are metamorphic, granite is igneous.	G10 Part II p. 117
21	3	10.7 Quantification of elements and compounds	36 g water = 2 mol = 2 × 6.022 × 10^{23} molecules.	G10 Part I p. 134
22	3	11.11 Electronics	Halon (or CO_2) extinguishers are used for electrical fires because they do not conduct electricity.	G11 Part II p. 50
23	3	11.12 Electrochemistry	For electroplating: the plating metal (copper) is the anode, the key is the cathode, and the electrolyte is a copper salt solution.	G11 Part II p. 99
24	3	11.7 Acids, bases and salts	Base + acid → salt + water: $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$.	G11 Part I p. 201
25	2	10.2 Motion in a straight line	Momentum is a vector; time is a scalar.	G10 Part I p. 50
26	1	11.9 Heat	t(°C) = T(K) - 273 = 300 - 273 = 27 °C.	G11 Part II p. 4
27	1	11.11 Electronics	A diode symbol with arrows pointing outward represents a light-emitting (optical) diode.	G11 Part II p. 64
28	2	11.4 Waves and their applications	EM waves carry no charge; they travel in vacuum, are transverse and obey the laws of reflection.	G11 Part I p. 81
29	3	11.5 Geometrical optics	Rays passing through the optical centre (AB and EF) go straight through without bending.	G11 Part I p. 133
30	1	10.2 Motion in a straight line	Displacement is the straight-line distance from A to B across the road: 6 m.	G10 Part I p. 26
31	4	11.9 Heat	Q = mc(θ) = 10 × 4200 × 50 = 2 100 000 J.	G11 Part II p. 11
32	2	11.5 Geometrical optics	Compound microscopes and astronomical telescopes both use two convex lenses; a simple microscope uses one.	G11 Part I p. 126
33	3	10.4 Newton's laws of motion	Momentum = 2 kg × 4 m s^{-1} = 8 kg m s^{-1}.	G10 Part I p. 94
34	4	11.11 Electronics	Capacitance depends on plate area, plate separation and the dielectric.	G11 Part II p. 62
35	3	11.11 Electronics	Doping with a Group 13 element (aluminium) creates holes: p-type.	G11 Part II p. 53
36	4	11.5 Geometrical optics	Apparent depth = real depth / refractive index = 26 / 1.3 = 20 cm.	G11 Part I p. 123
37	2	11.15 Biosphere	Fossil-fuel burning and the El Nino effect caused a record rise in atmospheric CO_2 in 2016.	G11 Part II p. 190
38	1	11.8 Heat changes associated with chemical reactions	The 2017 World Science Day for Peace and Development theme was 'Science for global understanding'.	G11 Part I p. 210
39	2	11.15 Biosphere	Polystyrene (lunch) boxes were banned in Sri Lanka from 1 September 2017.	G11 Part II p. 198
40	1	11.15 Biosphere	Using food waste as animal feed and recycling plastics are eco-friendly; burying heavy-metal waste pollutes soil and water.	G11 Part II p. 208

Paper I • 2016

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Which of the following is a vector quantity?

(1) weight **(2)** time **(3)** speed **(4)** distance

2. According to the standards of binomial nomenclature, select the option which gives correctly the scientific name of Jungle Fowl.

(1) Gallus Lafayetti (2) GALLUS LAFAYETTI
(3) *Gallus lafayetti* (4) *Gallus Lafayetti*

3. The gas which is used to produce margarine from vegetable oils is

(1) O_2 **(2)** H_2 **(3)** CO_2 **(4)** N_2

4. Which of the following seeds is adapted for dispersal by wind?

(1) Rubber **(2)** Epala **(3)** Bitter gourd **(4)** Wara

5. What is the colour of phenolphthalein in the basic medium?

(1) Red **(2)** Pink **(3)** Yellow **(4)** Blue

6. What is the acid that is used for coagulation of rubber latex?

(1) HCl **(2)** H_2SO_4 **(3)** CH_3COOH **(4)** HNO_3

7. Which of the following is an amphoteric oxide?

(1) Na_2O **(2)** P_2O_5 **(3)** Al_2O_3 **(4)** Cl_2O_7

8. Which of the following can be used as a disinfectant?

(1) Chlorine **(2)** Iodine **(3)** Boric acid **(4)** Magnesium hydroxide

9. The catalyst which is used in the manufacture of sulphuric acid by the contact method is

(1) Copper. **(2)** Nickel. **(3)** Iron. **(4)** Vanadium pentoxide.

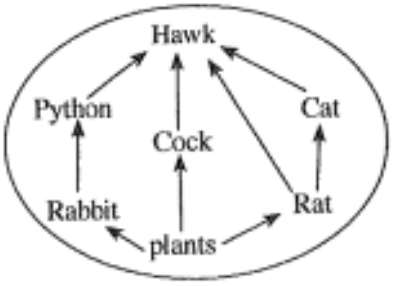
10. Monocotyledonae plants

(1) bear trimerous flowers. **(2)** show secondary growth.
(3) possess leaves with a reticulate venation. **(4)** have a tap root.

11. In which of the following instances does a chemical change occur?

(1) In vaporization of water **(2)** In burning of fire wood
(3) In melting of wax **(4)** In melting of moth balls

12. Who is the tertiary consumer in this food web?



(1) Cock **(2)** Python **(3)** Hawk **(4)** Cat

13. Select the option which gives a type of non-granulocytes and a type of granulocytes respectively.

(1) neutrophils, eosinophils **(2)** neutrophils, monocytes
(3) lymphocytes, monocytes **(4)** monocytes, basophils

14. The number of lone pair electrons around O atom in a H_2O molecule is

(1) 2 **(2)** 4 **(3)** 6 **(4)** 8

15. On a certain day, in Nuwara Eliya town, the daytime temperature was 16 °C and night-time temperature was 4 °C. What is the temperature difference between day and night in Nuwara Eliya town on that day, in Kelvin?

(1) 12 K **(2)** 277 K **(3)** 285 K **(4)** 289 K

16. What is the number of double bonds in an isoprene molecule?

(1) 1 **(2)** 2 **(3)** 3 **(4)** 4

17. Kamal works in a glass factory for a long period of time. In a medical test, it was revealed that his lung tissues are getting deteriorated gradually. Accordingly, which disease is Kamal suffering from?

(1) Asbestosis **(2)** Bronchitis **(3)** Gastritis **(4)** Silicosis

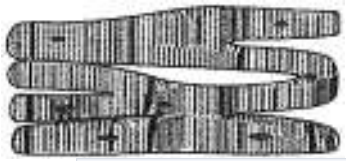
18. In the asexual reproduction,

(1) a large number of offspring is produced in a short period of time.
(2) meiosis occurs.
(3) gametes are produced.
(4) new species with better adaptation to environment are produced.

19. The focal length of a mirror is 30 cm. When an object is kept on the principal axis of the mirror, the image formed by the mirror is real and its size is equal to the size of the object. The distance from the mirror to the object is

(1) 30 cm. **(2)** 60 cm. **(3)** 120 cm. **(4)** 150 cm.

20. A diagram of a muscle tissue is given below. Select the option which gives correctly the name of this muscle tissue and its function.



	Muscle tissue	Function
(1)	Cardiac muscles	Voluntarily controlled
(2)	Skeletal muscles	Involuntarily controlled
(3)	Skeletal muscles	Voluntarily controlled
(4)	Cardiac muscles	Involuntarily controlled

21. What is the pressure exerted by water at a point located 2 m vertically below the water level in a lake?

(Take the density of water as 1 000 kg m^{-3} and acceleration due to gravity as 10 m s^{-2})

(1) 1 000 N m^{-2} **(2)** 2 000 N m^{-2} **(3)** 10 000 N m^{-2} **(4)** 20 000 N m^{-2}

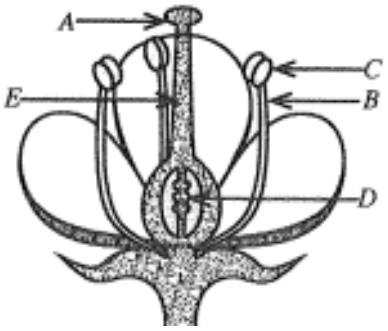
22. Amali's skin is dry and blisters have appeared on her knee and elbows. Further, Bito spots are in her eyes. From which of the following deficiencies of Vitamins is Amali suffering?

(1) Vitamin A **(2)** Vitamin B **(3)** Vitamin C **(4)** Vitamin D

23. Which of the following statements is **false** regarding photosynthesis?

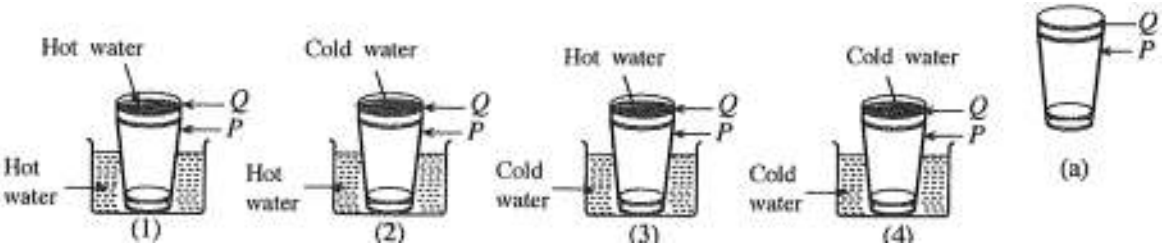
(1) Photosynthesis can be done artificially.
(2) Solar energy is converted into chemical energy during photosynthesis.
(3) O_2 gas is produced as a by-product of photosynthesis.
(4) Glucose produced during photosynthesis is temporarily stored in plant leaves as starch.

24. A diagram of a longitudinal section of a bisexual flower is given below. Select the option which gives two parts belonging to gynoecium and androecium respectively.



(1) A and C **(2)** B and D **(3)** A and E **(4)** C and E

25. As shown in the figure (a), the glass Q stick inside the glass P. Which of the following strategies is suitable to separate the two glasses easily?



26. Consider the following statements made by a student.

A – Cinnamon oil can be extracted from Cinnamon leaves by using steam distillation.
B – Petrol can be obtained from crude oil by using fractional distillation.
C – Distilled water can be obtained from well water by using simple distillation.

Of the above statements,

(1) only A and B are true. **(2)** only B and C are true.
(3) only A and C are true. **(4)** all A, B and C are true.

27. Which of the following reactions is a neutralization reaction?

(1) $CaO + H_2O \rightarrow Ca(OH)_2$ **(2)** $FeSO_4 + 2NaOH \rightarrow Fe(OH)_2 + Na_2SO_4$
(3) $NaOH + HCl \rightarrow NaCl + H_2O$ **(4)** $CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$

28. The chemical formula of the carbonate of an element **M** is $\mathbf{M_2CO_3}$. What is the chemical formula of the chloride of **M**?

(1) $\mathbf{MCl}$ **(2)** $\mathbf{M_2Cl}$ **(3)** $\mathbf{MCl_2}$ **(4)** $\mathbf{M_3Cl_2}$

29. What is the number of O atoms in 22 g of CO_2 gas? (C = 12, O = 16)

(1) 2 **(2)** 6.022×10^{23} **(3)** $2 \times 6.022 \times 10^{23}$ **(4)** $22 \times 6.022 \times 10^{23}$

30. Three properties of a particular element are given below.

- Occurs in crystalline form as well as in amorphous form.
- Insoluble in water, but very soluble in CS_2 solvent.
- Burns with a blue flame in air.

Which of the following could be the element with above properties?

(1) Na **(2)** Mg **(3)** C **(4)** S

31. The limiting frictional force between two objects with rough surfaces in contact depends on

(1) the area of the contact surfaces.
(2) the normal reaction and the nature of the contact surfaces.
(3) the nature of the contact surfaces and the area of the contact surfaces.
(4) the area of the contact surfaces and the normal reaction.

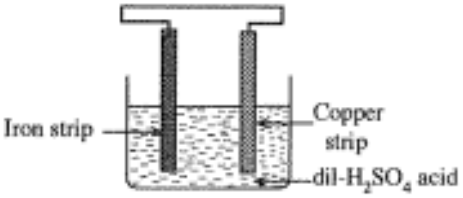
32. The gravitational acceleration on the moon is $1/6^{th}$ that of the earth. If the gravitational acceleration on the earth is 10 m s^{-2}, what would be the weight of an astronaut of mass 60 kg, on the moon?

(1) 1/6 N **(2)** 10 N **(3)** 100 N **(4)** 1000/6 N

33. The mole fraction of NaOH in a solution formed, when 2 moles of NaOH is dissolved in 10 moles of water is

(1) 1/10 **(2)** 1/6 **(3)** 1/5 **(4)** 5/6

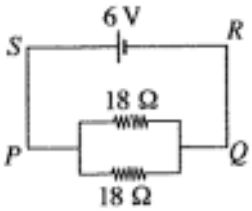
34. Which of the following statements is **false** regarding the electrochemical cell given in the figure?



(1) Iron strip acts as the anode.
(2) A reduction reaction occurs at the copper strip.
(3) Gas bubbles evolved rapidly at the iron strip.
(4) Electrons flow towards the copper strip across the external wire.

▸ *Answer questions No.* **35** *and* **36** *using the circuit given below.*

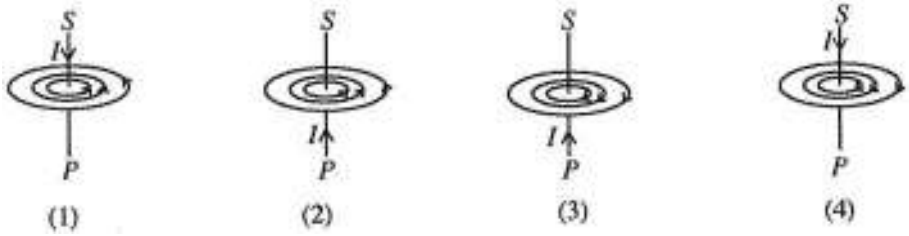
35.



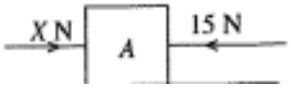
What is the current (I) produced by the cell?

(1) 1/6 A **(2)** 2/3 A **(3)** 3 A **(4)** 6 A

36. Due to the current (I) flows through the straight conducting part SP, a magnetic field is formed around SP. Select the option which indicates correctly the direction of the magnetic field.



37. Consider the object A which is kept on a smooth horizontal surface as shown in the figure. Two horizontal forces of 15 N and X N are acting on A as shown in the figure. If the object is moving in the direction of the force X with a resultant force of 10 N, what is the value of X?



(1) 15 **(2)** 25 **(3)** 35 **(4)** 45

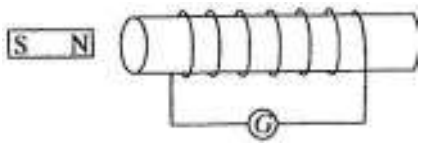
38. Consider the following data relevant to the motion of a child in a straight line path from a certain point.

Time (s)	Displacement (m)
0	0
1	2
2	4
3	6
4	6
5	6
6	8
7	8
8	7
9	4
10	2
11	0

Which of the following statements is **false** regarding the motion of the child in the given time?

(1) The child has moved at a uniform velocity in the first three seconds.
(2) The total time that the child remained at rest is 5 seconds.
(3) The child has returned to the starting point.
(4) The total distance that the child has moved is 16 m.

39. A figure of an arrangement to demonstrate the electromagnetic induction is given here.



In which of the following instances the galvanometer G does **not** indicate a deflection?

(1) When moving the magnet towards the coil while keeping the coil stationary.
(2) When keeping both the magnet and the coil stationary.
(3) When moving the magnet away from the coil while keeping the coil stationary.
(4) When moving the coil away from the magnet while keeping the magnet stationary.

40. Anil, Jagath, Sujith and Namal living in Kurunegala town have had their breakfast on a certain day as shown in the following table.

Name	Anil	Jagath	Sujith	Namal
Food	Rice	String hoppers (made up of rice flour)	Bread (made up of wheat flour)	Rotti (made up of wheat flour)
	Dhal curry	Dhal curry	Dhal curry	Potato curry
	Coconut sambol	Fish curry	Coconut sambol	Coconut sambol

Rice and coconut had been obtained from Kurunegala area and potatoes had been obtained from Nuwara Eliya area. Rice flour had been obtained from Polonnaruwa area and fish from Negambo. Dahl and wheat flour had been obtained from India and America respectively.

Accordingly, who has taken the meal with the lowest food mile?

(1) Anil **(2)** Jagath **(3)** Sujith **(4)** Namal

2016 — answer key and reviews

Source of answers: Prepared answer key (no official 2016 scheme in the collection); worked from the Grade 10/11 textbooks.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	2	21	4	31	2
2	3	12	3	22	1	32	3
3	2	13	4	23	1	33	2
4	4	14	2	24	1	34	3
5	2	15	1	25	2	35	2
6	3	16	2	26	4	36	4
7	3	17	4	27	3	37	2
8	1	18	1	28	1	38	2
9	4	19	2	29	2	39	2
10	1	20	4	30	4	40	1

Q	Ans	Unit	Why this is the answer	Textbook
1	1	10.2 Motion in a straight line	Weight is a force, so it has direction: a vector. Time, speed and distance are scalars.	G10 Part I p. 24
2	3	10.13 The world of life (classification and nomenclature)	Binomial rules: Genus capitalised, species epithet all lower case: Gallus lafayetti.	G10 Part II p. 24
3	2	10.16 Changes in matter	Vegetable oils are hardened to margarine by adding hydrogen (hydrogenation, Ni catalyst).	G10 Part II p. 113
4	4	10.14 Continuity of life (reproduction)	Wara (Calotropis) seeds carry silky hairs that are carried by wind; rubber is explosive, bitter gourd by animals.	G10 Part II p. 43
5	2	11.7 Acids, bases and salts	Phenolphthalein is colourless in acid and pink in base.	G11 Part I p. 196
6	3	11.7 Acids, bases and salts	Acetic acid (or formic acid) coagulates rubber latex in the rubber industry.	G11 Part I p. 193
7	3	10.3 Structure of matter	Al_2O_3 reacts with both acids and bases: amphoteric.	G10 Part I p. 73
8	1	10.16 Changes in matter	Chlorine is used to disinfect drinking water and swimming pools.	G10 Part II p. 92
9	4	10.17 Rate of reactions	The contact process (SO_2 to SO_3) uses vanadium pentoxide, V_2O_5, as the catalyst.	G10 Part II p. 121
10	1	10.13 The world of life (classification and nomenclature)	Monocots have floral parts in threes (trimerous), parallel venation, fibrous roots and no secondary growth.	G10 Part II p. 14
11	2	10.16 Changes in matter	Burning firewood forms new substances (CO_2, H_2O, ash): a chemical change. The others are physical changes.	G10 Part II p. 87
12	3	11.15 Biosphere	Plants → herbivores (rabbit, rat, cock) → python/cat → hawk: the hawk feeds at the tertiary level.	G11 Part II p. 172
13	4	11.6 Biological processes in the human body	Monocytes are agranular (non-granulocytes); basophils have granules (granulocytes).	G11 Part I p. 164
14	2	10.10 Chemical bonds	Oxygen has 6 valence electrons; 2 are used in O-H bonds, leaving 2 lone pairs = 4 lone-pair electrons.	G10 Part I p. 179
15	1	11.9 Heat	A temperature difference is the same in kelvin and degrees Celsius: 16 - 4 = 12 K.	G11 Part II p. 5
16	2	11.14 Hydrocarbons and their derivatives	Isoprene (2-methylbuta-1,3-diene, C_5H_8) has two C=C double bonds.	G11 Part II p. 156

Q	Ans	Unit	Why this is the answer	Textbook
17	4	11.6 Biological processes in the human body	Long-term inhalation of silica dust in glass factories damages lung tissue: silicosis.	G11 Part I p. 157
18	1	10.14 Continuity of life (reproduction)	Asexual reproduction quickly gives many identical offspring; no gametes or meiosis are involved.	G10 Part II p. 27
19	2	11.5 Geometrical optics	A concave mirror forms a real, same-size image when the object is at C = 2f = 60 cm.	G11 Part I p. 112
20	4	11.1 Living tissues	Branched, striated fibres: cardiac muscle, which is involuntary.	G11 Part I p. 14
21	4	10.15 Hydrostatic pressure and its applications	$P = h\,\rho\,g = 2\text{ m} \times 1000\text{ kg m}^{-3} \times 10\text{ m s}^{-2} = 20\,000\text{ N m}^{-2}$.	G10 Part II p. 67
22	1	10.1 Chemical basis of life	Dry skin and Bitot's spots in the eyes are signs of vitamin A deficiency.	G10 Part I p. 20
23	1	11.2 Photosynthesis	False statement: photosynthesis cannot (at present) be carried out artificially; the others are true.	G11 Part I p. 28
24	1	10.14 Continuity of life (reproduction)	A is the stigma (gynoecium) and C is the anther (androecium). E is the style, B the filament, D an ovule.	G10 Part II p. 35
25	2	11.9 Heat	Cold water in the inner glass Q makes it contract; hot water around the outer glass P makes it expand.	G11 Part II p. 17
26	4	11.3 Mixtures	Steam distillation (cinnamon oil), fractional distillation (petrol) and simple distillation (pure water) are all correct.	G11 Part I p. 66
27	3	11.7 Acids, bases and salts	Acid + base → salt + water: $NaOH + HCl \rightarrow NaCl + H_2O$.	G11 Part I p. 197
28	1	10.3 Structure of matter	M_2CO_3 shows M forms M^+ ions, so its chloride is MCl.	G10 Part I p. 77
29	2	10.7 Quantification of elements and compounds	22 g CO_2 = 0.5 mol; each molecule has 2 O atoms, so 1 mol of O atoms = 6.022×10^{23}.	G10 Part I p. 133
30	4	10.3 Structure of matter	Sulphur: crystalline (rhombic, monoclinic) and amorphous forms, soluble in CS_2, burns with a blue flame.	G10 Part I p. 71
31	2	10.5 Friction	Limiting friction depends on the normal reaction and the nature of the surfaces, not the contact area.	G10 Part I p. 109
32	3	10.4 Newton's laws of motion	Weight on Moon = $60\text{ kg} \times (10/6)\text{ m s}^{-2} = 100$ N.	G10 Part I p. 95
33	2	11.3 Mixtures	Mole fraction = 2 / (2 + 10) = 1/6.	G11 Part I p. 43
34	3	11.12 Electrochemistry	False: in this Fe/Cu cell hydrogen bubbles form at the copper (cathode), not the iron strip.	G11 Part II p. 84
35	2	10.19 Current electricity	Two 18 Ω resistors in parallel = 9 Ω; I = V/R = 6/9 = 2/3 A.	G10 Part II p. 163
36	4	11.13 Electromagnetism and electromagnetic induction	Current flows from the + terminal through S to P (downwards); the right-hand grip rule gives a clockwise field viewed from above.	G11 Part II p. 119
37	2	10.9 Resultant force	Resultant = X - 15 = 10, so X = 25 N.	G10 Part I p. 167
38	2	10.2 Motion in a straight line	False: the child was at rest only from 3-5 s and 6-7 s, a total of 3 s, not 5 s.	G10 Part I p. 31
39	2	11.13 Electromagnetism and electromagnetic induction	No relative motion between magnet and coil means no change in flux, so no induced current.	G11 Part II p. 133
40	1	11.15 Biosphere	Anil's rice and coconut are from Kurunegala itself; only dhal travels far.	G11 Part II p. 208

Paper I • 2015 (old syllabus)

QUESTION PAPER

Multiple-choice questions • 40 questions • 1 hour • underline / circle the correct option

1. Which of the following plants is a non-flowering plant with seeds?
(1) Cycas **(2)** Nephrolepis **(3)** Paddy **(4)** Grass

2. Select the answer which correctly gives the scientific name of pea plant, according to the binomial nomenclature.
(1) *Pisum Sativum* (2) Pisum Sativum (3) *Pisum sativum* (4) Pisum sativum

3. Which of the following is a non-living structure of a plant cell?
(1) Chloroplast **(2)** Cell wall **(3)** Golgi body **(4)** Ribosome

4. Number of premolar teeth on both sides of the upper jaw of a healthy adult is
(1) two. **(2)** four. **(3)** six. **(4)** eight.

5. When a bottle of cinnamon oil is opened the smell of cinnamon oil spreads in the air. To which transport method does this belong?
(1) Mass flow **(2)** Osmosis **(3)** Evaporation **(4)** Diffusion

6. Increase of which of the following factors does **not** increase transpiration?
(1) Humidity of air **(2)** Speed of wind
(3) Temperature of the Environment **(4)** Light intensity

7. In the human digestive system, which enzyme in the pancreatic juice digests protein?
(1) Trypsin **(2)** Peptidase **(3)** Pepsin **(4)** Lipase

8. The class teacher was unable to attend school for two days due to reddishness of the throat, pain in the throat and loss of voice. What could be the illness that she had?
(1) Asthma **(2)** Gastritis **(3)** Tuberculosis **(4)** Laryngitis

9. A person who does not have any visual defect sees an object clearly in general, when its image is formed,
(1) very close to the lens of the eye. **(2)** in between lens of the eye and the retina.
(3) on the retina. **(4)** behind the retina.

10. "Both sons born to particular parents are suffering from colour blindness." Which of the following, can **exactly** be said regarding this statement?
(1) Mother is suffering from colour blindness.
(2) Father is suffering from colour blindness.
(3) Either mother or father is suffering from colour blindness.
(4) Both mother and father are suffering from colour blindness.

11. A student observed the specimens A and B under the compound microscope and identified their tissues as parenchyma and sclerenchyma respectively. Which of the following plant parts would be the specimens A and B respectively?
(1) a potato, a carrot **(2)** mid rib of a bitter gourd leaf, a carrot
(3) a potato, a pear fruit **(4)** a seed of coffee, a pear fruit

12. "Organisms with more suited genetic variations will live longer." This statement can be explained by the
(1) theory of special creation. **(2)** theory of spontaneous generation.
(3) theory of use and disuse. **(4)** theory of natural selection.

13. Which metal is used to galvanise Iron?

(1) Copper **(2)** Lead **(3)** Aluminium **(4)** Zinc

14. In the experiments done in the school laboratory, oxygen gas is collected by the

(1) downward displacement of water. **(2)** downward displacement of air.
(3) upward displacement of air. **(4)** upward displacement of water.

15. An element **X** reacts with Cl_2 gas and forms the ionic compound **XCl_2**. The electronic configuration of **X** could be

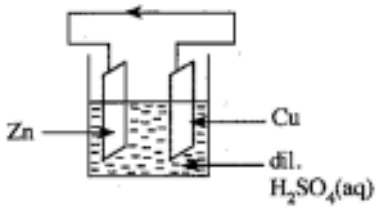
(1) 2, 6 **(2)** 2, 8 **(3)** 2, 8, 1 **(4)** 2, 8, 2

16. When a particular gas is bubbled into a colourless aqueous solution, the solution turns milky. The solution and the gas would be

(1) $CuSO_4$ and O_2 **(2)** $Ca(OH)_2$ and CO_2 **(3)** $ZnSO_4$ and O_2 **(4)** $CaCO_3$ and CO_2

▸ *Use the simple voltaic cell in the figure given below to answer the questions No.* **17** *and* **18***.*

17.



The direction of the arrow in the external circuit shows

(1) the direction of flow of electrons.
(2) the direction of flow of the standard current.
(3) the direction of flow of ions.
(4) the direction of flow of electrons and the standard current.

18. What is the anodic reaction of the cell?

(1) $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ **(2)** $Zn^{2+}(aq) + 2e \rightarrow Zn(s)$
(3) $Zn(s) \rightarrow Zn^{2+}(aq) + 2e$ **(4)** $2H^{+}(aq) + 2e \rightarrow H_2(g)$

19. Consider the following statements made regarding a certain element.

- Occurs in allotropic forms in nature.
- Has a high melting point.
- It is used in the extraction of metals.

What would this element be?

(1) K **(2)** Al **(3)** C **(4)** S

20. Select the answer which shows the colour of the blue and red litmus papers, when they are dipped in a vinegar solution and in a table salt solution separately.

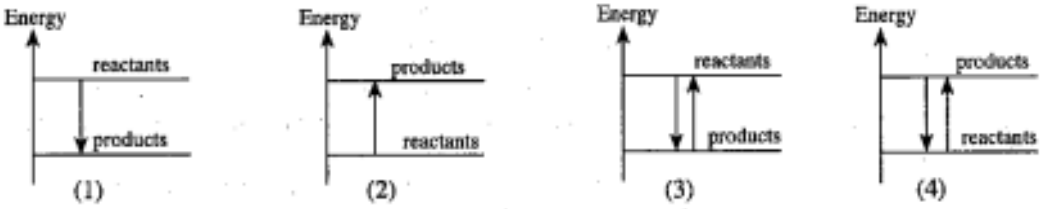
	Litmus paper	**Colour in Vinegar solution**	**Colour in Table salt solution**
(1)	Red	Blue	Red
(2)	Blue	Red	Blue
(3)	Red	Red	Blue
(4)	Blue	Blue	Blue

▸ *Consider the following statement and answer the questions No.* **21** *and* **22***. "An amount of heat 1.47 kJ has evolved when 1 g of solid NaOH completely reacted with a solution of dil. HCl."*

21. What is the amount of heat evolved when 1 mol of solid NaOH completely reacted with a HCl solution? (Na = 23, O = 16, H = 1)

(1) 1.47 kJ **(2)** 5.88 kJ **(3)** 58.80 kJ **(4)** 147.00 kJ

22. What is the correct energy diagram relevant to the reaction mentiond in the statement above?



23. Some plants in Hakgala botanical garden in Sri Lanka are grown in a glass house. For plants, this glass house provides

(1) sufficient O_2 gas. **(2)** suitable temperature.
(3) sufficient CO_2 gas. **(4)** sufficient light.

24. A student was able to observe a green coloured layer on the surface of a water body where waste water removed from a vegetable bed gets collected. He made the following statements according to the observation.

A – Excessive amount of inorganic fertilizers have been used highly for the cultivation of vegetables.
B – The green layer is concentrated with algae.
C – BOD value of water in the water body has become low.

Of the above, statements

(1) only A and B are correct. **(2)** only A and C are correct.
(3) only B and C are correct. **(4)** all A, B and C are correct.

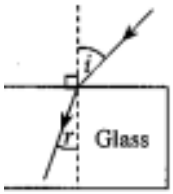
25. The average temperature of the human body is 37 °C. This temperature in the Kelvin scale is

(1) 236. **(2)** 273. **(3)** 310. **(4)** 337.

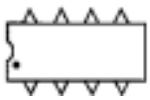
26. Which of the following elements can be doped with a piece of pure Silicon to convert it into an n-type semiconductor?

(1) Boron **(2)** Aluminium **(3)** Phosporous **(4)** Germanium

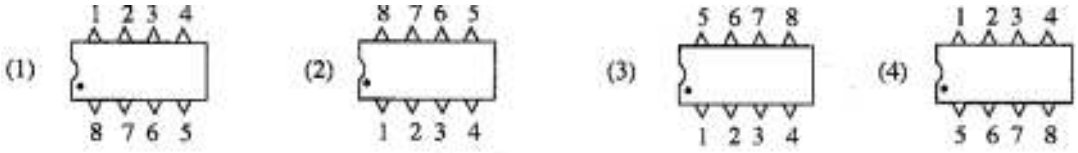
27. As shown in the figure, a ray of light is incident on a block of glass which is kept in air. When the magnitude of the angle of incidence is gradually increased up to 90° the magnitude of the angle of refraction will



(1) increase. **(2)** decrease.
(3) increase and then decrease. **(4)** not change.

28. 

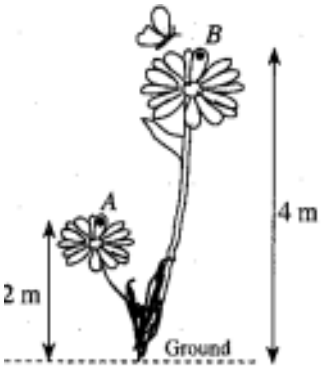
In which of the following ways is the terminals of this integrated circuit numbered correctly?



29. The volume of gold of a gold chain which was presented by a father to his daughter is said to be 2 cm^3. If the density of that gold is 18 g cm^{-3}, what is the mass of the chain, the daughter received?

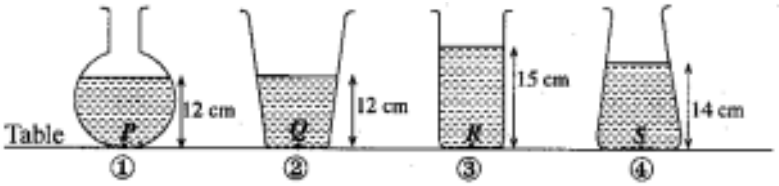
(1) 9 g **(2)** 18 g **(3)** 27 g **(4)** 36 g

30. As shown in the figure, a small butterfly of mass 5 g (0.005 kg) flew from a point A on one flower to a point B on another flower. What is the change in potential energy of the butterfly when it flew from A to B? (acceleration due to gravity = 10 m s^{-2})



(1) 0.01 J **(2)** 0.10 J **(3)** 0.20 J **(4)** 0.50 J

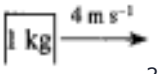
31. Consider the following containers (1), (2), (3) and (4). The four containers are filled with pure water up to the heights of 12 cm, 12 cm, 15 cm and 14 cm respectively.



P, Q, R and S are points located at the bottom of the containers. Of the points, which point experiences the maximum pressure due to water?

(1) P **(2)** Q **(3)** R **(4)** S

32. As shown in the figure an object of mass 1 kg moving at a uniform velocity of 4 m s^{-1} subsequently came to rest due to uniform deceleration. If the time that it decelerated is 2 s, select the answer which gives its deceleration and the momentum before the deceleration starts, respectively.



(1) 2 m s^{-2}, 4 kg m s^{-1} **(2)** 4 m s^{-2}, 2 kg m s^{-1} **(3)** 8 m s^{-2}, 1 kg m s^{-1} **(4)** 4 m s^{-2}, 4 kg m s^{-1}

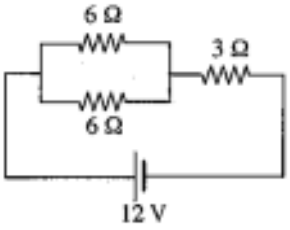
33. Consider the following statements.

A – Pair of scissors is a second order lever.
B – Mechanical advantage of a simple machine is given by the ratio effort/load.
C – When a work is done with a non-moving single pulley, the velocity ratio of the pulley is 1.

Of the above statements,

(1) only B is true. **(2)** only C is true.
(3) only A and C are true. **(4)** all A, B and C are true.

34. What is the potential difference between the terminals of the 3 Ω resistor in the given circuit?

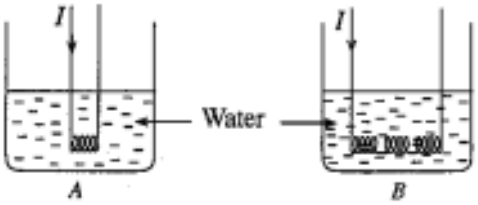


(1) 3 V **(2)** 6 V **(3)** 9 V **(4)** 12 V

35. A child heard the thunder 5 seconds after he saw a flash of lightning. If the speed of sound in air is 330 m s^{-1}, what is the distance between the place where the child was and the place where the lightning has occurred?

(1) 1 500 m **(2)** 1 650 m **(3)** 2 000 m **(4)** 2 200 m

36. Two similar beakers A and B contain similar volumes of water. **One** of four similar nichrome coils is immersed in beaker A and the other **three** coils connected in series are immersed in beaker B as shown in figures. The same current I is passed through the coils for the same period of time as shown in figures. If the increase in temperature of water in A and B are t_1 and t_2 respectively and there is no heat loss, which of the following is correct with regard to the temperatures?



(1) $t_2 = t_1$ **(2)** $t_2 = 2t_1$ **(3)** $t_2 = 3t_1$ **(4)** $t_2 = t_1/3$

37. The Department of Registration of Persons expects to issue electronic identity cards to citizens in Sri Lanka. This is a result of which of the following technologies?

(1) Information technology **(2)** Nanotechnology
(3) Molecular biotechnology **(4)** Genetic engineering technology

38. Consider the following statements.

P – Fulfilling the basic requirements of animals including human
Q – Maintaining the natural cycles like carbon cycle and water cycle
R – Improving the beauty and cultural values of the country

The services of biodiversity in Sri Lanka are

(1) only P and Q. **(2)** only P and R. **(3)** only Q and R. **(4)** all P, Q and R.

39. Which of the following suggestions is most suitable to solve more efficiently and effectively the environmental and social problems that have arisen due to the equipment such as televisions, computers and telephones removed from the rapidly developing world under global village concept?

(1) Minimizing the use of those equipment
(2) Minimizing the amount of those equipment produced
(3) Creating substitutions for those equipment
(4) Taking action to repair those equipment for reuse by the manufacturers themselves

40. What is the theme of world science day in the year 2015?

(1) Science for technology **(2)** Science for health and well-being
(3) Science for a sustainable future **(4)** Science for exploration of the universe

2015 (old syllabus) — answer key and reviews

Source of answers: Official key from the Department of Examinations Evaluation Report 2015 (old syllabus); facility = % of candidates correct.

Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	1	11	3	21	3	31	3
2	3	12	4	22	1	32	1
3	2	13	4	23	2	33	2
4	2	14	1	24	1	34	2
5	4	15	4	25	3	35	2
6	1	16	2	26	3	36	3
7	1	17	2	27	1	37	1
8	4	18	3	28	2	38	4
9	3	19	3	29	4	39	4
10	1	20	2	30	2	40	3

Q	Ans	Unit	Why this is the answer	Textbook
1	1	**10.13** The world of life (classification and nomenclature)	Cycas bears seeds but no flowers (gymnosperm). Nephrolepis is a fern without seeds. [79%]	G10 Part II p. 11
2	3	**10.13** The world of life (classification and nomenclature)	Genus capitalised, species lower case, both underlined: Pisum sativum. [76%]	G10 Part II p. 24
3	2	**10.6** Plant and animal cells	The cellulose cell wall is non-living; chloroplasts, Golgi bodies and ribosomes are living organelles. [63%]	G10 Part I p. 113
4	2	**11.6** Biological processes in the human body	An adult has 2 premolars on each side of each jaw: 4 in the upper jaw. [52%]	G11 Part I p. 161
5	4	**10.6** Plant and animal cells	Scent spreads from high to low concentration by random particle movement: diffusion. [62%]	G10 Part I p. 117
6	1	**11.1** Living tissues	Humid air reduces the water-vapour gradient, so transpiration falls. [50%]	G11 Part I p. 18
7	1	**11.6** Biological processes in the human body	Pancreatic trypsin digests proteins in the duodenum; pepsin acts in the stomach. [29%]	G11 Part I p. 146
8	4	**11.6** Biological processes in the human body	Red, painful throat and loss of voice: inflammation of the larynx (laryngitis). [77%]	G11 Part I p. 156
9	3	**11.5** Geometrical optics	A normal eye focuses the image exactly on the retina. [59%]	G11 Part I p. 107
10	1	**10.20** Inheritance	Colour blindness is X-linked recessive; sons get their X from the mother, so she must carry/express it. [17%]	G10 Part II p. 185
11	3	**11.1** Living tissues	Potato tuber stores food in parenchyma; the gritty stone cells of a pear are sclerenchyma. [43%]	G11 Part I p. 5
12	4	**10.20** Inheritance	Darwin's theory of natural selection: better-adapted variants survive and reproduce. [55%]	G10 Part II p. 187
13	4	**11.12** Electrochemistry	Galvanising coats iron with zinc. [48%]	G11 Part II p. 85
14	1	**10.16** Changes in matter	Oxygen is only slightly soluble, so it is collected over water (downward displacement of water). [40%]	G10 Part II p. 104
15	4	**10.10** Chemical bonds	XCl_2 means X forms X^{2+} ions: Group 2, configuration 2,8,2 (magnesium). [41%]	G10 Part I p. 169
16	2	**10.16** Changes in matter	CO_2 turns lime water [$Ca(OH)_2$] milky by forming insoluble $CaCO_3$. [42%]	G10 Part II p. 108
17	2	**11.12** Electrochemistry	Conventional (standard) current flows from + to - in the external circuit, opposite to electrons. [37%]	G11 Part II p. 82

Q	Ans	Unit	Why this is the answer	Textbook
18	3	11.12 Electrochemistry	Zinc is the anode and is oxidised: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}$. [43%]	G11 Part II p. 83
19	3	10.3 Structure of matter	Carbon: allotropes (diamond, graphite), very high melting point, used as coke to reduce metal ores. [59%]	G10 Part I p. 71
20	2	11.7 Acids, bases and salts	Vinegar is acidic (blue litmus turns red); salt solution is neutral (no change). [48%]	G11 Part I p. 195
21	3	11.8 Heat changes associated with chemical reactions	1 mol NaOH = 40 g: 1.47 kJ x 40 = 58.8 kJ. [47%]	G11 Part I p. 207
22	1	11.8 Heat changes associated with chemical reactions	Neutralisation is exothermic: products lie lower than reactants. [31%]	G11 Part I p. 203
23	2	11.2 Photosynthesis	A glasshouse traps heat, giving plants a suitable temperature. [53%]	G11 Part I p. 22
24	1	11.15 Biosphere	Excess fertiliser causes algal growth (eutrophication). BOD rises, it does not fall, so C is false. [36%]	G11 Part II p. 194
25	3	11.9 Heat	Temperature conversion: T(K) = t(°C) + 273. [45%]	G11 Part II p. 5
26	3	11.11 Electronics	Doping silicon with a Group 15 element (phosphorus) adds free electrons: n-type. [33%]	G11 Part II p. 53
27	1	11.5 Geometrical optics	As the angle of incidence increases, the angle of refraction also increases. [41%]	G11 Part I p. 121
28	2	11.11 Electronics	IC pins are numbered anticlockwise from the notch/dot, viewed from above. [45%]	G11 Part II p. 72
29	4	10.15 Hydrostatic pressure and its applications	Mass = density × volume = 18 g cm^{-3} × 2 cm^{3} = 36 g. [60%]	G10 Part II p. 67
30	2	10.18 Work, energy and power	Change in potential energy = mgh = 0.005 × 10 x h (height difference from the figure) = 0.10 J. [47%]	G10 Part II p. 134
31	3	10.15 Hydrostatic pressure and its applications	Liquid pressure depends only on depth: the 15 cm column at R gives the greatest pressure. [56%]	G10 Part II p. 66
32	1	10.4 Newton's laws of motion	Deceleration = 4/2 = 2 m s^{-2}; momentum = 1 × 4 = 4 kg m s^{-1}. [43%]	G10 Part I p. 94
33	2	10.11 Turning effect of a force	Scissors are a first-order lever (A false); MA = load/effort and a fixed pulley has VR = 1. [36%]	G10 Part I p. 197
34	2	10.19 Current electricity	Solve the circuit with the 12 V supply: the 3 Ω resistor takes 6 V. [31%]	G10 Part II p. 164
35	2	11.4 Waves and their applications	Distance = speed × time = 330 × 5 = 1650 m (light arrives almost instantly). [83%]	G11 Part I p. 90
36	3	11.10 Power and energy of electric appliances	Heat = $I^{2}Rt$; three identical coils in series give three times the heat to the same mass of water. [51%]	G11 Part II p. 35
37	1	10.20 Inheritance	Electronic identity cards depend on information technology. [57%]	G10 Part II p. 188
38	4	11.15 Biosphere	Biodiversity supplies basic needs, maintains natural cycles and has aesthetic and cultural value. [38%]	G11 Part II p. 178
39	4	11.15 Biosphere	Making manufacturers responsible for repair and reuse best reduces e-waste problems. [61%]	G11 Part II p. 208
40	3	11.15 Biosphere	The 2015 theme of World Science Day for Peace and Development was 'Science for a sustainable future'. [42%]	G11 Part II p. 201

3

Structured essays with answers

Paper II Part A, 2025 to 2015 (newest first)

- Four compulsory questions, 15 marks each
- Every question retyped, answer under each part
- Official schemes with marks
- Prepared answers for 2016, 2017 and 2020

How this section is arranged

Each Part A question is retyped in full. The answer to every sub-part sits directly beneath it in a green box, with the marks in the right-hand column. Cover the green boxes, answer on paper, then uncover and mark yourself.

Paper	Answers
2025 (2026)	Official marking scheme
2024 (2025)	Official marking scheme
2023 (2024)	Official marking scheme
2022 (2023)	Official marking scheme
2021 (2022)	Official marking scheme
2020	Prepared answers (textbook-based)
2019	Official marking scheme
2018	Official marking scheme
2017 (new syllabus)	Prepared answers (textbook-based)
2017 (old syllabus)	Prepared answers (textbook-based)
2016	Prepared answers (textbook-based)
2015 (old syllabus)	Official answers: Evaluation Report

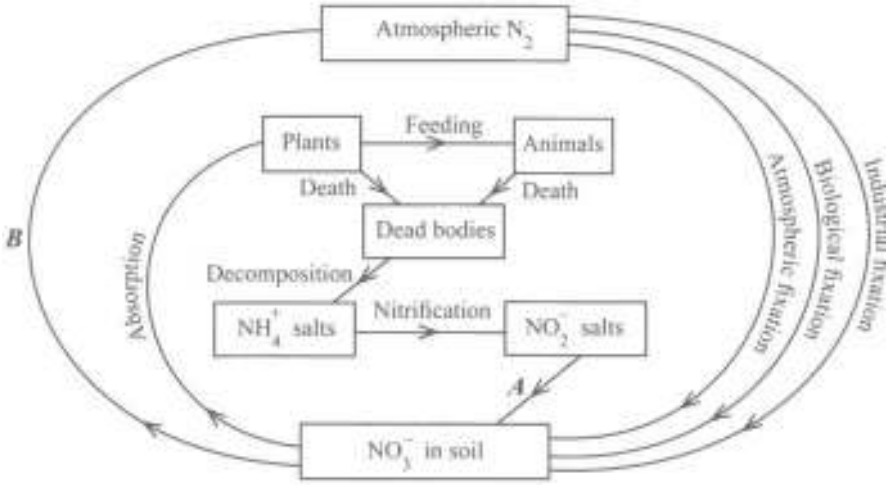
Paper II • 2025 (2026)

OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

Question 1 — Nitrogen cycle and risk factors of death

(A) A sketch of the nitrogen cycle is indicated below.



(i) By what name are the cycles such as nitrogen cycle and carbon cycle known in common?

biogeochemical cycles **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 178*

(ii) Name the processes A and B in the above nitrogen cycle.

(a) Process A: .....

nitrification **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(b) Process B: .....

denitrification **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(iii) (a) Under what environmental condition does the process B above occur?

anaerobic conditions / give marks for swamps / paddy fields / environmental conditions creating anaerobic nature in soil **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 167*

(b) State one special adaptation shown by some plants growing in the environments with the condition you mentioned in (a) above to satisfy their nitrogen requirement.

carnivorous plants or plants showing such adaptation / insectivorous plants (e.g. Nepenthes, Drosera) — amendment **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(iv) What is the mode of nitrogen fixation relevant to each of the following instances?

	Instance	Mode of fixation
(a)	Lightning	.....
(b)	Rhizobium living symbiotically in the root nodules of legumes	.....

(a) atmospheric fixation (01) (b) biological fixation (01) **02**

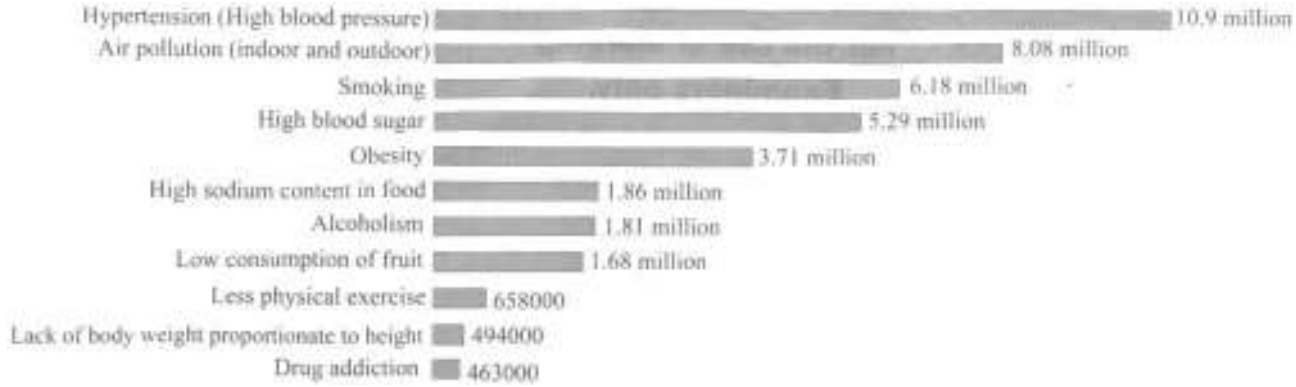
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(v) As what nutrient is the nitrogen contained in the salts absorbed by plants transmitted to animals?

protein **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(B) The number of deaths of people occurred in the year 2021 in the world due to various risk factors is indicated in the graph below.



Complete the following table taking the piece of information relevant to each of the following descriptions from the graph.

	Description	Piece of information
(i)	Risk factor causing the highest number of deaths	.....
(ii)	Number of people died due to indoor and outdoor air pollution	.....
(iii)	Total number of deaths occurring due to alcoholism and smoking	.....
(iv)	The risk factor leading to about double the number of deaths caused by excessive sodium in food	.....
(v)	The risk factor affecting most a traffic police officer engaged in his duty in the work environment	.....
(vi)	The risk factor directly connected with malnutrition	.....
(vii)	The risk factor directly connected with overnutrition	.....

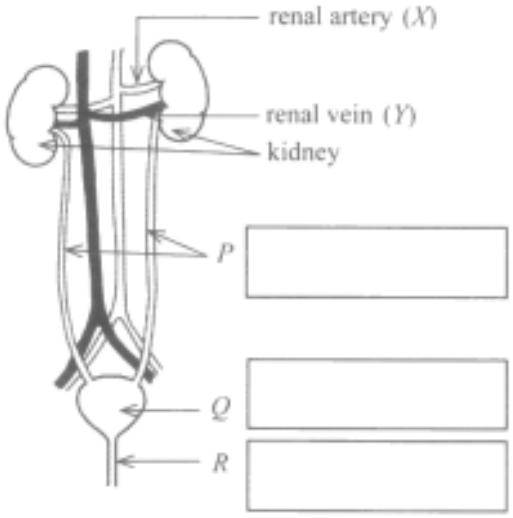
(i) hypertension / high blood pressure **01**

(ii) 8.08 million	**01**
(iii) 7.99 million	**01**
(iv) obesity	**01**
(v) air pollution	**01**
(vi) lack of body weight proportionate to height	**01**
(vii) obesity (01) — total	**07**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 172*

Question 2 — Urinary system and reflex actions

(A) A sketch of the human urinary system is indicated here.



(i) Write the parts labelled P, Q and R in the diagram in the boxes given opposite to each.

P - ureters (01); Q - (urinary) bladder (01); R - urethra (01)	**03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 158*

(ii) Of X and Y, which vessel contains blood with a higher concentration of nitrogenous excretory matter?

X / renal artery	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 158*

(iii) By what name are the structural and functional units contained in the kidneys known?

nephron / nephridium	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 159*

(iv) Name the **three** stages of the process of urine production taking place in the units you stated in part (iii) above.

(a) ultrafiltration	**01**
(b) selective reabsorption / selective resorption	**01**
(c) secretion (01) — order is not necessary	**03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 160*

(B) When a fly was coming towards the eye of a student ironing his clothes, his eyes blinked. On the spur of the moment his hand touched the iron. At that very moment his hand was withdrawn from the iron.

(i) By what name are the instant responses mentioned in the above incident commonly known?

reflex action / reflexes	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 177*

(ii) To what type of instant responses does the blinking of eyes when a fly is coming towards the eye belong?

cranial reflex actions / reflexes	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 177*

(iii) Name the receptor and effector relevant to the instant withdrawal of student's hand from the iron.

(a) Receptor: .....

skin (of hand) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 173*

(b) Effector: .....

muscles (of hand) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 173*

(iv) In the following chart, indicate in respective order, the neurones connected with the conduction of the impulse in the event of the hand's withdrawal.

..... → ..... → .....

sensory / afferent neuron (01) → inter / intermediate / internuncial neuron (01) → motor / efferent neuron (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 177*

Question 3 — Period 3 elements and their chlorides

This question concerns the elements from sodium to chlorine (Na, Mg, Al, Si, P, S, Cl) belonging to the third period of the periodic table.

(A) Figures (1) and (2) show graphically how the electronegativity and the first ionization energy vary against the atomic number of Na, Mg and Al of the elements stated above.

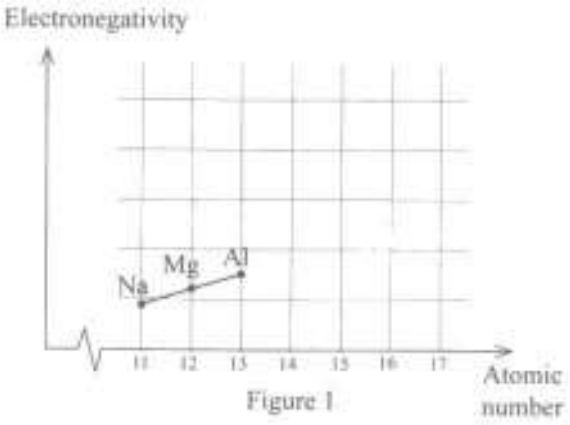


Figure 1

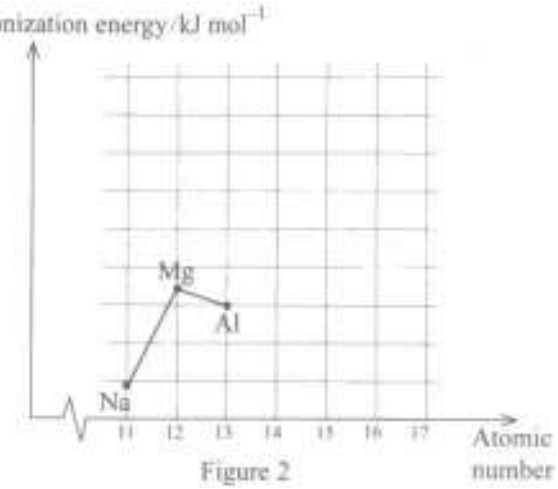


Figure 2

(i) Complete the above **two** graphs indicating approximately the points relevant to the other four elements.

Figure 1: points for Si, P, S and Cl continuing the steady increase (labelling unnecessary) **01**

Figure 2: marking Si and P correctly (01); marking S and Cl correctly (01) — S above Si, Si above Mg **03**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 54*

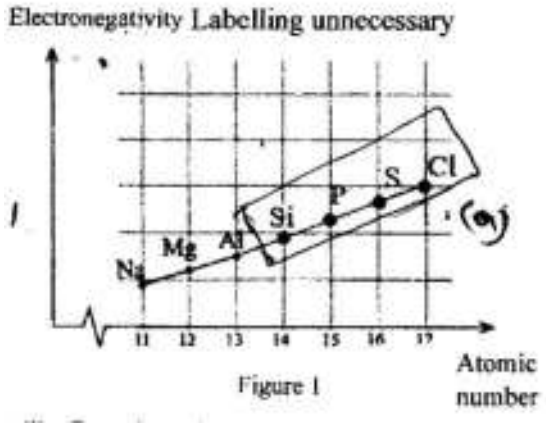


Figure 1

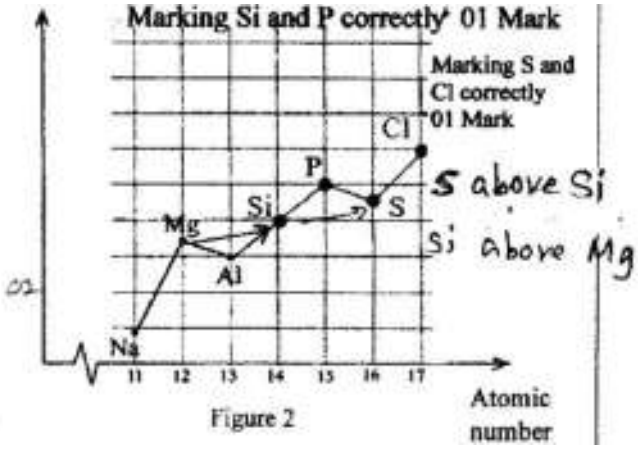


Figure 2

(ii) Of the above seven elements, select the element relevant to each of the following statements and write its symbol.

(a) forms an amphoteric oxide

Al **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 55*

(b) is a metalloid

Si **01**

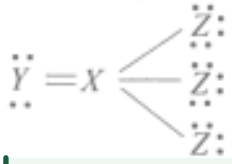
▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 65*

(c) reacts fast with cold water liberating hydrogen

Na (01) — total **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 96*

(iii) The Lewis structure of the compound $PSCl_3$ formed by the elements P, S and Cl is given below. Write opposite each letter the standard symbols of the elements represented by X, Y and Z in it.



X: P (01); Y: S (01); Z: Cl (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(B) (i) Complete the blank boxes in the following table relating to the chlorides formed by the elements Na, Mg, Al and Si.

Element	Na	Mg	Al	Si
Formula of the chloride	NaCl	$MgCl_2$	.....	$SiCl_4$
Nature of the bond	ionic	.....	.....	covalent

Formula of the chloride of Al: $AlCl_3$ **01**

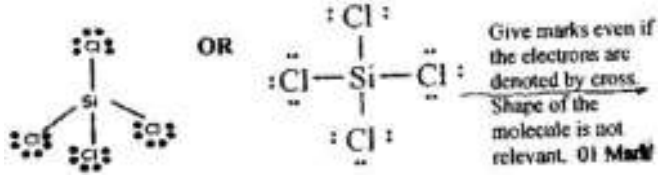
Nature of the bond: Mg - ionic (01); Al - covalent (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 173*

(ii) Draw the Lewis structure of $SiCl_4$.

Si in the centre bonded to four Cl atoms, each Cl atom carrying three lone pairs. Give marks even if the electrons are denoted by crosses. Shape of the molecule is not relevant. **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*



(iii) $SiCl_4$ reacts with water according to the following chemical equation.

$$SiCl_4 + 4H_2O \rightarrow H_4SiO_4 + 4x$$

(a) Write the chemical formula of the compound indicated by x.

HCl **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 78*

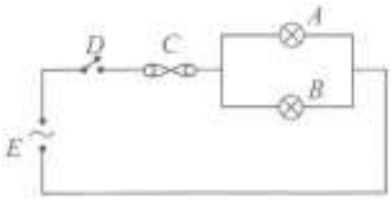
(b) Liberation of gas bubbles can be observed when a magnesium ribbon is put into the above reaction mixture. What could be that gas evolved?

hydrogen / H_2 gas / H_2 **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 96*

Question 4 — Domestic circuits and induction

(A) The figure shows a sub-circuit supplying electricity to two electric lamps A and B from the distribution box in a domestic electrical circuit.



(i) Name the electrical devices C and D and state the function carried out by each device in the following table.

Device	Name	Function
C	.....	.....
D	.....	.....

C - fuse / MCB (01); to control maximum current / for the protection (of the bulb) / to prevent flow of an excessive current **01**

D - switch (01); to close / open the circuit / to put on / off the circuit (01) **04**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(ii) What is represented by E?

alternate current / AC / alternate current supply / source **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(iii) When electric lamps A and B operate in their full power, the current flowing through C is 0.42 A. The lamp A has been marked 240 V, 60 W.

(a) How much is the current flowing through lamp A?

P = VI; I = 60/240 (A)

I = 0.25 (A) / ¼ (A) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(b) How much is the current flowing through lamp B?

0.42 (A) − 0.25 (A) = 0.17 (A) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(c) What is the resistance of lamp A?

V = IR; R = 240/0.25 (Ω)

R = 960 (Ω) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(iv) Though electric lamps should be connected in parallel in a domestic circuit, A and B were connected in series by a mistake. When that circuit is closed, is the current flowing through C is equal to or less than or greater than 0.42 A?

less **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 39*

(v) In a domestic circuit, an electric stove of power 2 kW was connected to a sub-circuit which can supply a maximum current of 5 A from the distribution box.

(a) What can happen in this instance?

burning of the fuse / disconnecting the MCB **01**

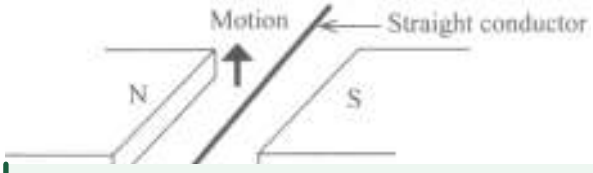
▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 38*

(b) Write the cause why it happens?

flow of a greater current **01**

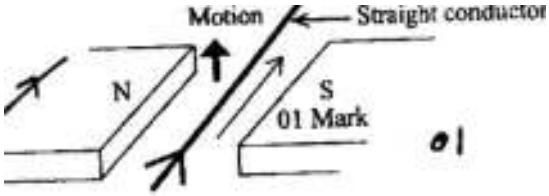
▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(B) (i) A student placed a straight conductor perpendicular to a magnetic field as shown in the diagram and moved it in the direction indicated by the arrow. Mark by an arrow head on the conductor, the direction of the current flowing through the conductor.



arrow head on the conductor pointing away from the observer (towards the far end of the conductor, upwards in the diagram) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*



(ii) Write the name of the rule used to find the direction of the current flowing through the conductor in part (i) above.

Fleming's right hand rule **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(iii) What is the name of the phenomenon generating the above current?

electromagnetic induction **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(iv) Name an instrument which has been produced making use of this phenomenon.

(alternate current / bicycle) dynamo / transformer / moving coil microphone / generators / ATM machine **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 138*

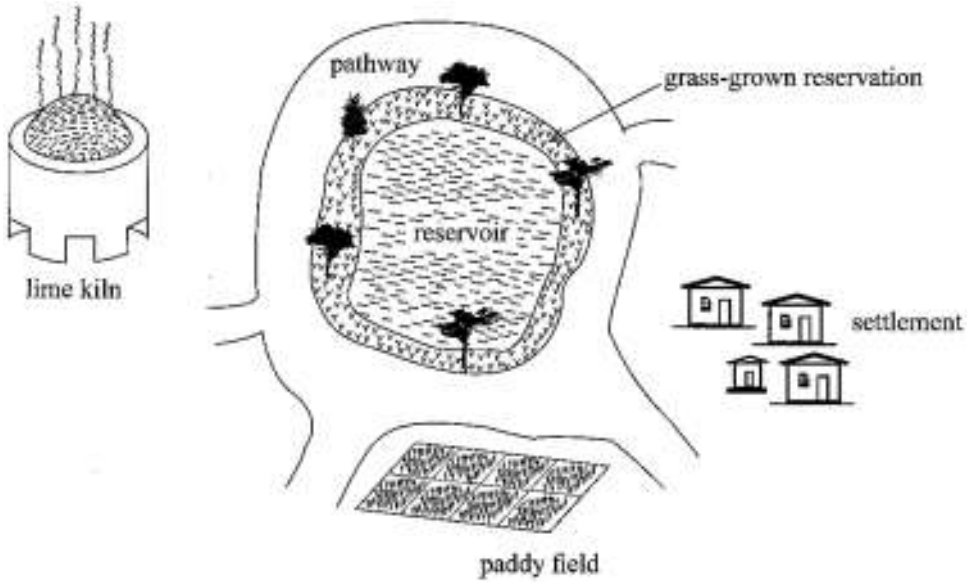
Paper II • 2024 (2025)

OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

Question 1 — A reservoir and its ecosystems

(A) The following figure presents several ecosystems that associate a reservoir of water.



(i) A food chain found in the environment accompanying this paddy field is indicated below.

Grass plant → Grasshopper → Myna

(a) In which organism does the largest amount of agrochemicals applied to the paddy field concentrate?

Myna **01**

▸ *Textbook: Science Grade 10 Part I, Unit 9 Resultant force, page 166*

(b) What is the process that makes the grass plant act as the producer?

Photosynthesis **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 172*

(ii) Growing of algae varieties as a green coloured layer floating on the surface of this reservoir has been taking place for a certain period of time.

(a) By what name is this condition known?

eutrophication **01**

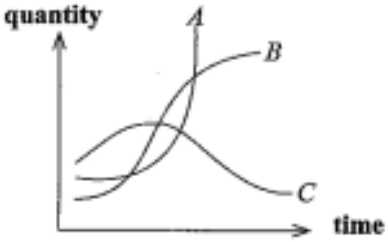
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 194*

(b) Name a type of ion causing this condition.

Nitrate / Phosphate / NO_3^- / PO_4^{3-} / HPO_4^{2-} / $H_2PO_4^-$ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 194*

(iii) The graph below indicates several curves relevant to various variations associating this reservoir within a period of several months.



(a) Which curve corresponds to the growth of algae in the reservoir?

B **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 171*

(b) Which curve corresponds to the oxygen concentration of the reservoir?

C **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 171*

(c) Describe briefly the reasons for the assumption of respective shapes by the two curves selected for (a) and (b) above.

B - Normal growth curve of a population / giving the reason for it

C - After the growth / increase in population, O_2 concentration decreases / increasing O_2 consumption for consumption **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 171*

(iv) State **two** environmental problems that would emerge because of the presence of the lime kiln in this location.

Increase in temperature of the environment / liberation of heat to the environment / soil becoming basic / water in the reservoir becoming basic / increase in the growth of algae / respiratory diseases caused on the people living in the settlement / collection of particulate substances / environmental pollution / air pollution / increasing CO_2 concentration — any two **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 180*

(B) Select the organism matching each description given and write the relevant letter on the dotted line.

(a) earthworm	(b) colocasia (habarala)	(c) frog	(d) amoeba	(e) carp	(f) selaginella

Give marks for the names also.

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 24*

(i) A unicellular organism which is likely to be present in a sample of water taken from this reservoir (.....)

d **01**

▸ *Textbook: Science Grade 10 Part I, Unit 8 Characteristics of organisms, page 140*

(ii) A non-flowering plant that would have grown in the grass-grown reservation (.....)

f **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 10*

(iii) An animal belonging to phylum Annelida that would be found in wet soil associated with the reservoir (.....)

a **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 16*

(iv) A plant with an underground stem that may be found in association with the reservoir (.....)

b **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(v) A vertebrate having a thin moist, grandular skin that would be encountered in this ecosystem (.....)

c (01) — total **15**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

Question 2 — Nucleic acids, photosynthesis and tissues

(A) Nucleic acids are a main type of biomolecules contained in living matter.

(i) (a) What is the structural unit of nucleic acids?

nucleotide **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 12*

(b) In addition to carbon, hydrogen and oxygen, name the other **two** elements that are necessarily contained in nucleic acids.

nitrogen / N and phosphorus / P **02**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 1*

(ii) Name the **two** types of nucleic acids and state a structural difference between them.

(a) two types of nucleic acids

DNA and RNA / deoxyribonucleic acid and ribonucleic acid **01**

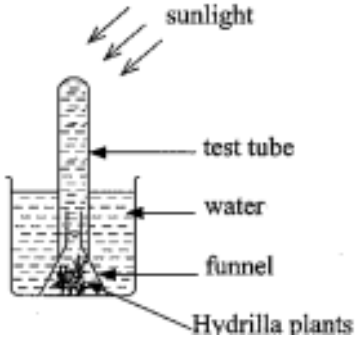
▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 12*

(b) structural difference

In DNA, building block is deoxyribonucleotide whereas in RNA it's ribonucleotide / DNA has a double helix structure but RNA lacks a double helix (it's a single structure) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 12*

(B) Given below is a diagram of an experimental set up relating to photosynthesis.



(i) What is the observation that can be made sometime after the setting up of this apparatus?

Gas bubbles evolve / gas bubbles deposited on the leaves / A gas gets collected in the test tube / Water level in the test tube decreases **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 113*

(ii) What test should be done to arrive at a conclusion from the observation in (i) above?

Bringing a glowing splint close to the gas collected **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(iii) What is the conclusion that could be made from that test?

Oxygen gas is liberated during photosynthesis / Green plants liberate oxygen gas in the presence of sun light **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(iv) When some soda water is mixed to the water in the beaker while arranging this set up, the time to make that observation decreases. State the reason for this briefly.

On addition of soda water to water, CO_2 gas is added to the medium (01); then rate of photosynthesis increases (01);

or When CO_2 concentration increases, rate of photosynthesis increases **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 39*

(C) (i) Several main tissue types found in the human body are given below.

epithelial tissues • connective tissues • skeletal muscle tissues

State which of the above tissues are present in each of the following.

(a) blood

connective tissue **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 10*

(b) wall of the urinary bladder

epithelial tissue **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 11*

(c) epidermis of the skin

epithelial tissue **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 10*

(ii) The nervous tissue has three types of neurones according to its functions. Of them, name each of the following types of neurones.

(a) The type of neurones transmitting impulses from the receptors to the central nervous system :

afferent neurone / sensory neurone **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 16*

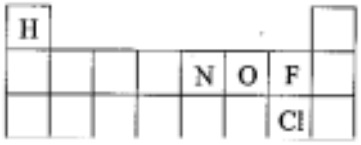
(b) The type of neurones transmitting impulses from the central nervous system to the effectors:

efferent neurone / motor neurone (01) — total **15**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 16*

Question 3 — Diatomic elements and metal reactions

(A) The figure indicates places occupied by five elements belonging to the first three periods of the periodic table which exist as diatomic molecules in their free state.



(i) Write the elements N, O and F

(a) in the ascending order of their electronegativity.

N, O, F **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(b) in the ascending order of their first ionisation energy.

O, N, F / N, O, F **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(ii) From the elements given, select the elements in which there are multiple bonds (more than one covalent bond) between the two atoms of their free molecules and draw the Lewis structures of their molecules in the boxes given below.

O_2 (O=O, two lone pairs on each O atom) and N_2 (:N≡N:) — these two may be interchanged **02**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*



(iii) The figure indicates a representation of the dot and cross structure of a molecule formed by the elements N, H and Cl. Write on the dotted lines the true symbols of the elements represented by the letters X, Y and Z in it.



X: ..... Y: ..... Z: .....

X: H (01) Y: N (01) Z: Cl **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iv) In chlorine, there exist two isotopes $^{35}_{17}Cl$ and $^{37}_{17}Cl$.

(a) In isotopes, which sub-atomic particles differ in number?

neutrons / n **01**

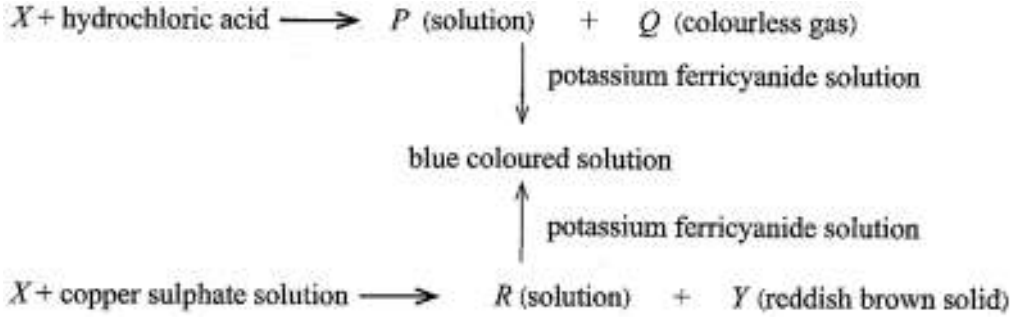
▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 61*

(b) How many types of chlorine molecules with different masses exist in naturally occurring chlorine?

3 / three **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(B) X and Y are two metals. X and Y are not their standard symbols. Observations made during two reactions involving metal X are summarized below.



(i) Identify X, Q and Y and write either their true name or the chemical symbol.

(a) X: ..... (b) Q: ..... (c) Y: .....

(a) X: iron / Fe (01) (b) Q: hydrogen / H_2 (01) (c) Y: copper / Cu **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 84*

(ii) How do you identify gas Q experimentally?

When a lighted splint / a flame is brought closer, it burns with a (squeaky) "pop" sound **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 104*

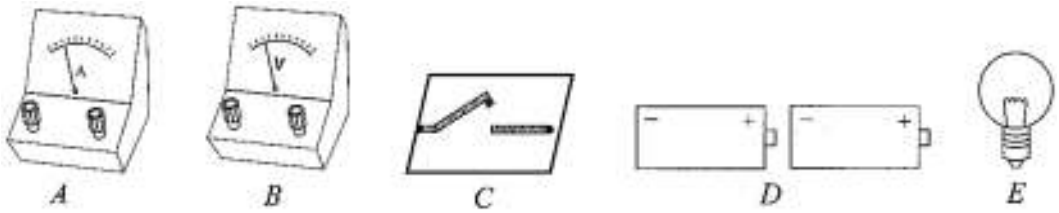
(iii) In the sentence given below underline the appropriate words printed in boldface.
In a simple cell constructed using the two metals X and Y, X is the **anode/cathode** and the electric **current/electrons** flow(s) from X to Y.

anode; electrons (01 × 2 = 02) — total **15**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 85*

Question 4 — Electric circuit and heat flow

(A) You have been assigned to construct a circuit to measure the potential difference across an electric bulb and the current flowing through it. The instruments which should be used for this are indicated below.



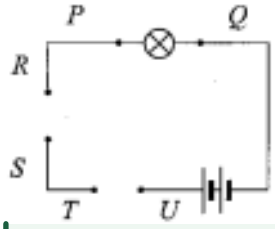
(i) Name the instruments indicated as A, B and C.

(a) A ..... (b) B ..... (c) C .....

(a) A: ammeter (01) (b) B: voltmeter (01) (c) C: switch / key **01**

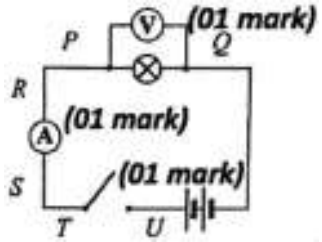
▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 148*

(ii) Using standard circuit symbols, draw in the following incomplete circuit diagram how you connect instruments A, B and C across the relevant pairs of points P and Q, R and S, and T and U.



voltmeter (V) connected across P and Q, parallel to the bulb (01); ammeter (A) between R and S (01); switch between T and U (01) — ammeter and switch may be interchanged **03**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 148*



(iii) (a) Name the way instrument A is connected.

in series **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 147*

(b) Name the way instrument B is connected.

in parallel **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 147*

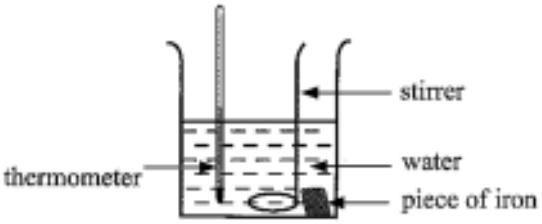
(iv) What is the extra device that should be connected to the circuit to increase/decrease the brightness of the bulb?

rheostat / variable resistor / pre-set resistors / resistance box / volume control (give marks for symbols drawn also) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 155*

(B) For a certain experiment, you have been asked to drop a piece of iron heated to a high temperature into a vessel containing water at room temperature and obtain readings in the thermometer while

stirring water.

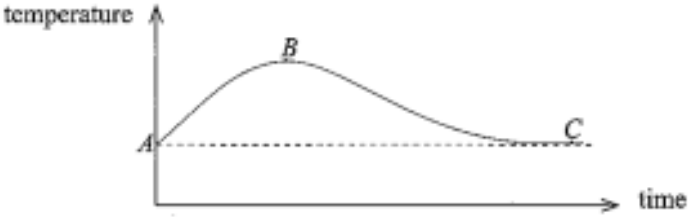


(i) Explain why water has to be stirred in this experiment.

To distribute temperature / heat uniformly throughout water / throughout the container **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 7*

(ii) The following graph indicates how the thermometer reading varies with time.



Write the instances of temperature variations and reasons for them in the following table.

	Temperature variation	**Reason for the temperature variation**
Part AB	(a)	(b) .....
Point B	Maximum temperature	Attaining thermal equilibrium
Part BC	(c)	(d) .....

(a) increases (01) (b) flow of heat from the piece of iron to water / loss of heat from the piece of iron to water (01);

(c) decreases (01) (d) flow of heat from water (the system) to the environment / loss of heat from water to the environment **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 7*

(iii) State the conclusion which you can draw from the above experiment.

Heat flows from a place / object at higher temperature to a place / object at lower temperature (01) — total **15**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 7*

Paper II • 2023 (2024)

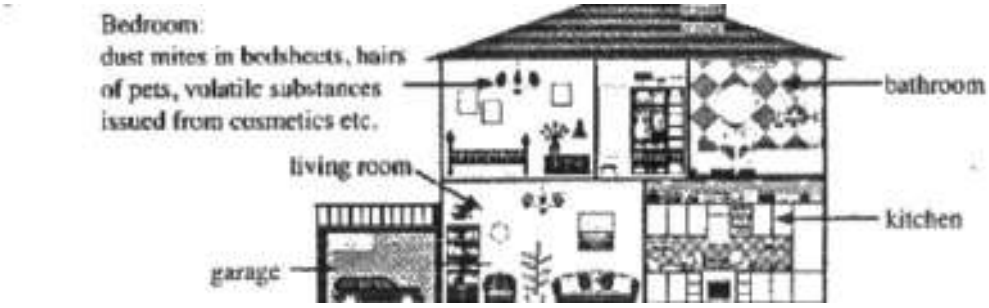
OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

No clean copy of Part A survives; the questions were retyped from the marking-scheme pages.

Question 1 — Indoor air pollution and microplastics

(A) Indoor air pollution is caused by the harmful pollutants released inside homes. Indoor air pollution is several times more harmful than the outdoor air pollution. The following figure indicates various places of a house subject to indoor air pollution and pollutants that may be present in one of those places.



From the above figure, identify a place which is an example for each of the following statements and write it in the box opposite to it.

Statement	Place
(i) Poisonous gases contributing to acid rains and global warming and volatile hydrocarbons may accumulate.	.....
(ii) Subjected to pollution more by volatile organic pollutants released during the use of perfumes, nail polish, etc.	.....
(iii) Contributes to indoor air pollution frequently releasing pathogenic micro-organisms, mould, fungi and foul smell.	.....
(iv) Volatile organic pollutants released from furniture and wall paints and solid particulate pollutants issued from carpets may occur in abundance.	.....

(i) garage **01**

(ii) bedroom **01**

(iii) bathroom / kitchen **01**

(iv) living room **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 111*

(v) State a personal addiction that pollutes indoor air and makes the dwellers victims of diseases such as lung cancer, heart attacks and strokes.

smoking **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 200*

(vi) State an eco-friendly practice adopted in this house to control indoor air pollution naturally.

Keeping a plant in the living room (indoor plant) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 210*

(vii) Suggest a measure that could be taken during architectural design to minimize indoor air pollution.

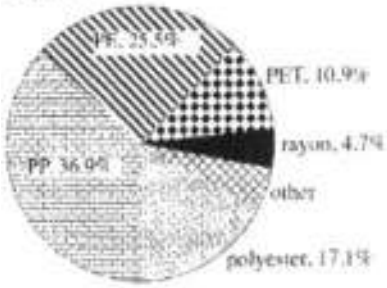
Installing large windows / Constructing a chimney / Fixing exhaust fans / fan lights **01**

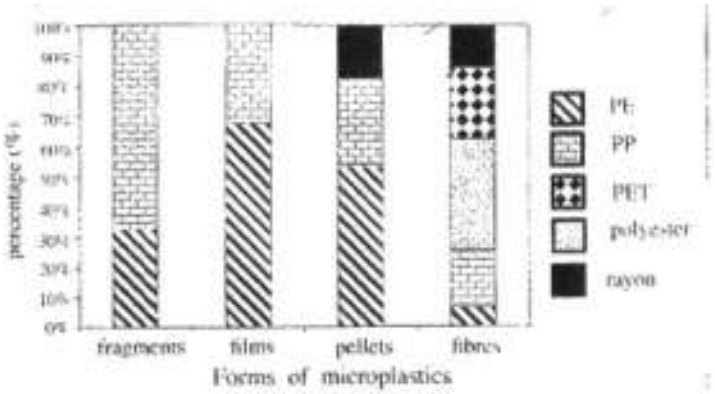
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 210*

(B) Microplastics mean pieces of any type of plastics that are less than 5 mm in length and have different shapes. Microplastic particles made of the polymer types polyethylene (PE), polypropylene

(PP), polyethylene terephthalate (PET), polyester and rayon have been found from a cultivated land. Figure A indicates the percentage composition of microplastics by polymer type in the cultivated land while figure B indicates the percentage composition of polymer types contained in different forms of microplastics.

Figure A





Using the information given in the figures, fill in the blanks of the following statements.

(i) According to figure A, the most abundant polymer type in the cultivated land is .....

polypropylene / PP **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 161*

(ii) According to figure A, the sum of the percentage compositions of polymer ..... and polymer ..... is approximately equal to the percentage composition of PP.

polyethylene / PE and polyethylene terephthalate (PET) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 44*

(iii) According to figure B, the polymers existing in the cultivated land as microplastics in the form of films are ..... and .....

polyethylene / PE and polypropylene / PP **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 164*

(iv) Microplastics in the form of ..... are composed of the highest number of various polymers.

fibre **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 158*

(v) State a way by which microplastics are added to the cultivated land.

runoff water / covers / agrochemical packages / fertilizers / wind / water added to the cultivation / from planting bags **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 202*

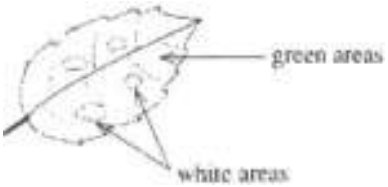
(vi) Suggest a method to separate microplastics contained in a sample of urea fertilizer.

Dissolving in water and filtering **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

Question 2 — Starch test, animals and reproduction

(A) A group of students preparing for a practical experiment sketched on a paper the diagram of a leaf with white and green areas of a shoe flower plant growing in a place well exposed to sunlight. The diagram is shown on the right. Later, that leaf was subjected to the starch test following the relevant steps.



(i) Name the chemical substance used to identify starch.

iodine solution / iodine / I_2 **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(ii) Indicate in the following table the observations made after applying the chemical substance you mentioned in (i) above.

Area of the leaf subjected to the test	Observation
(a) Green areas	.....
(b) White areas	.....

(a) Green areas: brown colour turning blue / purple / purplish blue **01**

(b) White areas: no colour change / pale yellow colour doesn't change / yellow / brown **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 26*

(iii) What conclusion can be drawn as per the observations made in relation to the green and white areas of the leaf in the above experiment?

chlorophyll / chloroplast (01) is essential for photosynthesis (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 26*

(B) Several species of animals that could be seen either in home or in home garden are given below.

cockroach, gecko, spider, snail, leech, centipede

From the above list, select the animal species with each of the following characteristic and write on the dotted line opposite each.

(i) bears a vertebral column

gecko **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 174*

(ii) has a muscular foot

snail **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 17*

(iii) body is divided into equal segments

leech **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 16*

(iv) bears four pairs of legs

spider **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 17*

(v) has a body consisting of three tagmas, head, thorax and abdomen

cockroach **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

(C) The following flow chart shows the steps of human reproduction up to the formation of the embryo. In it, structures/cells are shown in rectangles and processes are shown in ellipses.

- [ovaries] → (production) → [Y]
- [X] → (production) → [sperm]
- [Y] and [sperm] → (B) → [Z] → (mitosis) → [embryo]

(i) Write the structures/cells indicated as X, Y and Z in the respective rectangles.

X: testes / testicles / seminiferous tubules (01); Y: ovum (01); Z: zygote (01) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 49*

(ii) Write the process indicated as B in the respective ellipse.

fertilization **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 41*

(iii) In which site does the process B occur?

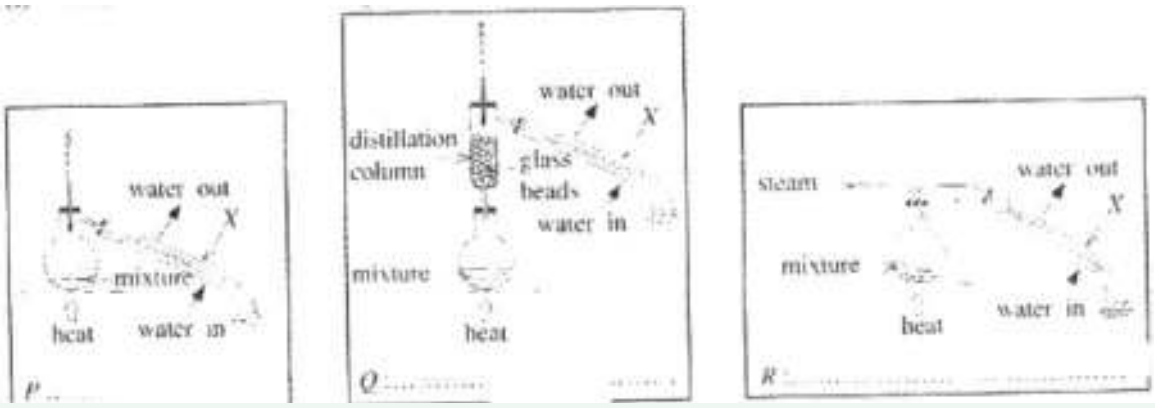
fallopian tube **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 53*

Question 3 — Distillation and the periodic table

(A) Steam distillation, simple distillation and fractional distillation are three distillation methods that can be used to separate the components of mixtures. Three sets of apparatus P, Q and R, assembled to effect distillation by each of those methods are illustrated below (not in respective order).

(i) Write below the relevant figures, the methods of distillation employing the set ups P, Q and R.



P: simple distillation (01); Q: fractional distillation (01); R: steam distillation (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(ii) Name the equipment labelled X.

Liebig condenser **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 58*

(iii) Of the above methods, write the most suitable distillation method for each of the following separations on the dotted line opposite each.

(a) separation of the components of a liquid hydrocarbon mixture

fractional distillation / Q **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(b) extraction of cinnamon oil from cinnamon leaves

steam distillation / R **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 66*

(c) obtaining salt-free pure water from sea water

simple distillation / P **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 58*

(B) The figure indicates the positions occupied by the elements beryllium, oxygen, chlorine, potassium and calcium in the periodic table.



(i) From the elements given, write the symbol of the element that shows each of the following properties in the box opposite each.

Property of the element	Example
(a) a coloured gas existing as diatomic molecules	.....
(b) highest in electronegativity	.....
(c) has the lowest first ionisation energy	.....

(a) Cl (b) O (c) K — 01 each **03**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 56*

(ii) State whether the compounds formed by the combination of following elements are ionic or covalent.

(a) calcium and chlorine

Ionic **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 81*

(b) chlorine and oxygen

Covalent **01**

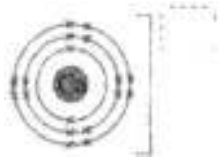
▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 185*

(iii) Beryllium chloride formed by the combination of beryllium and chlorine is a covalent compound. In the box given, draw the dot and cross structure of the beryllium chloride molecule.

Cl–Be–Cl in a line: each Be–Cl bond is a shared pair of one Be electron (•) and one Cl electron (×); each Cl atom has three more lone pairs (××) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(iv) Calcium oxide formed by the combination of calcium and oxygen is an ionic compound. Indicate in the figure,



(The figure also shows the oxide ion, O, in square brackets, for its electrons to be marked.)

(a) the charge of the calcium ion

2+ **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 56*

(b) all the electrons in the outermost shell of the oxide ion in calcium oxide.

eight electrons in the outermost shell of O (inner shell 2 electrons); the ion is written in brackets with the charge 2- **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 169*

Question 4 — Liquid pressure and waves

(A) The mouth of the funnel shown in figure 1 is fully closed by a tightly stretched sheet of rubber. The other end of the funnel is connected to one arm of a U tube partly filled with coloured water by a rubber tube.

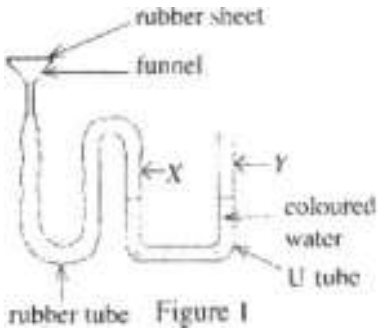


Figure 1

(i) In the situation shown in the figure 1, how will the water level in the arms of the U tube change when a finger is placed on the top of the rubber sheet and pressed slightly?

(a) arm X ..... (b) arm Y .....

(a) goes down / decrease (b) goes up / increase — 01 each **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 72*

(ii) Explain the reason for the observation in (i) above.

increase in the pressure (in the rubber tube) / exert a pressure **01**

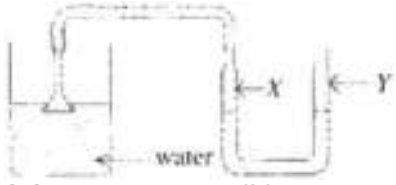
▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 75*

(iii) In the above set up, water levels in the U tube remain unchanged though the mouth of the funnel is turned to various sides in air. What is the reason for this?

Atmospheric pressure does not change / Always atmospheric pressure assumes the same value **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 72*

(iv) How will the water levels in the arms of the U tube change when the funnel with the rubber sheet is dipped in water shown in figure 2 and moved towards the bottom of the container gradually?



(a) arm X ..... (b) arm Y .....

(a) goes down (b) goes up — 01 each **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 72*

(v) State the conclusion that can be drawn according to the observation in (iv) above.

The pressure increases with the increasing depth in water / pressure depends on the water column **02**

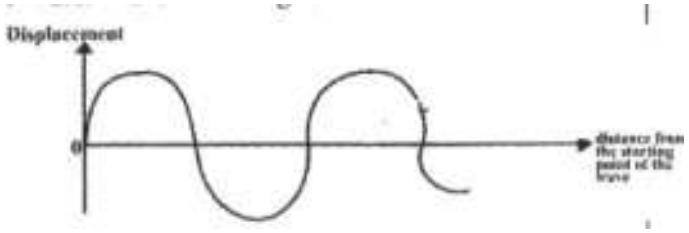
▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 66*

(vi) In place of water, an equal volume of coconut oil is added to the container with the funnel in figure 2. When the funnel is held close to the bottom of the container, in the presence of which liquid can a greater difference between the liquid levels of the U tube be observed?

water **01**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 72*

(B) The figure is the graphical representation of water wave travelling on a water surface.



(i) As regards the direction in which the water particles vibrate, name the type of waves to which this wave belongs.

Transverse waves **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 75*

(ii) Mark and label in the above figure, the wave length and amplitude of the wave represented by the graph.

wave length / λ marked as the distance between two successive crests (01); amplitude marked as the height of a crest from the 0 line (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 79*

(iii) When a light piece of styrofoam (regifoam) was placed on the water surface along which the wave travels, it was observed that it moves up and down. What is the reason for this observation?

Particles oscillate perpendicular to the direction of propagation of the wave. **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 75*

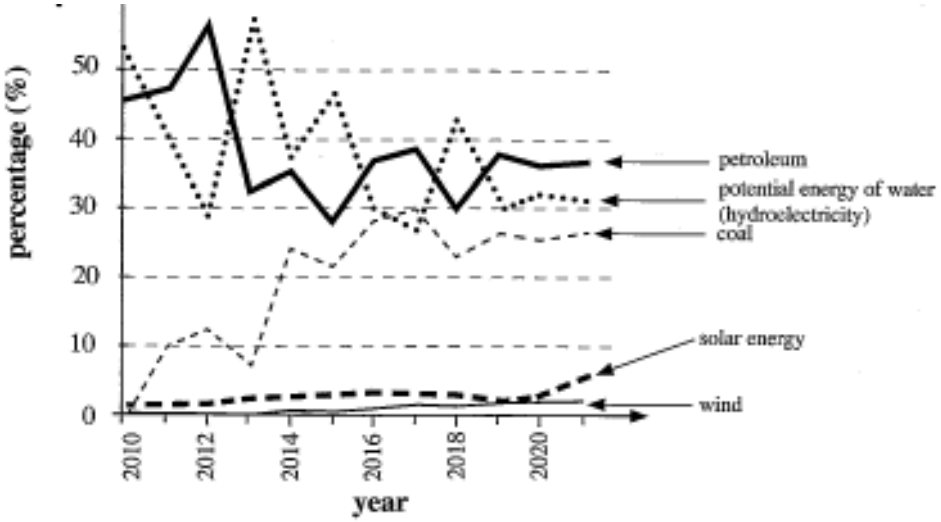
Paper II • 2022 (2023)

OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

Question 1 — Energy sources and the carbon cycle

(A) The following graph indicates how a developing country utilized various sources of energy for generating electricity.



Based on the information in the above graph, fill in the blanks in the following table.

	Statement	Answer
(i)	The year in which the potential energy of water has been utilized at the highest percentage	.....
(ii)	The renewable energy source utilized least	.....
(iii)	The energy source of which the utilization has increased rapidly during the time range given	.....
(iv)	The utilization of petroleum in the year 2018 as a percentage	.....

(i) 2013 — **01**

(ii) Wind — **01**

(iii) Coal — **01**

(iv) 30 (%) — 29 (%) also accepted (handwritten amendment) — **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(v) According to the above graph, what is the relationship that can be seen in the variation between the utilization of petroleum and utilization of potential energy of water to generate electricity?

Inversely proportional relationship / consumption of petroleum decreases with the increase in the consumption of potential energy of water or vice versa — **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

(vi) In the future, which energy source indicated here should be paid greater attention for generating electricity in a torrid zone country like Sri Lanka?

Solar energy / Sun — **01**

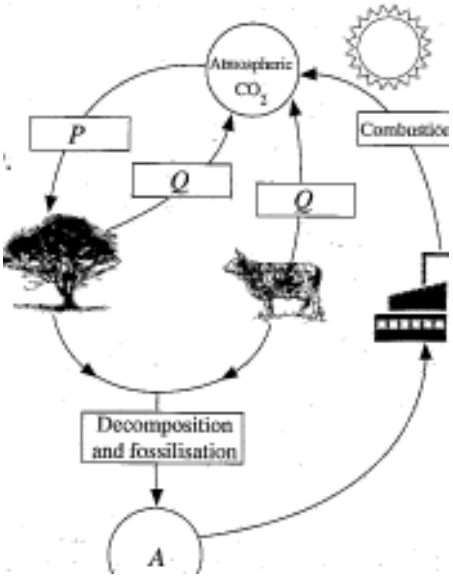
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 204*

(vii) Name a source of energy which is **not** included in this graph but is used in some developed countries to generate electricity.

Nuclear energy (or atomic power) / sea waves / tides (tidal waves) / natural gas / geothermal energy — **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 63*

(B) A diagram of a biogeochemical cycle is given here.



(i) What is the biogeochemical cycle illustrated by this diagram?

Carbon / C **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 178*

(ii) Name the processes indicated by the letters P and Q.

P = Photosynthesis (01); Q = Respiration (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 178*

(iii) Name a substance indicated by the letter A.

Fossil fuels / petroleum / coal / crude oil / peat / humus (01) — handwritten note: "petrol" not accepted

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 178*

(iv) What process indicated here occurs with the contribution of micro-organisms?

Decomposition **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 178*

(v) (a) What is the environmental crisis caused by the atmospheric CO_2 concentration exceeding the optimum level?

Global warming / increasing the temperature of the globe / increase in atmosphere temperature **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

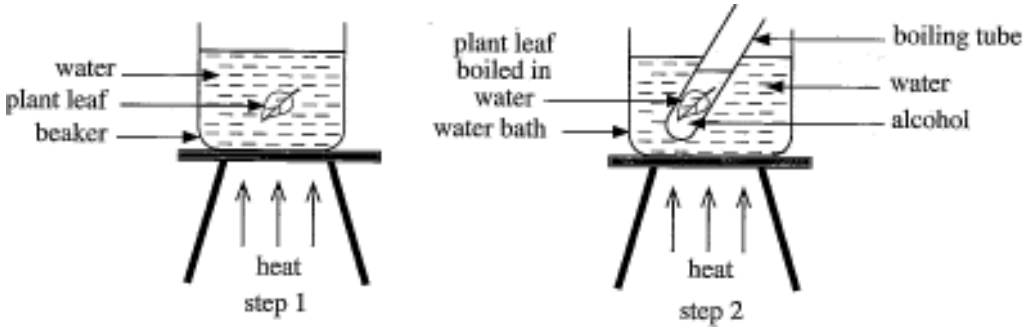
(b) State an unfavourable effect brought about by that crisis.

Melting of polar ice caps (glaciers) and inundation of islands / rising of the sea level / change of climatic patterns (01) — total for Q1: 15 marks

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 192*

Question 2 — Starch test, cells and sex inheritance

(A) The sketch given below indicates two steps of an experiment conducted to investigate whether starch is produced in plant leaves by photosynthesis.



(i) Write the reason for each of the following.

(a) boiling the plant leaf in water in step 1

To make the cells non-living / to destroy the cells / to make the cells die / to increase the permeability of plasma membranes (cell membranes) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(b) boiling the plant leaf in alcohol in step 2

To dissolve chlorophyll / to remove chlorophyll **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(c) using a water bath in step 2

As alcohol is highly inflammable **01**

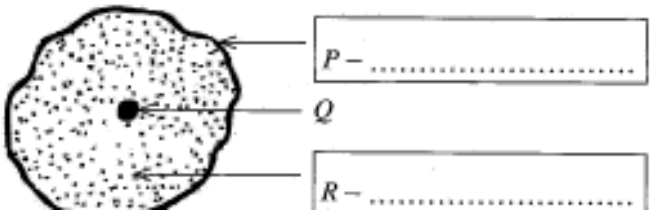
▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(ii) During step 2, what colour change can be seen in alcohol in the boiling tube?

(colourless) → green **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(B) Given below is a sketch of an animal cell drawn based on the observations made under a light microscope.



(i) Write in relevant boxes the names of the structures labelled P and R.

P – Plasma membrane / cell membrane (01); R – Cytoplasm (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 115*

(ii) State the function of P.

Acts as a semi-permeable / selectively permeable membrane / acts as a membrane enclosing the cell / acts as a protecting membrane / controlling the entry and exit of materials into and out of the cell **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 115*

(iii) Name a type of animal cell which does not contain the organelle Q.

(Mammal) red blood cells / RBC **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 163*

(iv) What is the structure which is absent in an animal cell but is present in every plant cell?

Cell wall **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 114*

(C) (i) The sex chromosomes contained in an egg mother cell and a sperm mother cell are indicated as (XX) and (XY) respectively. Accordingly, fill in the boxes a, b, c, d, e and f in the Punnett square given below.

♂ – Male gamete; ♀ – Female gamete

♂ \ ♀	**X**	**(a) .....**
(b)	(c)	(d) .....
Y	(e)	(f) .....

(a) X; (b) X — if a and b are correct give 1 mark **01**

(c) XX; (d) XX; (e) XY; (f) XY — if all c, d, e, f are correct give 4 marks **04**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 184*

(ii) State a genetic disorder caused by sex-linked inheritance.

Haemophilia / (red-green) colour blindness (01) — total for Q2: 15 marks

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 184*

Question 3 — Bonding and Period 3 elements

(A) Figures 1 and 2 indicate Lewis dot-and-cross structures of two molecules formed by the atoms belonging to three elements X, Y and Z. X, Y and Z are not their standard symbols. The atomic numbers of X and Y are less than 10. The atomic number of Z is higher than 10 and lower than 20.

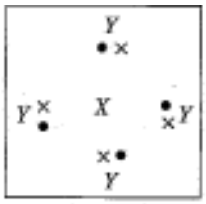


Figure 1

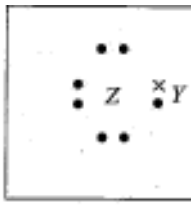


Figure 2

Write the answers relevant to the following blanks.

(i) The atomic number of X

6 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 55*

(ii) The period to which X belongs in the periodic table

2 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(iii) The group to which Z belongs in the periodic table

VII / 17 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(iv) The molecular formula of the compound formed by the combination of X and Z

XZ_4 / CCl_4 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(v) The type of chemical bonds existing between the atoms of X and Y

Covalent bonds **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 188*

(vi) The type of chemical bonds existing between the atoms of Z and Y

Covalent bonds **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 188*

(vii) The chemical formula of element Z when it exists in the free state

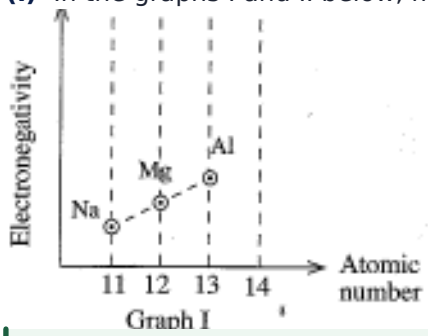
Z_2 / Cl_2 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 77*

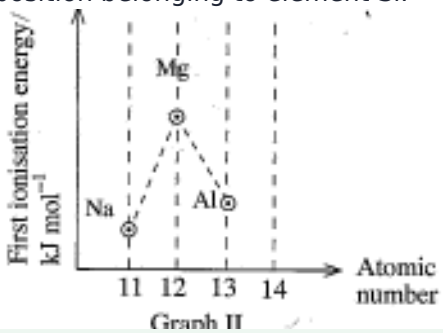
(B) The elements in the third period of the periodic table are given below with their atomic numbers.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Atomic number	11	12	13	14	15	16	17	18

(i) In the graphs I and II below, mark as ⊙, the position belonging to element Si.



Graph I



Graph II

Graph I: Si must be marked above Al (at atomic number 14) **01**

Graph II: Si must be marked above Mg (at atomic number 14) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(ii) Of the elements in the third period, select the element fitting each of the following statements and write its chemical symbol in the blank.

(a) The element forming a chloride with M^{2+} ions

Mg **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(b) The element forming an amphoteric oxide

Al **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 74*

(c) The element existing as a monatomic gas

Ar **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iii) (a) Which element in the third period reacts fast with cold water?

Na / Sodium **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(b) How do you confirm that a basic solution is formed after the above reaction?

Turning phenolphthalein pink / turning red litmus blue / giving a value above 7 with pH papers — give 01 mark for any one of the above **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 96*

(iv) Given below is an incomplete chemical equation for the reaction between magnesium metal and steam. Fill in the blanks in it.

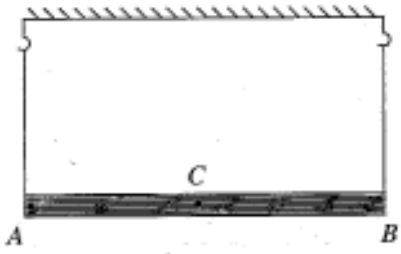
$$Mg(s) + H_2O\ (...) \rightarrow .....(s) + H_2(g)$$

$Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$ (01) — total for Q3: 15 marks

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

Question 4 — Equilibrium of a rod and spring energy

(A) The figure indicates how a uniform rod AB whose mid point is C, is suspended in the ceiling by two strings tied to its two ends and kept in equilibrium.



(i) Using arrow heads, mark the following forces in the figure.

(a) the tensions T_1 and T_2 exerted by the two strings on the rod

T_1 and T_2 marked using arrows upwards along the strings at A and B **01**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 205*

(b) the weight of the rod W

W marked using a downward arrow from point C **01**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 205*

(ii) What is the relationship existing between T_1 and T_2?

$T_1 = T_2$ **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(iii) Write by an equation, the relationship among T_1, T_2 and W.

$W = T_1 + T_2$ **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(iv) If the mass of the above rod is 200 g,

(a) what is the value of W in Newtons? ($g = 10\ m\ s^{-2}$)

W = 2 (N) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(b) indicate the values of T_1 and T_2 in Newtons.

T_1 = 1 (N) (01); T_2 = 1 (N) (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(B) Figure 1 below illustrates a helical spring connected to an immovable support on a table. The other end of the spring is in contact with a block of wood. Figure 2 below shows how the spring is compressed by applying a horizontal force P on the block of wood. Assume that there is no friction between the block of wood and the surface of the table.

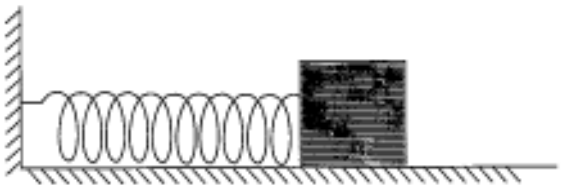


Figure 1

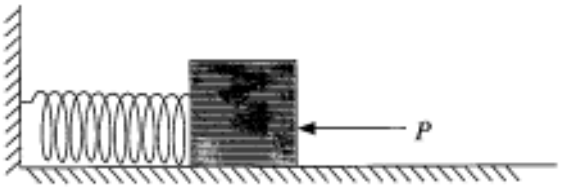


Figure 2

(i) Name the form of energy stored in the compressed spring.

(Elastic) potential energy **01**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 132*

(ii) (a) To what form of energy will the form of energy stated in (i) above be transformed when the force P is removed?

Kinetic (energy) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 102*

(b) If the amount of energy stored in the compressed spring is 16 J and the mass of the block of wood is 0.5 kg, calculate the initial velocity of the block of wood.

$E_K = ½ mv^2$ or $16 = ½ \times 0.5 v^2$ **01**

$v = 8 m s^{-1}$ (01) — 02 marks; 01 mark if units are not mentioned **02**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 102*

(c) State the nature of motion of the block of wood along the table after it is released from the spring.

Constant / uniform velocity or speed **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 102*

(d) If there was a constant friction between the surface of the table and the block of wood and if the table had a considerable length, draw the velocity-time graph for the expected motion of the block of wood after it has been released from the spring.

A straight line sloping downwards from the initial velocity to zero (velocity decreasing uniformly with time): plotting the graph correctly (01); naming the X and Y axes correctly — v ($m s^{-1}$) and t (s) (01) (02) — total for Q4: 15 marks

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 39*

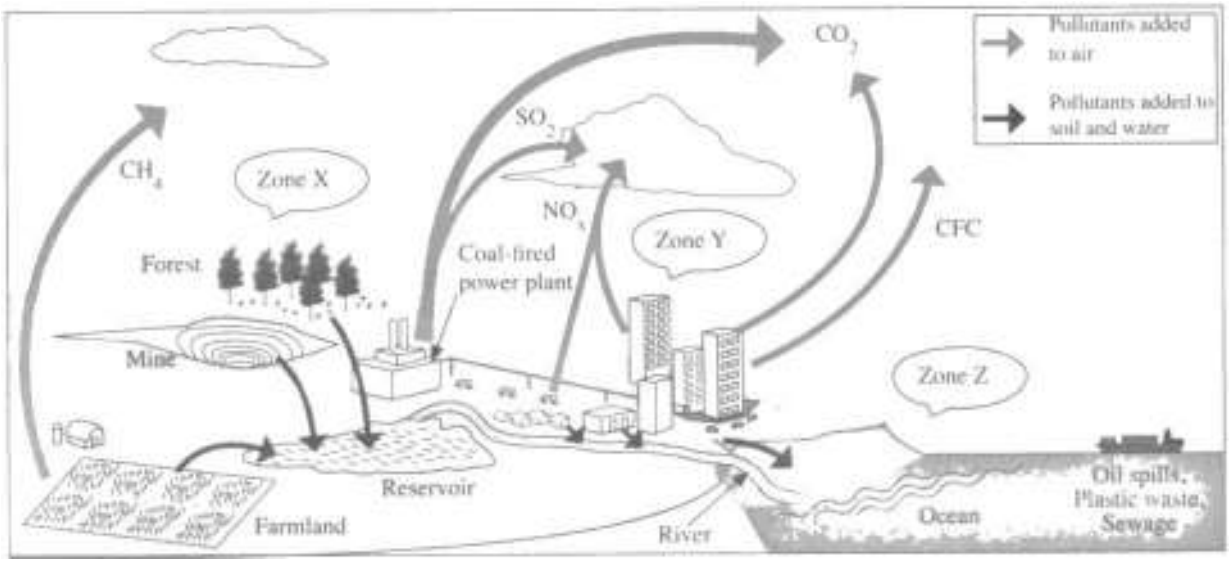
Paper II • 2021 (2022)

OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

Question 1 — Pollution of air, soil and water

(A) The following diagram briefly indicates the ways by which air, soil and water are polluted.



Fill in the blanks in the table selecting **an example** from the diagram relevant to each of the following statements.

(i) The gas contributing most to the increase in global warming

CO_2 / carbon dioxide **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 111*

(ii) The main source that releases the components causing eutrophication in the reservoir

Farmland **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 194*

(iii) Gaseous organic compound that depletes the ozone layer

CFC / chlorofluorocarbon **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 192*

(iv) The zone most prone to have photochemical smog

Zone Y **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 193*

(v) The source producing gases which cause acid rains

Coal-fired power plant / coal / vehicles / ships / factories **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 195*

(vi) The source that adds ground heavy metals to topsoil

Mine **01**

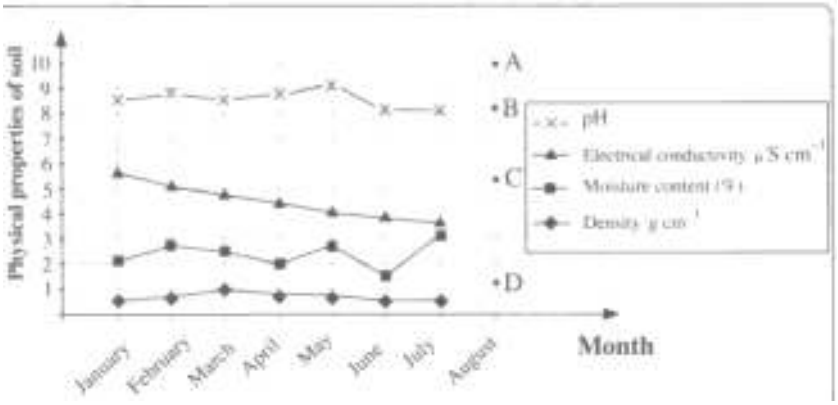
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 183*

(vii) The pollutant accumulated in living organisms through food chains and subjected to the minimum chemical digestion in the digestive system

Plastic (waste) — [total 07] **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 177*

(B) In a certain area, a study was conducted about soil pollution. In this study, soil samples were collected monthly from a selected site and their physical properties density, moisture content, electrical conductivity and pH value were determined and plotted.



Answer the following questions based on the above graphs.

(i) According to the density graph, what was the maximum density value reported?

1 g cm^{-3} **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(ii) In which month was the moisture content at a minimum value?

June **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(iii) How much is the amount of moisture contained in 100 g of the soil sample collected in April?

2 g / 2 / 2% **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(iv) In which time range had the soil pH stayed constant?

From June to July / June - July **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(v) Which physical property shows a continuous decrease during the period of data collection?

Electrical conductivity **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(vi) Which physical properties shown in the graph are determined by the amount of ionic components present in the soil?

Electrical conductivity (01); pH (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(vii) In August, on the days immediately before the sample collecting day, acid rains fell on the above area. Accordingly, of the points A, B, C and D, the pH value corresponding to which point would be the most probable soil pH value relevant to that month?

C — [total 08] **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 195*

Question 2 — Plants, amylase and the plant cell

(A) From the plants given in the box, select a plant which is an example for each of the following statements and write it on the dotted line opposite each.

Pinus, Coconut, Jack, Paddy, Marchantia, Acalypa (kuppamania/kuppameni), Cycas, Pogonatum

(i) A non-flowering plant without seeds

Marchantia / Pogonatum **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 11*

(ii) A non-flowering plant with seeds

Cycas / Pinus **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 12*

(iii) A monocotyledonous flowering plant

Coconut / Paddy **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 11*

(iv) A dicotyledonous flowering plant

Jack / Acalypa / Kuppamania — [total 04] **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 11*

(B) In order to demonstrate the action of the enzyme amylase on starch during the process of digestion of food, a mixture was made by adding starch and amylase to water. The mixture was placed in a water bath at a temperature 37 °C. After five minutes, a drop from the mixture was taken out, a drop of iodine solution was added to it and the colour was observed. The above test was repeated at times given in the following table. The colour observed in each instance is shown in the table.

Time/minutes	**5**	**15**	**25**	**35**	**45**
Colour observed	Violet-blue	Blue	Blue	Yellow-brown	Yellow-brown

(i) What is the compound formed by the action of amylase on starch in the aqueous medium?

Maltose **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 9*

(ii) Give the reason for the following observations.

(a) Appearance of blue colour after 15 minutes

Presence of starch **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 9*

(b) Appearance of yellow-brown colour after 35 minutes

All starch are reacted **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 9*

(iii) Why is the mixture subjected to the experiment kept in a water bath at 37 °C?

Providing the optimal temperature for enzymatic action / maintaining at the body temperature / to increase the rate of the reaction **01**

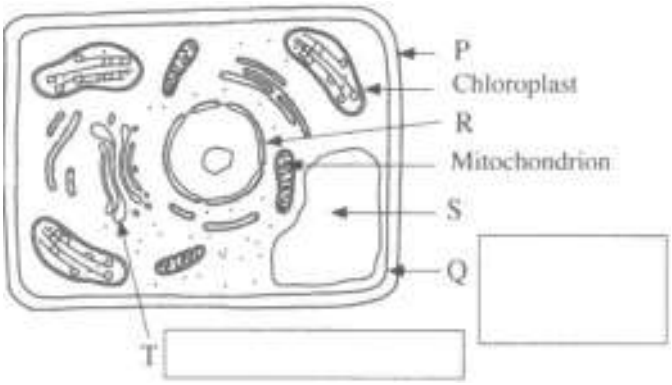
▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 9*

(iv) Which component does not undergo a chemical change though contributes to the chemical reaction pertaining to the above experiment?

Amylase / enzyme — [total 05] **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 9*

(C) Given below is a diagram of a typical plant cell drawn based on the electron microscopic observations.



(i) By which letter is the structure that helps to maintain the shape of plant cells named?

P **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

(ii) Write the names of the organelles labelled Q and T in the relevant boxes.

Q - Plasma membrane / cell membrane (01); T - Golgi complex / Golgi body / Golgi apparatus (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

(iii) By what letter is the organelle that can also be identified when observed under the optical microscope labelled?

R / S **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

(iv) State the function carried out by the following organelles.

(a) chloroplast

Carry out photosynthesis / production of food **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

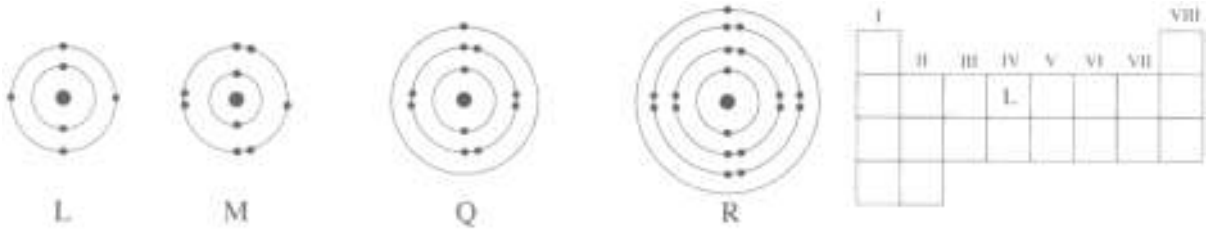
(b) mitochondrion

Cellular respiration / aerobic respiration / production of energy — [total 06] **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

Question 3 — Atomic structure and chemical bonds

(A) How electrons exist in the energy levels belonging to atoms of elements L, M, Q and R are illustrated in the following diagrams. L, M, Q and R are not the standard symbols of those elements. Given on the right hand side is a periodic table indicating the places of the first twenty elements.



(i) Using the given symbols, indicate the positions belonging to the elements M, Q and R in the periodic table as shown for element L.

M - group VII, period 2 (the box at the end of the second row, next to Ne); Q - group I, period 3; R - group I, period 4 **03**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(ii) Write the chemical formula of M existing in the gaseous state in the molecular form.

M_2 / F_2 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 77*

(iii) What is the chemical formula of the compound formed by the combination of L and M?

LM_4 / CF_4 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iv) Of L and M, which element is higher in electronegativity?

M / F **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(v) Of Q and R, which element is lower in first ionisation energy?

R / K **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(vi) State the acidic/basic nature of the following oxides formed by L and Q.

LO_2 : ..... Q_2O : .....

LO_2 : acidic (01) Q_2O : basic (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 73*

(vii) The diagram illustrates how Q exists in the ionic compound formed by the combination of Q and M. Draw how M exists in that compound.



M drawn with two shells holding 2 and 8 electrons (2, 8) inside square brackets (01), with the charge "-" (01) — [total 11] **02**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(B) Chemical bonds within the water molecules and among the water molecules are indicated in the diagram by the arrows ① and ② respectively. Using it fill in the blanks in the following sentences.



(i) The bond type indicated by the arrow ① is known as ..... and the bond type indicated by the arrow ② is known as .....

① covalent bond (01); ② hydrogen bond / inter molecular bond / inter molecular attraction / inter-molecular forces (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 188*

(ii) The type of bonds indicated by the arrow ..... is responsible for the existence of relatively higher boiling point of water.

② **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 183*

(iii) A very small ..... charge lies on the hydrogen atoms in the water molecules.

positive / + / δ+ — [total 04] **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 182*

Question 4 — Motion, forces and moments

(A) ABCD is a horizontal path. The distances between the points AB, BC and CD are equal. The parts of the path AB and CD offer friction. The part BC is smooth. A trolley of mass 4 kg was placed at A and a horizontal force of 12 N was applied as shown in the figure. When the trolley reached B, the 12 N force was removed. The trolley that entered part CD came to rest at D. The frictional force acting on the trolley when moving in the parts offering friction was 4 N.



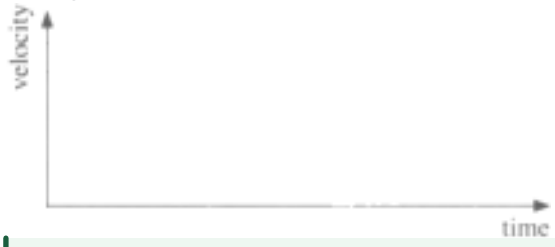
(i) Indicating the nature of the motion of the trolley from A to D, complete the following table.

	from A to B	from B to C	from C to D
Nature of motion of the trolley	acceleration	.....	.....

from B to C: uniform velocity (01); from C to D: deceleration / retardation / negative acceleration (01) **02**

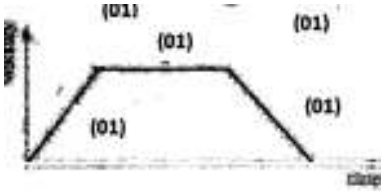
▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 89*

(ii) On the following system of axes, draw the approximate velocity-time graph for the motion of the trolley from A to D.



velocity increases uniformly from zero (straight line rising) (01); constant velocity (horizontal line) (01); velocity decreases uniformly to zero (straight line falling) (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 39*



(iii) What is the unbalanced force acting on the trolley in its motion from A to B?

8 N **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 89*

(iv) Calculate the acceleration of the trolley during its motion from A to B.

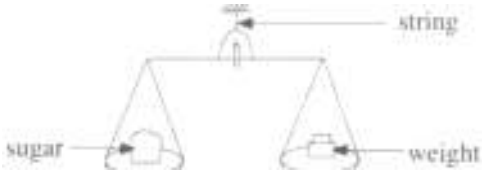
F = ma / a = F/m

= 8 N / 4 kg — any substitution **01**

a = 2 m s^{-2} — [total 08] **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 89*

(B) The diagram shows a pan balance used in a retail shop.



(i) When 1 kg of sugar is placed on one pan of the balance, what is the mass of the weight that should be placed on the other pan to counterpoise the balance?

1 kg **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 95*

(ii) What is the force acting on the string by which the balance is suspended when it is counterpoised as mentioned in (i) above? The mass of the balance only is 3 kg. (g = 10 m s^{-2})

50 N **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(iii) The figure shows a floor balance used in a wholesale store to weigh a large mass. A mass of 50 kg is placed on one side of the balance and a weight of mass m is suspended on the other side so that the balance is counterpoised.



(a) Find the moment created around point O by the mass of 50 kg.

500 N × 5/100 m / 25 N m / 500 N × 5 cm / 2500 N cm **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(b) Write an expression in terms of m for the moment created around point O by the weight.

mg × 1 m / mg × 100 cm / 10m **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(c) When the balance is counterpoised around point O, the anticlockwise moment created by the 50 kg mass and the clockwise moment created by the weight are equal. Find the value of m.

m = 2.5 kg **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(d) State **two** advantages of using a floor balance instead of a pan balance for measuring a large mass.

Easy to handle the weight / can measure a large mass / no need of large standard weight to weigh / no need to lift the balance — any two answers — [total 07] **02**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 93*

Paper II • 2020

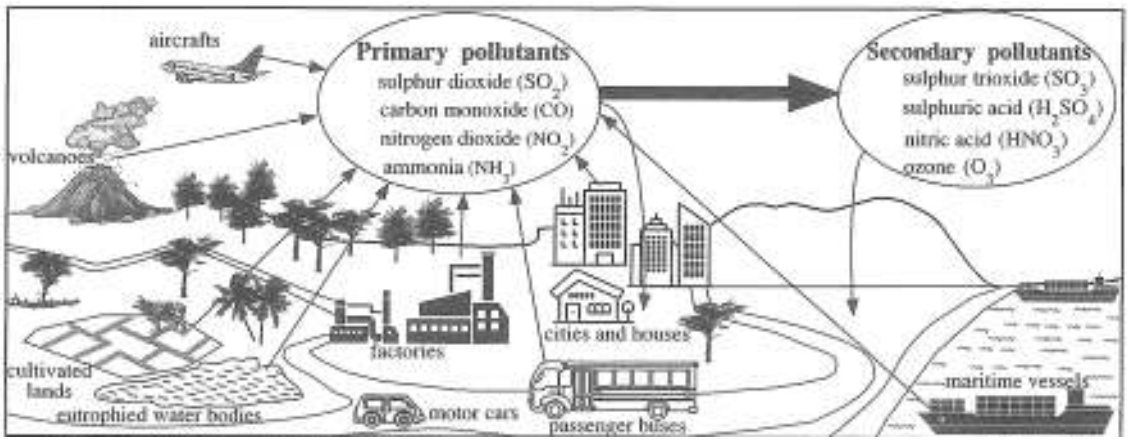
PREPARED ANSWERS (TEXTBOOK-BASED)

Part A • structured essay questions • answer all four • 15 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 1 — Air pollutants

(A) The following figure indicates several common sources of pollutants and the gaseous pollutants produced by them. The primary pollutants indicated in it are the gaseous pollutants directly added to the atmosphere. The secondary pollutants produced from the primary pollutants undergoing chemical changes in the atmosphere are also indicated in the figure.



Select an **example** relevant to each of the following statements from the figure and fill in the blanks in the table.

(i) A pollutant source producing primary pollutants without human interference.

Volcanoes

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 180*

(ii) A secondary pollutant affecting living beings favourably in the upper regions of the atmosphere and unfavourably in the lower regions of the atmosphere.

Ozone (O_3)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(iii) A primary pollutant producing secondary pollutants which contribute to acid rains.

Sulphur dioxide (SO_2) / nitrogen dioxide (NO_2)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 195*

(iv) A primary pollutant with basic properties that liberates from the eutrophied water bodies.

Ammonia (NH_3)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 73*

(v) A secondary pollutant that falls on soil and contributes to provide a main nutrient essential for plant growth.

Nitric acid (HNO_3) — forms nitrates in the soil, which supply nitrogen

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 179*

(vi) If the food mileage is shortened, the amount of gaseous pollutants released from this pollutant source is reduced.

Maritime vessels / aircrafts (used to transport food over long distances)

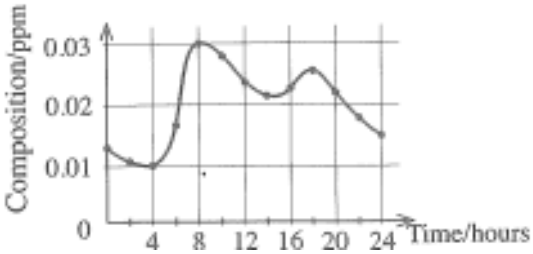
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 190*

(vii) If this mode of transport is selected, your carbon foot print during an inland tour can be minimized.

Passenger buses (public transport)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 201*

(B) In a populated city, the atmospheric nitrogen dioxide gas (NO_2) composition was measured during a day starting from Sunday midnight to Monday midnight. The variation graph of the composition of NO_2 drawn using those data is given below. Answer the following questions based on the graph.



(i) What is the maximum and minimum NO_2 composition existed on the relevant day?
maximum: ..... minimum: .....

maximum: 0.03 ppm; minimum: 0.01 ppm

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(ii) In which hour of the day is the maximum NO_2 composition recorded?

At the 8th hour (about 8 a.m.)

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(iii) According to the above graph, in the above city, two occasions are seen in which the NO_2 composition assumes a high value in a day. Give a reason for it.

These are the morning and evening rush hours: heavy traffic of people travelling to and from work releases more NO_2 from vehicle exhausts.

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 43*

(iv) In the above city, the increase in the NO_2 composition in the forenoon is greater than that of the afternoon. Give a reason for it?

On Monday morning (after the weekend) traffic is heaviest as everyone travels to work and school at the same time; in the afternoon, sunlight breaks down part of the NO_2 in photochemical reactions (forming ozone / photochemical smog) and the gas disperses more, so the rise is smaller.

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 193*

(v) Name another primary gaseous pollutant which would indicate a variation that corresponds to the variation of NO_2 composition during the relevant day in the above city.

Carbon monoxide (CO) (also released from vehicle exhausts)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

Question 2 — Cell organelles, plant tissues and photosynthesis

(A) Given below is an incomplete table about four organelles existing in a cell and their main functions. Fill in the blanks and complete the table.

	Organelle	Function
(i)	Nucleus	.....
(ii)	.....	providing energy required for metabolic activities
(iii)	Golgi complex	.....
(iv)	.....	protein transport

(i) Nucleus — controls all the activities of the cell / carries the genetic material (chromosomes)

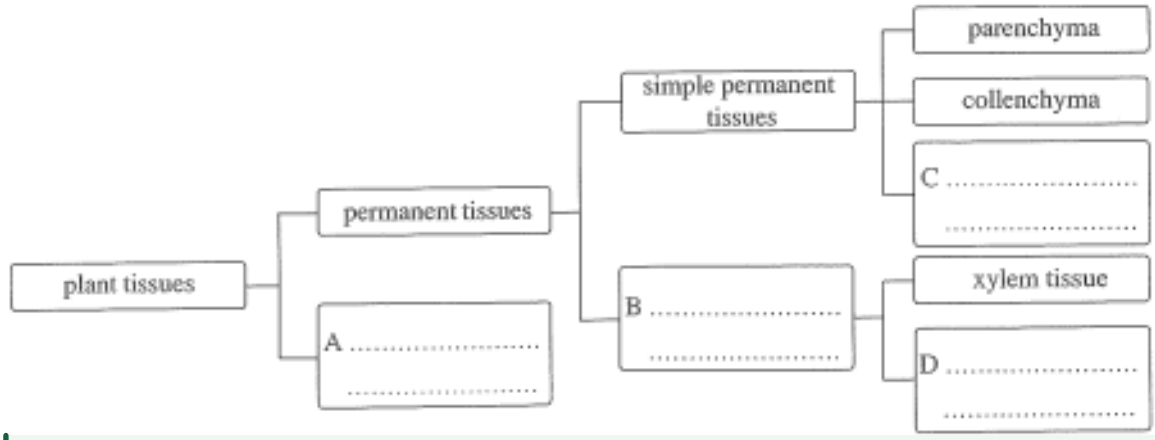
(ii) Mitochondrion

(iii) Golgi complex — packaging and secretion of substances (e.g. enzymes, materials for the cell wall)

(iv) (Rough) endoplasmic reticulum

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 116*

(B) (i) An incomplete chart indicating the classification of plant tissues is shown below. Write the tissue types relevant to the boxes A, B, C and D on the dotted lines given and complete the table.



A - meristematic tissues; B - complex permanent tissues; C - sclerenchyma; D - phloem tissue

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 4*

(ii) What is the type of tissue in which photosynthesis occurs most?

Parenchyma (chlorenchyma — the mesophyll of the leaf)

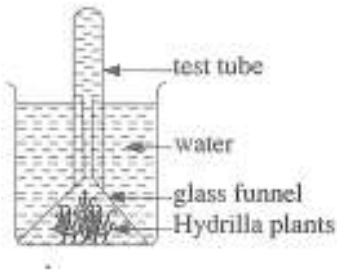
▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 4*

(iii) Name the type of tissue which contains seive tube elements.

Phloem

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 9*

(C) An apparatus set by a group of students to investigate a product of photosynthesis is shown in the diagram.



(i) What is the gas collected in the test tube when this apparatus is kept in sunlight?

Oxygen (O_2)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 113*

(ii) State a test that can be done to identify that gas and the observation you make during the test.

Test: .....

Observation: .....

Test: insert a glowing splinter into the gas collected in the test tube

Observation: the glowing splinter rekindles (bursts into flame)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(iii) A new apparatus similar to the above apparatus was made by putting water saturated with carbon dioxide gas instead of normal water.

(a) State an observation that could be expected with regard to the evolution of gas bubbles in the new apparatus when comparing with the evolution of gas bubbles in the first apparatus under similar environmental conditions.

Gas bubbles are given off at a faster rate (more bubbles per minute) than in the first apparatus.

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(b) Give reasons for the observation you mentioned above.

Carbon dioxide is a raw material of photosynthesis. When more dissolved CO_2 is available, the rate of photosynthesis increases, so more oxygen is released.

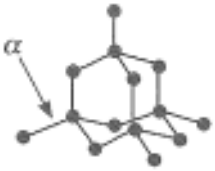
▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

Question 3 — Lattices and magnesium compounds

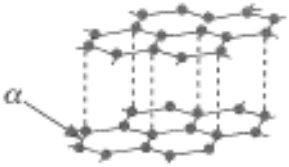
(A) The following figures indicate the lattice structures of three solid substances P, Q and R.

(i) Identify them and fill in the relevant blanks selecting the names of those substances and the lattice structures from the box given below.

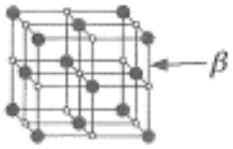
sodium chloride, diamond, graphite, ionic, atomic



(P)



(Q)



(R)

	(P)	(Q)	(R)
substance	.....	.....	.....
lattice	.....	atomic	.....

P - substance: diamond, lattice: atomic

Q - substance: graphite (lattice: atomic)

R - substance: sodium chloride, lattice: ionic

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 172*

(ii) Write the names of the chemical bonds labelled α and β in the lattice structures.

α - covalent bond; β - ionic bond (electrostatic attraction between Na^+ and Cl^- ions)

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 187*

(iii) Of the substances P, Q and R,

(a) which substance conducts electricity in the solid state?

Q (graphite)

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 184*

(b) which substance has the highest hardness?

P (diamond)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 71*

(B) Given below are two reactions in connection with the metal M.

M + oxygen gas → X (a white powder) (heat)

M + Y → **magnesium chloride** (an aqueous solution) + Z (a colourless gas)

(i) Identify M, X, Y and Z and write their names or chemical formulae on the dotted line.

M - magnesium (Mg); X - magnesium oxide (MgO); Y - hydrochloric acid (HCl); Z - hydrogen (H_2)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(ii) In compound X, the ionic form in which M exists is M^{2+}. Write the chemical symbol of the ionic form in which oxygen exists in that compound.

O^{2-}

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 172*

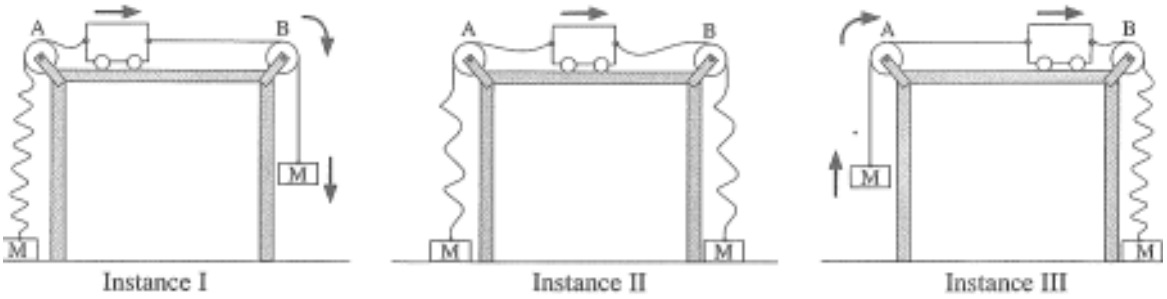
(iii) X is sparingly soluble in water. Which colour litmus papers give a colour change when testing that aqueous solution with litmus papers?

Red litmus papers (they turn blue, as the solution is basic)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 96*

Question 4 — Newton's laws and friction

(A) In an activity to demonstrate Newton's laws, a trolley connected to two equal masses M with strings is used. The figures show three instances in the activity. In those instances, the slack strings are represented by wavy lines while the taut strings are represented by straight lines. The strings are made to pass over two smooth pulleys A and B fixed to the two ends of a table. Arrows indicate the direction of motion of the trolley which smoothly moves on the horizontal table and the directions of motion of the masses.



(i) Inserting appropriately the terms given in the following box, complete the following table which describes the nature of motion of the trolley in the instances I, II and III.

uniform retardation, uniform acceleration, uniform velocity, Newton's first law, Newton's second law

Instance	Nature of motion of the trolley	Newton's law that describes the nature of motion of the trolley
I	.....	.....
II	.....	.....
III	.....	Newton's second law

I - uniform acceleration — Newton's second law

II - uniform velocity — Newton's first law

III - uniform retardation (Newton's second law)

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 97*

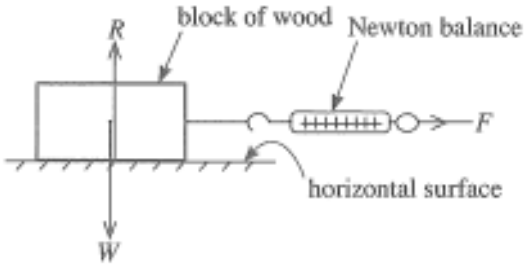
(ii) In one of the above instances, the trolley took 5 s to travel 50 cm on the table with uniform velocity. Find the uniform velocity with which the trolley moved.

velocity = distance ÷ time = 0.50 m ÷ 5 s

= 0.1 m s^{-1} (10 cm s^{-1})

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 89*

(B) The figure shows a cuboidal block of wood used to examine how the frictional force between a horizontal surface and an object placed on it changes. The block of wood is connected to a Newton balance by a string and a horizontal, external force F is applied. The experiment is conducted by increasing the value of the force F gradually from zero.



(i) Name the forces indicated by R and W.

R - normal reaction (of the surface on the block); W - weight of the block of wood

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 104*

(ii) The block of wood stays at rest until F is increased to a certain value from zero. By what name is the frictional force acting on the block of wood known before it starts to move?

Static friction (static frictional force)

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(iii) At the moment the motion starts, the frictional force acting on the block of wood reaches the maximum value.

(a) What is the name of that maximum frictional force?

Limiting friction (limiting frictional force)

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(b) Write **two** factors on which the magnitude of that frictional force depends.

The normal reaction (the force pressing the two surfaces together) / the nature (roughness) of the surfaces in contact

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 101*

(c) Suggest a method that can be practically applied to change one factor you stated in (b) above.

Place extra weights on the block of wood (changes the normal reaction) / cover the surface with sandpaper or polish it (changes the nature of the surfaces)

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 102*

Paper II • 2019

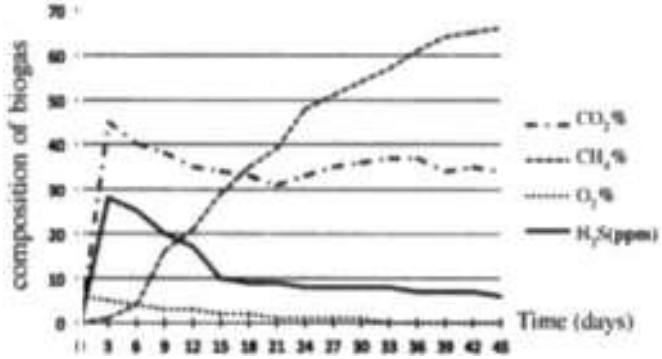
OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

This paper survives only inside its marking scheme; questions and answers were retyped from it.

Question 1 — Biogas, energy and the environment

(A) Gaseous fuel essential for the laboratory of a school is obtained from a biogas generator. Once in every three days, the composition of four types of gases contained in the biogas produced by it was determined. Those information are presented by the graph.



(i) In which gas has the production gradually increased during the relevant period?

CH_4 / methane — **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 105*

(ii) How much hydrogen sulphide was present in the gaseous mixture as per the composition on the 15th day?

10 ppm / 10 parts per million — no marks if ppm is not mentioned — **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 44*

(iii) Biogas is produced by the action of anaerobic bacteria on plant and animal waste. By the variation of the composition of which gas indicated in the graph is this justified?

O_2 / oxygen — **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 182*

(iv) Of the types of gases shown in the graph, which gas acts as a fuel?

CH_4 / methane — **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 182*

(v) Of the waste management principles known as 4R, for which principle is the maintenance of the biogas generator an example?

Recycle — **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 208*

(B) (i) Fixing of a larger number of windows is a noticeable feature of the above laboratory building. State **two** aspects each by which it contributes to maintain the conditions (a) and (b) given below.

(a) Creating a favourable environment for the laboratory users

Ensuring proper ventilation (relevant idea); lighting the room well (01) or any specific usage of it; maintaining a favourable temperature (relevant idea) — any 2 of them — **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 167*

(b) Minimizing electricity consumption

Minimizing the usage of electric bulbs (01); minimizing the usage of fans / minimizing the usage of air conditioners (01) — **02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 47*

(ii) In this laboratory, electricity is produced as follows to light the electric bulbs.
Step 1: Maintaining under high pressure the steam produced by boiling water by burning biogas.
Step 2: Operating a turbine by spurting steam kept under high pressure.
Step 3: Operating an electric generator by the running turbine.
Complete the following schematic diagram on the conversion of energy relating to the above process.

Chemical energy → (Step 01) →	Potential energy → (Step 02) →	(a) ..... → (Step 03) →	(b) .....

(a) kinetic energy (b) electric energy **02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 32*

(C) Given below are some compounds disposed to the draining gutter and the outer atmosphere during laboratory activities in a certain week.

$$Ca(OH)_2,\ K_2Cr_2O_7,\ Na_3PO_4,\ NO_2,\ SO_2$$

Of the above compounds, write the compound which is most relevant to each of the following statement on the dotted line given opposite to them.

(i) Contributes to increase the soil pH value

$Ca(OH)_2$ / calcium hydroxide **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 36*

(ii) Causes an increase in the heavy metal composition in underground water

$K_2Cr_2O_7$ / potassium dichromate **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 81*

(iii) Contributes to create an eutrophication state when accumulated in a water body

Na_3PO_4 / sodium phosphate **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 81*

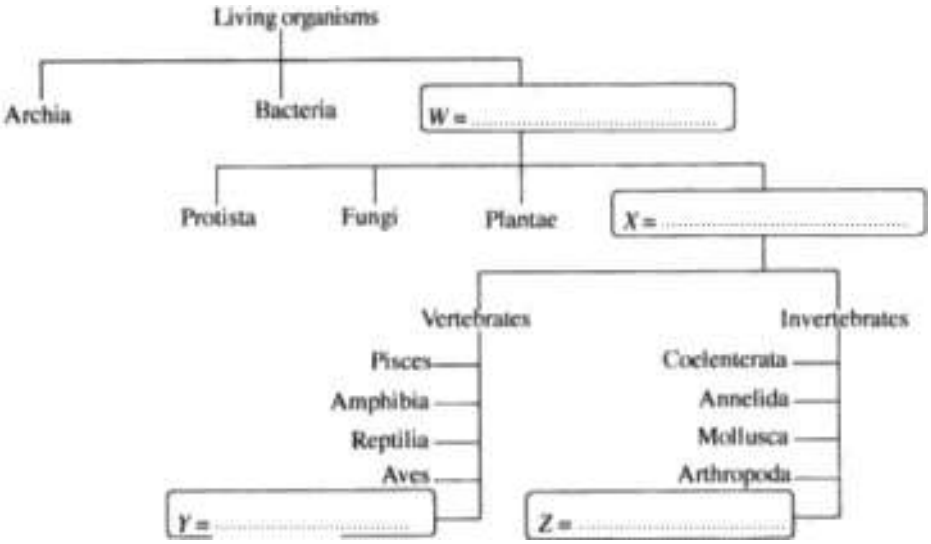
(iv) Contributes to produce photochemical smog as well as acid rain

NO_2 / nitrogen dioxide **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 193*

Question 2 — Classification and photosynthesis

(A) An outline of the classification of living organisms is given below:



Answer the following questions using the above chart.

(i) Complete the above chart by writing the relevant group of living organisms on the dotted line in the boxes W, X, Y and Z.

W = Eukarya (01); X = Animalia (01); Y = Mammalia (mammal) (01); Z = Echinodermata (01) **04**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 25*

(ii) Name the domain to which living organisms **not** sensitive to antibiotics belong.

Archea / Eukarya **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 4*

(iii) To which kingdom do algae belong?

Protista **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 7*

(iv) A characteristic specific to each group of invertebrate animals shown in the above classification chart is given below. Opposite each characteristic, write the group of animals having that characteristic on the dotted line given.

(a) Bearing soft bodies

Mollusca **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 17*

(b) Division of the body into equal segments

Annelida **01**

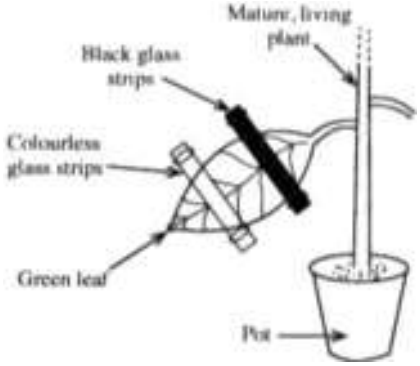
▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 16*

(c) Existing in two forms polyp and medusa

Coelenterata (01) — total **03**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 15*

(B) A set up arranged by a student to study a factor essential for the photosynthetic process is shown in the diagram. This set up was kept in the dark for 48 hours and then was exposed to light for 5 hours. Afterwards the glass strips covering the leaf were removed and the leaf was tested for starch.



(i) To test which factor essential for photosynthesis was this set up used?

light (give marks even for sunlight) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 24*

(ii) What is the reason for keeping the set up in the dark for 48 hours?

to remove starch / to destarch — 02 or 00 **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(iii) Write the colour that can be seen in each of the following parts of the leaf during the test for starch.

Part covered with the black glass strips: .....

Part covered with the colourless glass strips: .....

Part exposed to direct light: .....

Part covered with the black glass strips: (light) yellow / (light) brown **01**

Part covered with the colourless glass strips: purple / blackish blue / violet **01**

Part exposed to direct light: purple / blackish blue / violet (01) — total **03**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 24*

Question 3 — Period 2 elements and calcium compounds

(A) The symbols of the elements in the second period of the Periodic Table are given in the following table in respective order.

Li	**Be**	**B**	**C**	**N**	**O**	**F**	**Ne**

(i) Select the symbol of the element relevant to each of the following statements from the above table and write on the dotted line given opposite.

(a) Has the maximum first ionisation energy

Ne **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 63*

(b) Has the minimum electronegativity

Li **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(c) Diamond is one allotropic (polymorphic) form

C **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(d) Exists as diatomic molecules with a triple bond between the atoms

N **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 177*

(e) Exists as diatomic molecules as well as triatomic molecules in the atmosphere

O (01) — total **05**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(ii) Write the formula of the compound formed by the combination of the elements Li and O.

Li_2O **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iii) From the ions given below, select the cation and anion which the compound formed by the combination of Li and O contains and underline them.

$$Li^+ \; Li^{2+} \; Li_2^{2+} \; O^- \; O^{2-} \; O_2^{2-}$$

Li^+ (01) and O^{2-} (01) underlined **02**

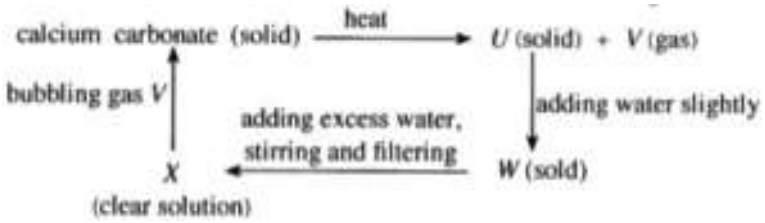
▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(iv) Draw the structure of the simplest monomer molecule which can polymerize and contains only the elements C and F.

$F_2C{=}CF_2$ (tetrafluoroethene): two carbon atoms joined by a double bond, each carbon atom bonded to two F atoms **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 181*

(B) The following flow chart shows a series of reactions carried out starting with calcium carbonate.



When gas V is bubbled through X, the solution turns milky because calcium carbonate is formed as a suspension. This observation is also used as a test to identify gas V.

(i) Write the chemical formulae of the compounds U and W.

U: CaO (01) W: $Ca(OH)_2$ (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 81*

(ii) Delete one word printed in bold so that a correct idea is expressed by each of the following sentences.

(a) Solid U is **acidic** / **basic**.

delete "acidic" (Solid U is basic) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 109*

(b) The bond in the solid U is **ionic** / **covalent**.

delete "covalent" (the bond is ionic) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 187*

(c) The pH value of an aqueous solution of the gas V is **lower** / **higher** than 7.

delete "higher" (the pH is lower than 7) (01) — total **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 109*

(iii) What can be seen when excess of the gas V is bubbled through the milky solution formed by the reaction between X and V?

becomes colourless (give a free mark) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 109*

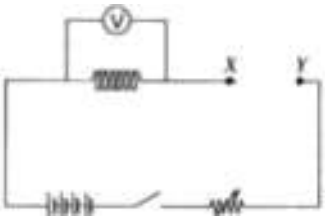
Question 4 — Electric circuits and moments

(A) A teacher provided the following materials and equipment to students.

a nichrome wire coil, four dry cells, an ammeter, a switch, a voltmeter, a rheostat, connecting wire

The Figure shows an incomplete circuit diagram of a set up arranged by those students to examine the relationship between the potential difference between the two ends of the nichrome wire coil and the

electric current flowing through it.



(i) By what name is the way the dry cells are connected to the circuit known?

In series **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 150*

(ii) Draw in the circuit diagram the standard symbol of the equipment that should be connected between the terminals X and Y.

the ammeter symbol (a circle marked A) drawn between X and Y **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 150*

(iii) Why is a rheostat connected to this circuit?

to change or control the current / potential difference / voltage **01**

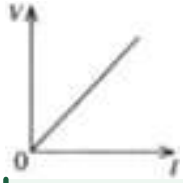
▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 150*

(iv) State a condition that would result if the switch is kept closed for a long time after completing the circuit correctly.

discharging of the battery / heating of the coil / increase in temperature / decreasing the electromotive force of the battery / increase in resistance **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 150*

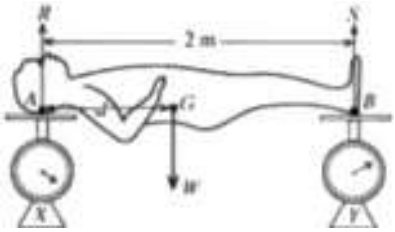
(v) Given here is the graph of V against I drawn using the readings obtained by the experiment. What is the physical quantity represented by the gradient of the graph?



R / resistance **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 150*

(B) The following activity was done by a group of students to find the centre of gravity of a metal statue. The head and the two feet of the statue were placed on the smooth pans of two identical balances X and Y kept on a horizontal floor as shown in the Figure. The reading in balance X was 250 N and the reading in balance Y was 150 N.



(i) What are the forces acting with regard to the equilibrium of the statue?

W / weight / gravitational force (01); perpendicular reaction at A / R (01); perpendicular reaction at B / S (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 204*

(ii) What is the reaction R through the point A and the reaction S through the point B of the statue?

R: 250 N (01) S: 150 N (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 77*

(iii) What is the weight (W) of the statue?

400 N **01**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 77*

(iv) The distance from A to the centre of gravity of the statue G is d. Write the moment of the weight of the statue around point A in terms of d.

W d / 400 (N) × d / weight × d **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(v) What is the moment of the reaction S around point A?

150 N × 2 m / 300 N m	**01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 195*

(vi) The anti-clockwise moment of S around point A is equal to the clockwise moment of weight W around point A. Find the value of d.

400 (N) × d = 300 (N m) / W d = 300 (N m) / d = 300 (N m) ÷ 400 (N)	**01**
d = 0.75 m / ¾ m / 75 cm (01)	**02**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 194*

Paper II • 2018

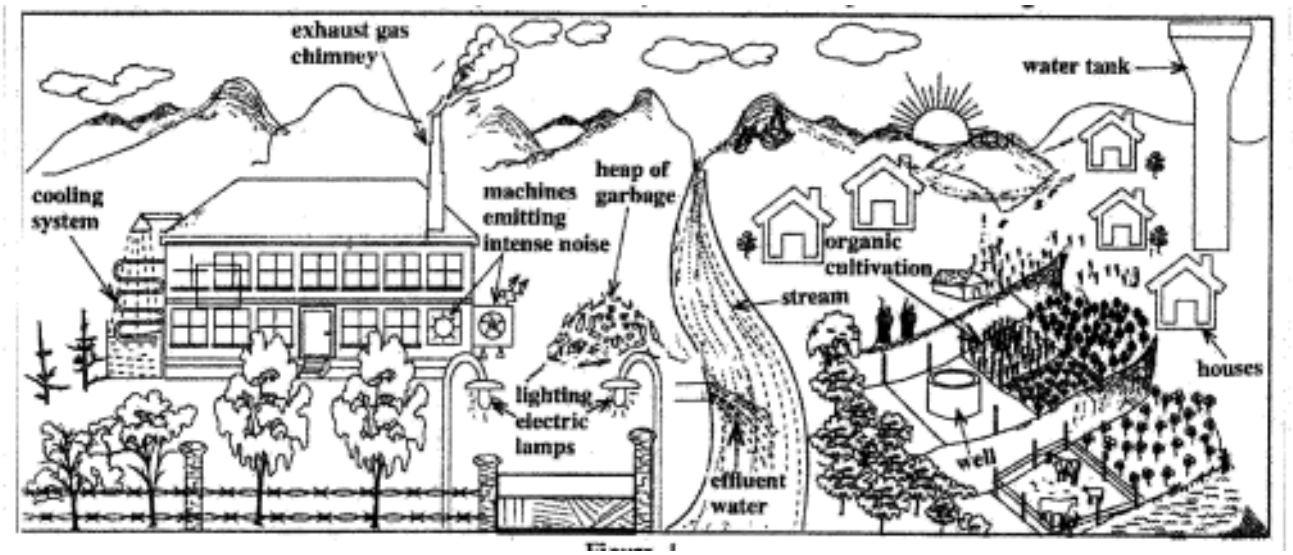
OFFICIAL MARKING SCHEME

Part A • structured essay questions • answer all four • 15 marks each

This paper survives only inside its marking scheme; questions and answers were retyped from it.

Question 1 — A factory and the environment

Figure 1 given below illustrates the setting of a factory located close to a settlement area and its surroundings. A few years after the commissioning of the factory, environmental problems emerged in the area.



(i) State **two** instances in which loss of energy occurs in relation to the factory as illustrated in the Figure.

(a) .....

(b) .....

lighting electrical lamps (during day time) / (machines) emitting intense noise / removing heat (through the cooling system) / burning fuel (unnecessarily) — give marks for any 2 answers **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 14*

(ii) Write **two** problems leading to environmental pollution which may emerge due to this factory.

(a) .....

(b) .....

collecting / dumping garbage in the environment / adding effluent water to the stream / intense noise / sound pollution / emission of exhaust gases to the atmosphere / emitting heat to the environment / thermal pollution — give marks for any 2 answers **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 180*

(iii) A group of students counted once in six months, the number of fish living in a specific area down the stream, and plotted a graph. That growth curve was found to differ from the typical population growth curve and assume the shape shown by letter a in Figure 2.

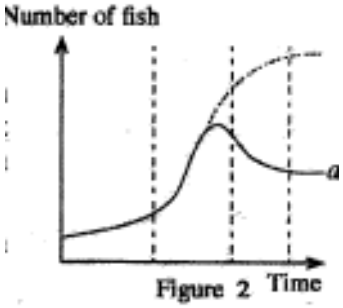


Figure 2

In which phase does the number of fish begin to decrease in the fish population?

high growth phase / exponential phase / phase II **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 170*

(iv) In the stream studied, the factors — **the number of fish, temperature of water** and **the amount of heavy metals added to the stream** — were measured for a period of about four years. Figure 3 shows the result of it. What factor can be given as the nearest cause for the decrease in the fish population as shown in Figure 3?

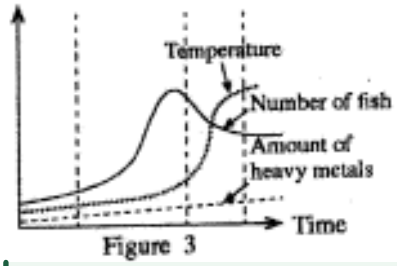


Figure 3

temperature **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 171*

(v) After some time, because of the entry of heavy metals into the blood of the people living in the settlements around the factory, they were subject to nervous disorders. Write schematically, using arrows, the instances of the process in which the heavy metals get into the blood like this.

effluent water → stream → drinking water → blood

effluent water → stream → crop cultivation → food → blood

effluent water → stream → fish → food → blood

effluent water → stream → aquatic plant → food → blood

effluent gases → air → respiration → blood

any one of the above in order **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 199*

(vi) State an importance of maintaining the organic cultivation shown in Figure 1 as a poly-culture.

reducing spreading of pests / reducing spreading of diseases (in the cultivation) / reducing forming pests with high resistance / protecting the nutrient balance in the soil / reducing competition (for resources) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 201*

(vii) Write **two** advantages of applying organic fertilizers for the cultivated land.

(a) .....

(b) .....

increasing the soil texture / ventilating the soil / increasing the retention of water / improving the soil structure / enhancing the activity of soil organisms / favorable condition for soil organisms — 01 mark for each **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 202*

(viii) From time-to-time, the waste products of the factory are sorted out and disposed. When the production of **waste** is high, they are mixed, piled up as **garbage** and disposed at a later stage. What is the advantage of disposing the factory waste separately from time-to-time than disposing them as garbage after mixing and piling up?

waste management is easy / recycling (of waste) is easy / can be reused / reducing environmental pollution — for any one fact **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 180*

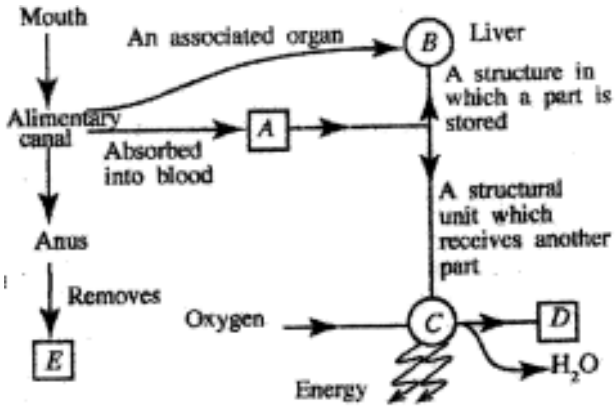
(ix) In controlling the rise in global warming, as personal responsibilities it is important to minimize the environmental indicators such as one's **carbon footprint, water footprint** and **food mileage**. The people in the settlement consume flour made in the factory from cereals imported from abroad. By raising which environmental indicator given above do the people contribute to increase global warming by this practice?

food mileage **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 207*

Question 2 — Nutrition, plants and photosynthesis

(A) The Figure shows a part of a **concept map** prepared incorporating some functions occurring in the human body and the structures relevant to them.



(i) A is a digestive product containing only carbon, hydrogen and oxygen. Name it.

glucose / $C_6H_{12}O_6$ — give marks even for writing monosaccharide or fructose / galactose **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 4*

(ii) State a digestive product absorbed by the lacteal in the alimentary canal without being absorbed into blood.

fatty acids / glycerol **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 148*

(iii) A part of the nutrient A is stored in B (liver). Before this storing, it gets converted into another chemical substance. What is that chemical substance?

glycogen **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 181*

(iv) What structural unit is represented by C?

cell / mitochondrion **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 110*

(v) D is produced as a product of a chemical process taking place in C. What is D?

carbon dioxide / CO_2 **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 109*

(vi) What is the reason for not considering E an excretory product?

not a product of metabolic activities / left overs of undigested food **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 157*

(vii) Four main processes taking place in the body relevant to the above concept map are given in the incomplete flow chart below. Fill in the blank boxes in it.

Digestion of food →	**..... →**	**Transport of digestive products →**	**.....**

absorption (01); cellular respiration / deposition or assimilation (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 154*

(B) The Figure below indicates a part of a dicotyledonous plant with a leaf.



(i) What is the main morphological feature that can be used to identify that this leaf belongs to a dicotyledonous plant?

(reticulate) venation **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(ii) State a morphological feature of the root system of the plant to which this leaf belongs.

having a tap root **01**

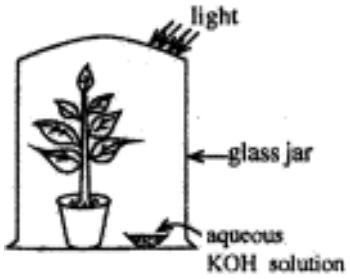
▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(iii) State a morphological feature in which the stem of a monocotyledonous plant differs from the stem of the plant to which this leaf belongs.

unbranched / having a stem with uniform girth **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(C) The Figure indicates an apparatus set up by a student for an experiment conducted with regard to photosynthesis.



(i) Mention the aim of this experiment.

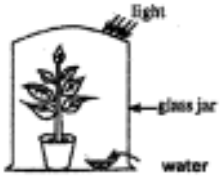
testing whether CO_2 / carbon dioxide is needed for photosynthesis **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 23*

(ii) Draw a labelled sketch of a set-up of a control experiment suitable for this experiment in the given box.

the same set-up with water instead of aqueous KOH solution (glass jar, plant, light, water) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 25*



Question 3 — Gases and the Periodic Table

(A) The following table presents in summarised form, **incomplete** information relevant to the preparation of three gases and tests for their identification. Complete the table using words or correct symbols/formulae as appropriate.

Method of preparation	Substances left in the reaction mixture after the reaction	Test carried out on the gas	Observation	Gas produced
Adding (i) ..... drop-wise on manganese dioxide solid	Water and (ii)	Holding a glowing splint	Glowing splint lighted	(iii) .....
Adding dilute (iv) ..... acid on (v) ..... metal	Zinc chloride aqueous solution	Holding a lighted ekle	(vi)	Hydrogen
Adding dilute sulphuric acid to (vii)	Magnesium sulphate and water	(viii)	(ix)	Carbon dioxide

(i) hydrogen peroxide / H_2O_2 (01) (ii) manganese dioxide / MnO_2 (01) (iii) O_2 / oxygen **01**

(iv) hydrochloric / HCl (01) (v) zinc / Zn (01) (vi) (gas) burns giving 'pop' sound **01**

(vii) magnesium carbonate / $MgCO_3$ (01) (viii) passing the gas through (colourless) lime water / $Ca(OH)_2$(aq) — no marks for $Ca(OH)_2$ only (01) (ix) (colourless) lime water turns milky / white / turbid (01) **09**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 109*

(B) Given here are the symbols of some of the first twenty elements in the Periodic Table and their locations in the Periodic Table.

H							He
Li					O	F	Ne
Na	Mg	Al				Cl	Ar
K	Ca						

(i) Fill in the blanks in the following sentences using the elements given in the Table.

(a) ..... is the element with maximum first ionisation energy.

helium / He **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(b) ..... is the element of highest electronegativity.

fluorine / F **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(c) The electronic configuration of magnesium is ..... .

2, 8, 2 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 60*

(d) The formula of the compound formed by the combination of aluminium (Al) and oxygen (O) is ..... .

Al_2O_3 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(ii) In the following sentences, select the appropriate word, out of the words given within parentheses and **underline** it.

(a) The bond of the compound formed between hydrogen and chlorine is (ionic/covalent/polar covalent).

polar covalent **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 182*

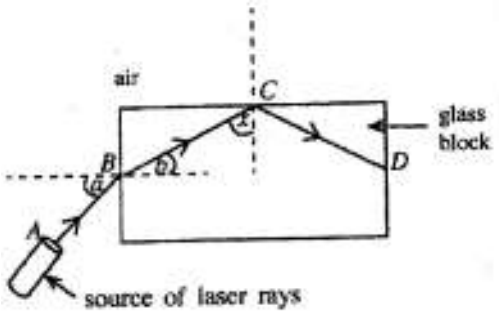
(b) The oxide formed by the combination of aluminium and oxygen is (acidic/basic/amphoteric).

amphoteric **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 73*

Question 4 — Refraction of light and expansion

(A) In an activity related to light, a student placed a glass block on a white paper laid on a horizontal surface. Then, as shown in the Figure, he pointed a laser ray to the glass block along the plane of the paper. The path of the laser ray was marked A B C D.



(i) By what name is the phenomenon known to which the ray is subjected after falling on point B?

refraction **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(ii) Write the names of the following angles in relation to the phenomenon occurring at point B.
Angle a : ..... Angle b : .....

Angle a: angle of incidence (01); Angle b: angle of refraction (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(iii) When the value of the angle 'a' increases, how does the value of the angle 'b' change corresponding to that?

(when (a) increases (b) also) increases **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(iv) According to the Figure, what is the phenomenon to which the ray is subjected at point C?

total internal reflection **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 125*

(v) State a device that adopts the phenomenon you mentioned in (iv) above in modern communication technology.

optic fibre **01**

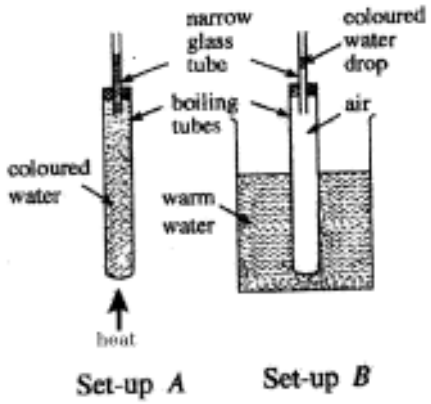
▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 139*

(vi) If the angle between the ray BC and the normal at point C is x, is the angle × equal to, greater than or smaller than the critical angle of the glass-air interface?

x is greater (than the critical angle) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(B) Two sets of apparatus arranged by a student to demonstrate a certain phenomenon related to heat are given here.



(i) What is expected to be demonstrated by each of these set-ups?

Set-up A : .....

Set-up B : .....

Set-up A: (thermal) expansion of a liquid / water **01**

Set-up B: (thermal) expansion of a gas / air (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 20*

(ii) When heated for some time, what changes can be seen in the narrow glass tubes in the above two set-ups?

Set-up A : .....

Set-up B : .....

Set-up A: rising the water level in the tube / goes down slightly and rises up **01**

Set-up B: (coloured) drop of water rises up (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 20*

(iii) By what method is heat transferred across the wall of the boiling tube in set-up B?

(thermal) conduction / radiation **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(iv) The mass of water in the boiling tube and the water in the glass tube connected to it in set-up A was 50 g. Initial temperature of that water was 30 °C. If that mass of water got heated up to 40 °C, calculate the quantity of heat absorbed by water. (Consider the specific heat capacity of water is 4200 J kg^{-1} $°C^{-1}$).

mass of water m = 50/1000 (kg) **01**

amount of heat absorbed Q = mcθ

= 50/1000 (kg) × 4200 (J kg^{-1} $°C^{-1}$) × 10 (°C) **01**

= 2100 J (01) **03**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 12*

Paper II • 2017 (new syllabus)

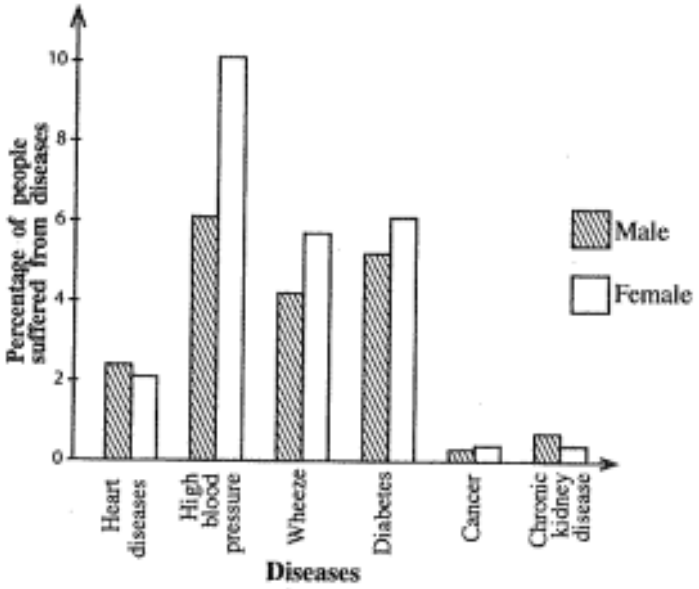
PREPARED ANSWERS (TEXTBOOK-BASED)

Part A • structured essay questions • answer all four • 15 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 1 — Diseases and waste management

The graph given here has been drawn considering several diseases, according to the data gathered from a census carried out recently in Sri Lanka on people who suffered from diseases.



(i) What is the category that all diseases stated in the graph generally belong to?

Non-communicable diseases (NCDs) / lifestyle diseases

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 197*

(ii) Among the diseases given in the graph, from which disease do the most number of people suffer?

High blood pressure

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 198*

(iii) According to the graph, which diseases are males more susceptible in comparison to the females?

Heart diseases and chronic kidney disease (the bars for males are higher than those for females)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 198*

(iv) (a) From the diseases given in the graph, name a disease which has a high tendency to affect the humans by persistent organic pollutants.

Cancer

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 190*

(b) Write **two** special features of persistent organic pollutants.

Not biodegradable, so they remain in the environment for a long time / fat-soluble, so they accumulate in body tissues / biomagnify along food chains / toxic even in small amounts / can be carried over long distances (any two)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 190*

(v) State a fact related to agriculture that is considered as a reason for the chronic kidney disease.

Excessive / improper use of agrochemicals (fertilizers and pesticides), which contaminate drinking water with heavy metals such as cadmium and arsenic

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 199*

(vi) One step that Sri Lanka has taken at present to control people getting subjected to certain diseases is given below.

Introducing a colour code for soft drinks to indicate their sugar content.

Which disease given in the graph is likely to be reduced to a great extent in the coming years due to the above action?

Diabetes

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 197*

(vii) Write **two** bad habits that contribute for getting subjected to cancer.

Smoking / chewing betel with tobacco / drinking alcohol / eating processed or fast food containing additives / lack of exercise (any two)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 197*

(viii) Many diseases can be prevented by keeping the environment clean. Some items found in school environment which may cause environmental pollution are given below.

Broken test tubes, Plastic bottles, Batteries, Pen tubes, Fluorescent bulbs, Envelopes, Filter papers

Classify the above items into **four** categories based on appropriate criteria, to make the waste management convenient for their disposal.

Glass – broken test tubes

Plastic – plastic bottles, pen tubes

Paper – envelopes, filter papers

Hazardous waste / e-waste – batteries, fluorescent bulbs

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 208*

Question 2 — Vertebrates and photosynthesis

(A) Based on the structural features, vertebrates are classified into five groups. Consider the following table prepared in relation to it.

Vertebrate group	Pisces	A	B	Aves	C
Examples	Sea horse, Skate	Toad, Salamander	Tortoise, Cobra	Jungle fowl, Parrot	Bat, Whale

(i) Name the vertebrate groups **A**, **B** and **C**.

A : ..... B : ..... C : .....

A – Amphibia; B – Reptilia; C – Mammalia

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 19*

(ii) Name **two** cold blooded animals mentioned in the table.

Sea horse / skate / toad / salamander / tortoise / cobra (any two)

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(iii) To which vertebrate group stated in the table do the humans belong?

Mammalia

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 19*

(iv) Write **two** specific features related to flying, that belongs to vertebrates in Aves group.

Forelimbs modified into wings / body covered with feathers / light, hollow (pneumatic) bones / streamlined body / air sacs connected to the lungs (any two)

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(B) You are assigned to show experimentally, that oxygen gas is produced during photosynthesis.

(i) You are provided with the equipment and materials given below for the apparatus set-up relevant to the experiment. Draw a rough sketch of the set-up that you make using the given equipment.

A beaker, A boiling tube, A glass funnel, A hydrilla plant, Water

Sketch: a hydrilla plant placed in a beaker of water and covered with an inverted glass funnel; a boiling tube completely filled with water is inverted over the stem of the funnel (stem of the funnel below the water level).

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 27*

(ii) Write an observation that can be made when the set-up is exposed to sunlight.

Gas bubbles are released from the plant and collect at the top of the boiling tube (the water level in the tube falls)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 102*

(iii) How would you confirm that the gas produced during this experiment is oxygen?

Introduce a glowing splinter into the gas collected; it rekindles (bursts into flame)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(iv) Write the balanced chemical equation for the photosynthesis process.

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ (in the presence of light and chlorophyll)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

Question 3 — Period 2 elements and oxygen

(A) All the elements belonging to the second period of the periodic table are given below without following the correct order.

B Li C Be Ne F O N

(i) Arrange all the above elements as in the periodic table.

Li, Be, B, C, N, O, F, Ne

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(ii) Write the electronic configuration of F.

2, 7

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iii) (a) Write the chemical formula of the compound which is formed in the reaction between Li and O.

Li_2O

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(b) What is the type of chemical bond present in the compound stated in (a) above?

Ionic bond / electrovalent bond

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iv) In the given box, draw the **Lewis structure** of CO_2 molecule which is formed with the combination of one C atom and two O atoms.

O=C=O with two shared electron pairs (a double bond) between the C atom and each O atom; each O atom also carries two lone pairs of electrons (no lone pairs on C)

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(v) Diamond and graphite are main allotropic forms of C. Which of these allotropic forms conduct electricity?

Graphite

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 71*

(vi) From the elements in this period, write respectively, the element which has the lowest first ionization energy and the element which has the highest electronegativity.

Lowest first ionization energy – Li; highest electronegativity – F

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(B) The following questions are based on an experiment on producing a sample of oxygen gas in the laboratory.

(i) Among the compounds given below, which compound can be used to produce oxygen gas?
$CaCO_3$, $KMnO_4$, $MgSO_4$: .....

$KMnO_4$ / potassium permanganate

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 105*

(ii) What is the type of reaction that takes place during the production of oxygen gas when only the compound you stated above is used?

Decomposition (thermal decomposition) reaction

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 89*

(iii) Which equipment must be used to place the compound to carry out the experiment?

A boiling tube / hard-glass test tube (which is heated)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

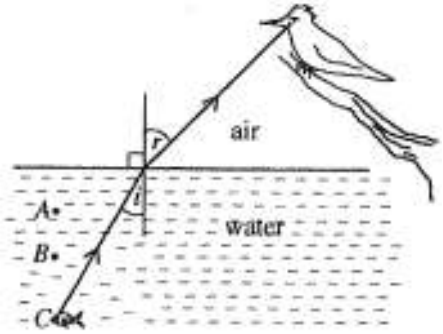
(iv) What is the name given to the method that is used in the laboratory, to collect oxygen gas produced in this experiment?

Downward displacement of water / collecting over water

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

Question 4 — Refraction and electronic devices

(A) The figure shows a ray diagram relevant to a situation in which a fish in a pond is viewed by a kingfisher.



(i) Name the angles i and r shown in the ray diagram.

i - ..... r - .....

i – angle of incidence; r – angle of refraction

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 138*

(ii) **Considering the two media** in the figure, state what is given by the constant sin i / sin r.

The refractive index of air with respect to water (for light passing from water into air) / 1 ÷ refractive index of water

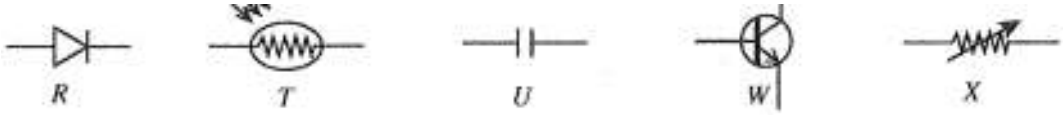
▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 123*

(iii) Of the three positions A, B and C, at what position does the fish appear to the kingfisher?

B (the fish appears raised, on the backward extension of the refracted ray)

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 126*

(B) The standard symbols for some devices used in circuits are given below, labelled as R, T, U, W and X.



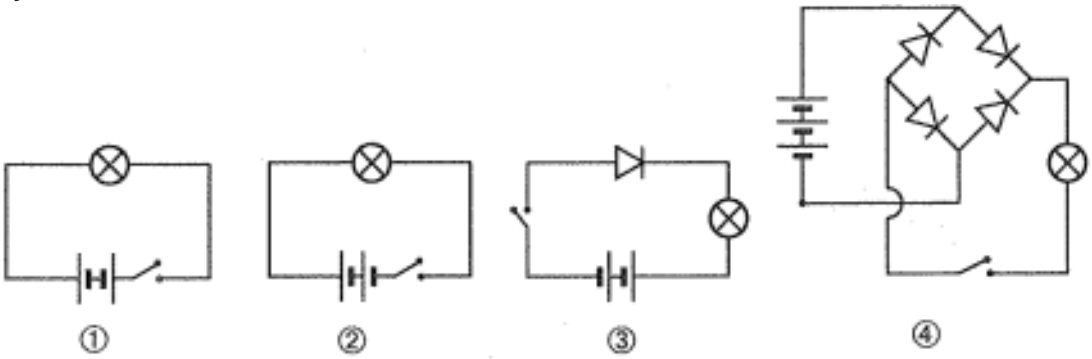
(i) Name the devices relevant to T, W and X.

T : ..... W : ..... X : .....

T – light dependent resistor (LDR); W – transistor (n-p-n); X – variable resistor (rheostat)

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 160*

(ii) Four circuits constructed in the laboratory are given below as ①, ②, ③ and ④ with standard symbols. Cells of 1.5 V, Bulbs of 2.5 V, identical diodes and switches have been used in the circuits.



(a) State in the table below, whether the bulb lights up or does not light up when the switches in the circuits are closed,

Circuit	Bulb lights up / Bulb does not light up
①	.....
②	.....
③	.....
④	.....

① does not light up; ② lights up; ③ does not light up (diode is reverse biased); ④ lights up (bridge rectifier)

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 149*

(b) Write down, relating to potential difference, the conclusion that can be reached through your observations in ① and ② in (a) above.

When two cells are connected with like terminals together (①) their potential differences cancel (0 V); when connected in series, positive to negative (②), their potential differences add up (3 V), which is enough to light the bulb

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 149*

(c) Removing the battery in the circuit ④ above and instead, an alternating voltage of suitable value is connected and the switch is closed. The wave pattern relevant to the input in this circuit is given in figure (a). Draw the corresponding output wave pattern in figure (b).

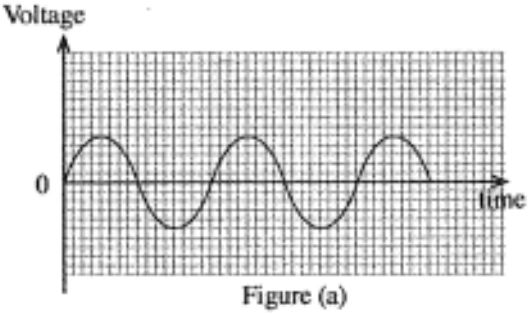


Figure (a)

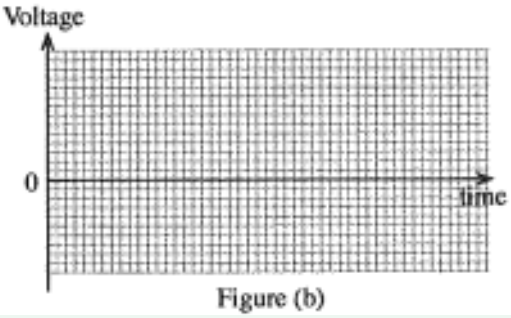


Figure (b)

Full-wave rectified output: the negative half-cycles are turned upwards, so the graph is a continuous series of positive humps (all above the time axis, same height and width as the input half-cycles, no gaps)

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 61*

(d) From the devices T, U, W and X, which can be used to smoothen the output current in the new circuit relevant to (c) above?

U – the capacitor

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 71*

Paper II • 2017 (old syllabus)

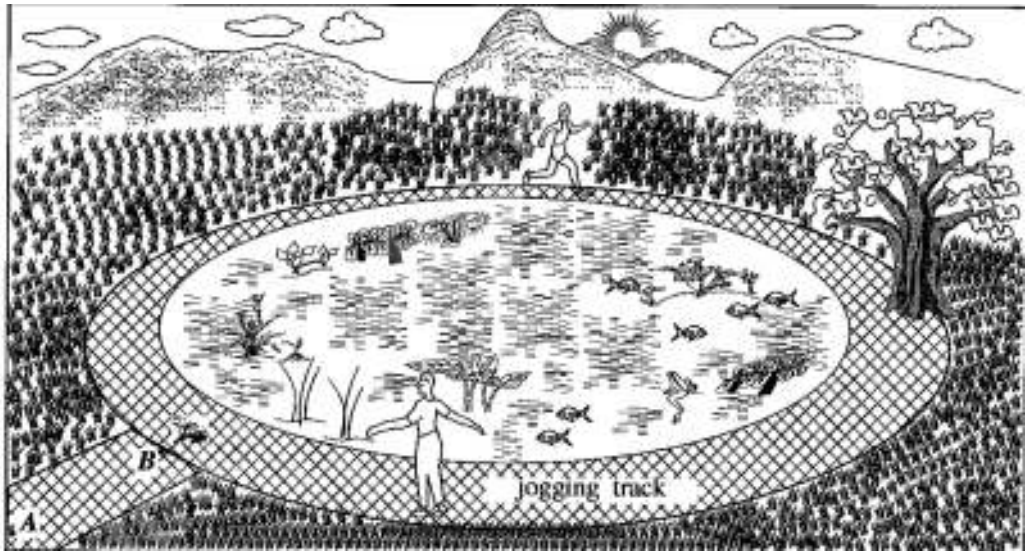
PREPARED ANSWERS (TEXTBOOK-BASED)

Part A • structured essay questions • answer all four • 15 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 1 — Pond ecosystem, water quality and motion

The following figure shows a fresh water pond with a jogging track. Grass is grown around the jogging track. (Figure is not drawn to correct scale.)



(i) Several ecosystems can be seen in the above diagram. Name them.

Fresh water pond (aquatic) ecosystem; grassland ecosystem

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 172*

(ii) Write down a food chain that can exist in the above environment.

grass → grasshopper → frog → snake / aquatic plants (algae) → small fish → kingfisher (any correct food chain)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 173*

(iii) Following information were revealed when a sample of water of the fresh water pond was tested.

- $CaSO_4$ is dissolved in water.
- The BOD value of water is less than 1 ppm.

According to the information above,

(a) I. what can be said about the hardness of the water in the pond?

The water is permanently hard (hardness due to $CaSO_4$ is not removed by boiling).

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 25*

II. which type of ions is responsible for the hardness of water here?

Calcium ions / Ca^{2+}

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 94*

(b) what can be said about the purity of the water in the pond?

BOD is less than 1 ppm, so the water is clean / pure, with very little organic pollution.

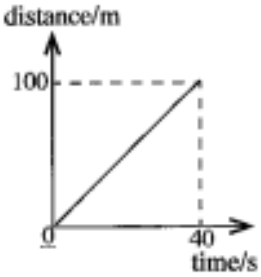
▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 25*

(c) what is meant by BOD?

BOD (biochemical oxygen demand) is the amount of dissolved oxygen used by micro-organisms to decompose the organic matter present in a sample of water (usually measured in ppm over 5 days at 20 °C).

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 58*

(v) The distance – time graph for the motion of a person in a straight line from A to B in the jogging track is given here. Accordingly,



(a) what is the length of AB?

AB = 100 m

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 39*

(b) find the speed of the person that walked from A to B.

speed = distance ÷ time = 100 m ÷ 40 s

= 2.5 m s^{-1}

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 47*

Question 2 — Reproduction and transpiration

(A) If each of the following statements is correct, mark (✓) and if it is incorrect mark (X) in the bracket given in front of each of them.

(i) Gametes are formed in the asexual reproduction. (.....)

(X) — gametes are not formed in asexual reproduction

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(ii) Fertilization takes place in the uterus of the female reproductive system. (.....)

(X) — fertilization takes place in the fallopian tube (oviduct)

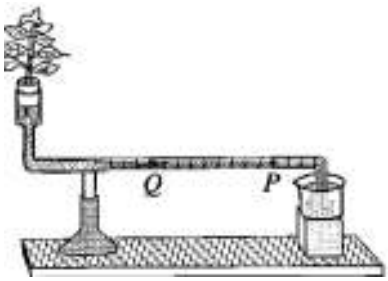
▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 51*

(iii) Secondary sexual characteristics of males are caused by testosterone hormone. (.....)

(✓)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 47*

(B) The following figure shows an experimental set-up that is arranged to measure the rate of transpiration of a plant.



(i) Mention the name of this instrument?

Potometer

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 60*

(ii) (a) What is the strategy that must be followed when the twig of the plant used for this experiment is cut?

The twig is cut under water and fixed to the apparatus under water.

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 32*

(b) What is the reason for following the strategy stated in (a) above?

To prevent air entering the xylem vessels, which would break / block the water column.

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 120*

(iii) What is the other instrument that is needed to find the rate of transpiration in this experiment?

A stop watch (clock)

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 31*

(iv) Considering the movement of the air bubble from P to Q in the horizontal tube, write down the equation used to calculate the rate of transpiration.

Rate of transpiration = distance moved by the air bubble from P to Q ÷ time taken

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 136*

(v) Write **two** factors that affect the rate of transpiration.

Any two: light intensity; temperature; humidity of the air; wind speed; availability of water in the soil

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 102*

(vi) Write down an adaptation in each of the following plants to minimize the transpiration.

Rubber: .....

Temple tree (Araliya/Alari): .....

Aloe: .....

Rubber: sheds its leaves during the dry season

Temple tree: sheds its leaves (in the dry season) / leaves have a thick waxy cuticle

Aloe: thick, fleshy (succulent) leaves with a thick cuticle and few / sunken stomata

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 5*

Question 3 — Solutions and solubility

Different type of mixtures can be prepared using different solutes and solvents.

(i) In the table below the **column I** consists of some solutes and the **column II** consists of some solvents. Match each of the solute in **column I** with a suitable solvent in **column II**, to prepare homogenous mixtures. (One matching is shown: Sodium hydroxide → Water)

Column I	Column II
Sodium hydroxide	Ethyl alcohol
Sulphur	Kerosene
Iodine	Water
Grease	Carbon disulphide

Sulphur → Carbon disulphide; Iodine → Ethyl alcohol; Grease → Kerosene

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 38*

(ii) Of the solvents in **column II**,

(a) name a polar organic solvent .....

Ethyl alcohol

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 38*

(b) name a non-polar inorganic solvent .....

Carbon disulphide

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 38*

(iii) Write **two** factors which affect the solubility.

Any two: temperature; nature of the solute; nature of the solvent; pressure (for gases)

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 37*

(iv) 40 g of sodium hydroxide is dissolved in a 2.0 dm^3 of sodium hydroxide solution. Find the composition of that solution in terms of

(a) mass/volume (w/v)

40 g ÷ 2.0 dm^3 = 20 g dm^{-3}

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 45*

(b) mole/volume (n/v) (Na = 23, O = 16, H = 1)

Molar mass of NaOH = 23 + 16 + 1 = 40 g mol^{-1}; amount = 40 g ÷ 40 g mol^{-1} = 1.0 mol

concentration = 1.0 mol ÷ 2.0 dm^3 = 0.5 mol dm^{-3}

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 43*

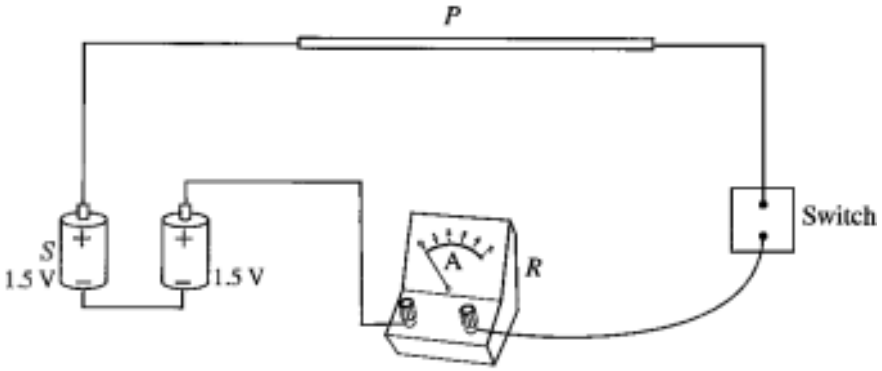
(v) What is the reason for evolving air bubbles when heating water?

The solubility of gases (dissolved air) in water decreases as the temperature rises, so the dissolved air escapes as bubbles.

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 39*

Question 4 — Resistance of a nichrome wire

A circuit prepared by a student to find the resistance of a nichrome wire called P of 2 cm long is given in the figure.



(i) Draw the standard circuit symbols relevant to the devices given as R and S.
R: ..... S: .....

R — ammeter: a circle with the letter A inside

S — cell: a long thin line (+ terminal) and a short thick line (– terminal)

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 145*

(ii) There is an error in the circuit. State what it is.

The two cells are connected with like terminals together (+ to +), so their e.m.f.s oppose each other (net voltage zero).

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 152*

(iii) How do you correct the error of the circuit?

Connect the positive terminal of one cell to the negative terminal of the other, i.e. connect the cells in series.

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 83*

(iv) (a) If the current through the corrected circuit was 1.5 A, find the resistance of the wire P. (Take the data given in the figure for the calculation.)

V = 1.5 V + 1.5 V = 3.0 V

R = V ÷ I = 3.0 V ÷ 1.5 A = 2 Ω

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 153*

(b) Write **two** factors that affect the resistance of a conductor.

Any two: length; cross-sectional area; type of material (resistivity); temperature

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 153*

(v) The resistance of a nichrome wire of 6 cm long is 6 Ω. It is necessary to make a resistor with the equivalent resistance of 1.5 Ω by using the wire P above and 6 cm nichrome wire, and that resistor must be connected to the circuit.

(a) Show using a suitable calculation, the way of obtaining the equivalent resistance as 1.5 Ω according to the resistance of these wires.

Wire P = 2 Ω and the 6 cm wire = 6 Ω connected in parallel:

1/R = 1/2 + 1/6 = 4/6, so R = 6/4 = 1.5 Ω

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 162*

(b) How would you connect the two wires to the above circuit to make the equivalent resistance 1.5 Ω?

Connect the two wires in parallel (side by side, both ends joined) in place of P in the circuit.

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 162*

Paper II • 2016

PREPARED ANSWERS (TEXTBOOK-BASED)

Part A • structured essay questions • answer all four • 15 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 1 — Environmental pollution

Ozone layer depletion, global warming, eutrophication, biomagnification and acid rains are a few direct effects of environmental pollution.

(i) What is meant by biomagnification?

The increase in the concentration of a persistent (non-biodegradable) toxic substance such as DDT or mercury in the bodies of organisms at each higher trophic level of a food chain

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(ii) What is the function of the ozone layer?

It absorbs most of the harmful ultraviolet (UV) radiation coming from the Sun

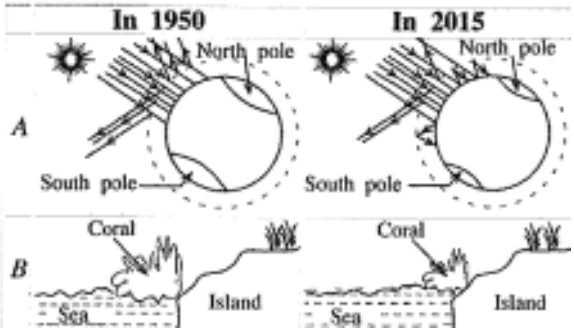
▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 192*

(iii) During the past century, the sea level has risen by about 10-20 cm. Which of the above effects was directly responsible for this?

Global warming (melting of polar ice and thermal expansion of sea water)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 192*

(iv) Consider the figures A and B. (These are rough diagrams.)



(a) State which of the above **two** effects are shown by A and B.

A: .....

B: .....

A – ozone layer depletion (thinning of the ozone layer over the poles); B – global warming (rising sea level submerging the coral island)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 192*

(b) State **two** gases responsible for B and state **one** method for each that releases each of these gases. (Write the relevant method in front of the name of the gas.)

CO_2 – burning fossil fuels / deforestation

CH_4 – decay of organic matter / paddy fields / cattle farming

N_2O – excess use of chemical fertilizers; CFCs – refrigerators, air conditioners, aerosol sprays (any two gases with a method each)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(v) Some solid waste material responsible for environmental pollution are as follows.

Florescent lamps, polythene, chemical fertilizers, detergents, animal excretory matters

(a) Of the above, state a material which causes eutrophication.

Chemical fertilizers / detergents / animal excretory matters (any one)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(b) From which of the above materials, mercury could mostly be released to the environment?

Florescent lamps

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(c) For which of the 4R waste handling techniques can each of the following activities be considered as an example?

I. Use of organic fertilizer instead or chemical fertilizer: .....

Replace (using an eco-friendly substitute)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 209*

II. Production of biogas using animal excretory matter: .....

Recycle

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(vi) Write down **two** renewable energy resources which are eco-friendly.

Solar energy / wind energy / hydropower / biomass (biogas) / tidal energy / geothermal energy (any two)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 209*

Question 2 — Invertebrates and respiration

(A) Invertebrates are separated into phyla based on their features.

(i) In the second column of the table given below, state the phylum which has each of the features indicated as a, b, c and d in the first column.

Feature	Phylum
a - Multicellular body build up of two germinal layers	.....
b - Presence of a muscular foot	.....
c - Living only in marine habitats	.....
d - Presence of a chitinous cuticle	.....

a – Cnidaria (Coelenterata); b – Mollusca; c – Echinodermata; d – Arthropoda

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 15*

(ii) Name an animal that possesses the feature (a) given in the above table.

Hydra / jellyfish / sea anemone / coral (any one)

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 15*

(iii) Write down the kingdom and domain to which the phyla stated in (i) above belong.
Kingdom: ..... Domain: .....

Kingdom – Animalia; Domain – Eukarya

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 3*

(B) Respiration is a process of living organisms.

(i) (a) State the **two** types of respiration that can takes place in organisms.

Aerobic respiration and anaerobic respiration

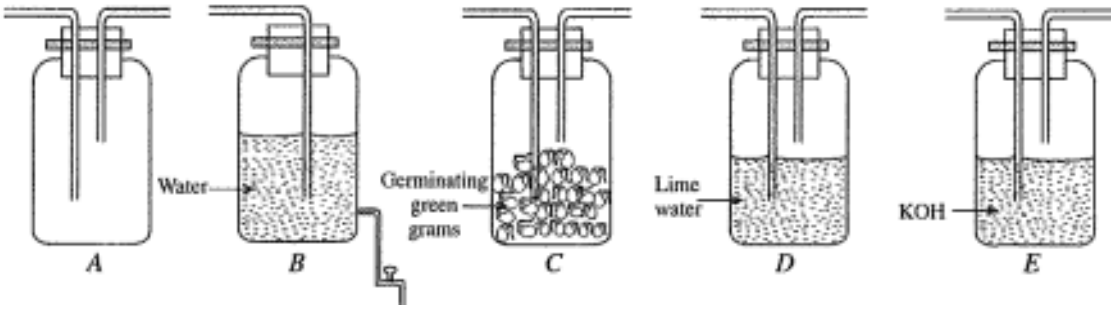
▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 154*

(b) Which one of the two types of respirations stated in (a) above produces more energy?

Aerobic respiration

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 154*

(ii) The apparatus needed to arrange a set-up to show experimentally, that carbon dioxide gas is released during the respiration are given below without a sequential order.



(a) What is the solution that should be put into the bottle A?

Lime water

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 108*

(b) After putting the relevant solution into the bottle A, write down the correct sequence in which the above bottles (A, B, C, D and E) should be connected.

E → D → C → A → B (KOH → lime water → germinating seeds → lime water → water bottle / aspirator)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 108*

(c) State what should be done after connecting all the bottles correctly.

Open the tap of bottle B so that water flows out slowly, drawing air through the whole set-up

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(d) After the step mentioned in (c) above, state the change that could be observed in the set-up.

Lime water in D remains clear (CO_2 in the air is removed by KOH), but lime water in A turns milky (CO_2 released by the germinating seeds)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 108*

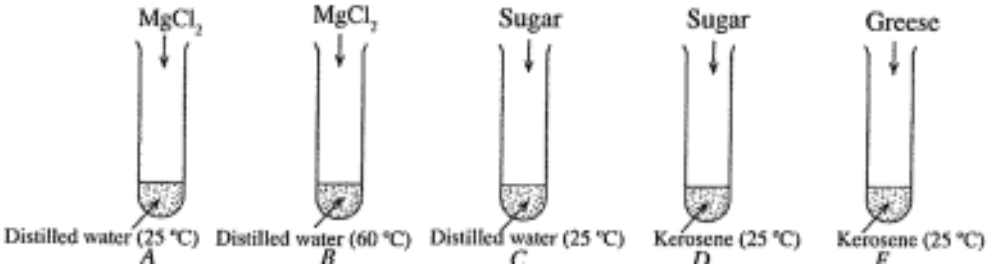
(e) State the change that should be done to the above set-up to arrange a control set-up relevant to the above experiment.

Replace the germinating seeds in C with boiled (dead) seeds, keeping everything else the same

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

Question 3 — Solutions and solubility

As shown in the following figures, $MgCl_2$, sugar and grease are added to the test tubes A, B, C, D and E. After that the substances in the tubes are stirred well.



(i) (a) In which test tube a solid-liquid heterogeneous mixture is formed?

D

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 34*

(b) Write respectively, the solute and the solvent in this mixture.

Solute – sugar; solvent – kerosene (sugar does not dissolve in kerosene, so a heterogeneous mixture forms)

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 37*

(ii) (a) Define 'solubility of a solute'.

The maximum mass of the solute that dissolves in a given amount of solvent (e.g. 100 g) at a given temperature to form a saturated solution

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 36*

(b) What factor that affects the solubility can be shown by each of the following pairs of test tubes?

I. A and B:

Temperature

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 37*

II. C and D:

Nature of the solvent

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 37*

III. D and E:

Nature of the solute

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 37*

(iii) In the above experiment, 1.9 g of $MgCl_2$ was added to the tube A and the total volume of the solution formed was 10 cm^3.

(a) Find the number of moles of $MgCl_2$ added. (Mg = 24, Cl = 35.5)

Molar mass of $MgCl_2$ = 24 + 2 × 35.5 = 95 g mol^{-1}

Number of moles = 1.9 g ÷ 95 g mol^{-1} = 0.02 mol

▸ *Textbook: Science Grade 10 Part I, Unit 7 Quantification of elements and compounds, page 132*

(b) Calculate the concentration of $MgCl_2$ in the solution.

Volume = 10 cm^3 = 0.01 dm^3

Concentration = 0.02 mol ÷ 0.01 dm^3 = 2 mol dm^{-3}

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

(iv) Water is a good solvent. Write **two** special properties possessed by water due to the intermolecular forces.

High boiling point / high specific heat capacity / high surface tension / ice is less dense than water (water expands on freezing) (any two — due to hydrogen bonds)

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 183*

Question 4 — Waves and sound

Consider the following types of waves.

Ultraviolet rays, Infra-red rays, Micro waves, X-rays, Gamma rays, Visible light, Sound waves, Ultrasound waves

(i) Of the above waves, mention a wave that propagates with compressions and rarefaction.

Sound waves / ultrasound waves

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(ii) Write down a special characteristic of ultrasound waves.

Frequency is above 20 000 Hz, so they cannot be heard by humans / they reflect well and travel in straight lines

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(iii) In the field of medicine, which type of the above waves is generally used to observe the conditions of the fetus inside the womb of a pregnant mother?

Ultrasound waves

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(iv) A part of the electromagnetic spectrum is given below.

A	**B**	**Visible Light**	**Ultraviolet rays**	**C**	**Gamma rays**

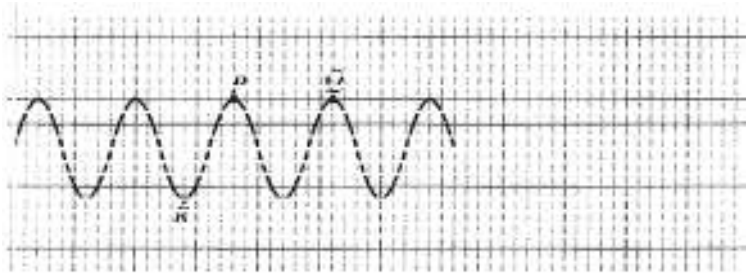
(a) Considering the sequence of above waves, write down the types of waves that should be in the places A, B and C.

A: ..... B: ..... C: .....

A – micro waves; B – infra-red rays; C – X-rays

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(b) A waveform relevant to Gamma rays is given below.



I. By which name the point R of the wave can be identified?

Trough

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

II. Which physical quantity of the wave is equal to the distance between the points P and Q of the wave?

Wavelength

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

III. Considering the features of the waveform given above for Gamma rays, draw a typical waveform in the following grid, for the type of waves represented by C in the spectrum above when the amplitudes are equal.

A wave with the same amplitude as the gamma-ray wave but with a longer wavelength (fewer complete waves across the same width of the grid), since X-rays have a lower frequency than gamma rays

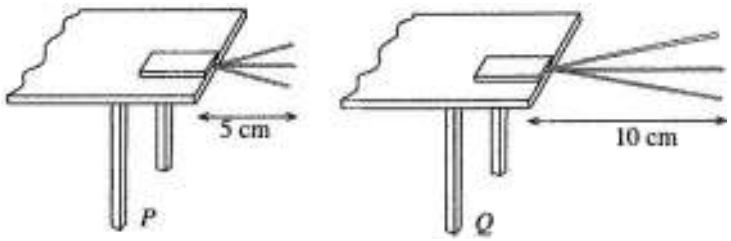
▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

IV. Of the six waves given in the electromagnetic spectrum above, which wave has the highest frequency?

Gamma rays

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(v) A diagram depicting two instances P and Q of an activity done in the laboratory to study a certain characteristic of sound waves is given below. A hacksaw blade is kept on the table and a heavy metal block is kept on the blade when this activity was done as shown in the figure. Then the blade was vibrated.



(a) Which characteristic of a sound wave can be studied from this activity?

Pitch

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(b) On which physical quantity does the characteristic you mentioned (a) above depend?

Frequency (of vibration)

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(c) What conclusion can be arrived at through this activity?

The shorter the vibrating length, the higher the frequency and so the higher the pitch (P gives a higher pitch than Q)

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

(vi) How does the speed of sound in air vary with the temperature?

The speed of sound in air increases as the temperature increases

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 82*

Paper II • 2015 (old syllabus)

OFFICIAL ANSWERS: EVALUATION REPORT

Part A • structured essay questions • answer all four • 15 marks each

Question 1 — The coast and the ocean

A coastal area of Sri Lanka in the Indian Ocean is given in the following figure.



(i) (a) As shown in the figure, the coconut trees which grow closer to the coast, bend towards the ocean as a result of a particular tropic movement. Identify that tropic movement and write the stimulus relevant to it.

Tropic movement : ..... Stimulus: .....

[Facility: 36 % of candidates answered correctly]

Tropic movement: Positive (+) phototropic (01) Stimulus: Light / Sun light (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 62*

(b) The animals given in the table live in the Indian ocean and its coastal areas. State the phylum of each of those animals.

Animal	Phylum
Sea anemone	.....
Rag worm	.....

[Facility: 61 % of candidates answered correctly]

Sea anemone: Coelenterata / Cnidaria (01) Rag worm: Annelida (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 15*

(ii) The valuable mineral Ilmenite is contained in the sand of the ocean.

(a) Out of the coastal areas in Sri Lanka, name an area which has Ilmenite in abundance.

[Facility: 21 % of candidates answered correctly]

Pulmudai / North of Trincomalee / Kaluwella (in Galle) / Nilaweli **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 198*

(b) Name an industry in Sri Lanka, which uses Ilmenite.

[Facility: 5 % of candidates answered correctly]

Paper industry / paint industry / pigment production **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 64*

(iii) Sodium metal is extracted from sea water. Name the method which is used to extract sodium metal and mention the reason for using that method.

(a) Method: .....

[Facility: 29 % of candidates answered correctly]

Electrolysis (of fused Sodium Chloride / fused NaCl) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 89*

(b) Reason: .....

[Facility: 18 % of candidates answered correctly]

exist the top of the activity series / reactivity of sodium is very high **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 99*

(iv) Which type of mechanical waves do the small water waves formed on the surface of the ocean belong?

[Facility: 54 % of candidates answered correctly]

Transverse waves **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 74*

(v) A ship sailing in the Indian ocean is in the figure above.

(a) The mass of the ship is 75 000 kg. When the ship floats in still water of the ocean, what is the upthrust acting on it? (Take the acceleration due to gravity as 10 m s^{-2})

[Facility: 44 % of candidates answered correctly]

(75 000 kg × 10 m s^{-2}) = 750 000 (N) or = 7.5 × 10^5 (N) / 75 × 10^4 (N)

Give marks only for the final answer **01**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 76*

(b) Items made of iron having a small volume sink in water, but the ships made by the same material float in the ocean. State the reason for this.

[Facility: 8 % of candidates answered correctly]

To have a larger volume, ship has been made with a large hollow **01**

The upthrust acting on the ship / the weight of the water displaced by the ship is equal to the weight of the ship. (01) Therefore the ship floats in water. **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 76*

(vi) (a) Pollution of ocean and its environment is a major problem faced by our country at present. Mention **two** reasons which influence this environmental pollution.

[Facility: 65 % of candidates answered correctly]

Mixing oil removed by ships, with water / Using dynamite for fishing / Industrial waste water being added to sea water / Mixing detergents to sea water / Mixing agro-chemicals with sea water through rivers / Poluthene / plastic / garbage / faecal matter being added with environment associated with ocean / Breaking coral deposits / Unauthorized construction adjoining the coastal belt

Give marks for two acceptable reasons as above **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 181*

(b) State a suggestion that can be implemented for the conservation of the ocean and its coast.

[Facility: 62 % of candidates answered correctly]

Protect mongroove environment / Avoid unsystematic constructions / Releasing waste water after purifying / Banding sand mining from estuaries / Enforcement of rules and regarding coastal conservation / Awareness of the community about coastal conservation

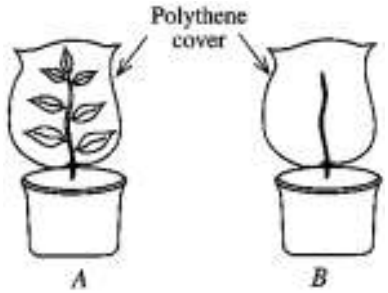
Give marks for two acceptable reasons as above **01**

Total marks 15

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 180*

Question 2 — Transpiration and the Sinharaja forest

(A) The two setup A and B arranged by grade 10 students of a school to demonstrate that transpiration in plants take place mainly by leaves are given here. They kept the two setup in the sun for 5 hours and took down the observations.



(i) Mention the observations which confirms the transpiration takes place mostly from leaves.

[Facility: 28 % of candidates answered correctly]

More water / liquid droplets collected in the (inner surface of the) polythene cover in A **01**

Less amount of water / liquid droplets collected in the (inner surface of the) polythene cover in B **01**

or: More water droplets in polythene cover A rather than B **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 34*

(ii) From which structure in the leaves does transpiration mostly take place?

[Facility: 52 % of candidates answered correctly]

Stomata **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 214*

(iii) What is the transpiration which takes place in setup B called?

[Facility: 25 % of candidates answered correctly]

Lenticel transpiration / Cuticular transpiration **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 27*

(iv) From the above two setup, what is the setup relevant to the control experiment?

[Facility: 41 % of candidates answered correctly]

B / setup without leaves **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 22*

(v) After removing the polythene cover in A above, upper and lower surfaces of a part of a leaf were covered with two dry cobalt chloride papers. After that, the two cobalt chloride papers were covered with 2 glass slides and tightened with clips and kept for some time.

(a) State the observations made in this situation.

[Facility: 13 % of candidates answered correctly]

The pink colour of the cobalt chloride at the lower surface is more than that of upper surface / The cobalt chloride paper of the lower surface turns pink colour first **02**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 13*

(b) What is the conclusion that could be arrived at through the observation?

[Facility: 22 % of candidates answered correctly]

Transpiration occur through the lower surface more than the upper surface / The lower surface has more stomata **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 24*

(B) A group of students who visited Sinharaja forest, prepared a list of plants and animals observed by them. A part of that list is given below.

P – A species of mushroom that grew on a decaying log
Q – Orchid plants with flowers which grew on trees
R – Snails on branches of a tree covered with mosses.
S – A coucal (Atikukula/Shenbagam), perched on a branch of a tree
T - A cobra moving on the ground

(i) How does the mushroom stated in P, fulfil its nutrition requirements?

[Facility: 59 % of candidates answered correctly]

Absorbing the materials from the log by converting complex materials to simple materials / decomposition or from the decaying log or from the log that the mushroom grown **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 168*

(ii) Mention an adaptation shown by orchid flowers to prevent self pollination.

[Facility: 10 % of candidates answered correctly]

Hercogamy / having the stamens and stigma away from each other **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 38*

(iii) (a) By considering the above list, write down a food chain which can exist in the Sinharaja forest.

[Facility: 43 % of candidates answered correctly]

Mosses → Snail → Coucal or Orchid → Snail → Coucal

Give marks for the 'plant' instead of first link; give marks for the 'cobra' as the fourth link **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 177*

(b) In that food chain, who is the first level consumer?

[Facility: 53 % of candidates answered correctly]

Snail **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 173*

(iv) What is the method of biodiversity conservation, used for the conservation of an ecosystem such as Sinharaja forest, called?

[Facility: 22 % of candidates answered correctly]

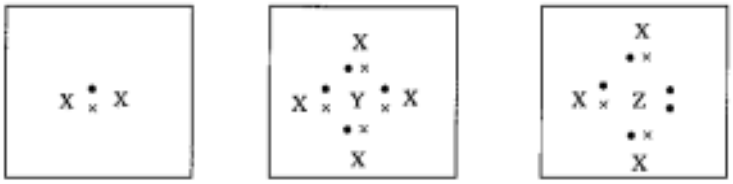
in-situ conservation **01**

Total marks 15

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 168*

Question 3 — Bonding, reactions and gases

(A) The Lewis structures of three molecules which are formed by the atoms X, Y and Z are shown in the following figures (1), (2) and (3). X, Y and Z are **not** standard symbols of the atoms.



(1) (2) (3)

(i) What is the valency of atom Y?

[Facility: 64 % of candidates answered correctly]

4 / Four **01**

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 75*

(ii) What is the number of the figure which shows a homoatomic molecule?

[Facility: 64 % of candidates answered correctly]

(Number) 1 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(iii) Write the molecular formula of the molecule shown in figure (3).

[Facility: 26 % of candidates answered correctly]

ZX_3 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(iv) What is the type of bonds found in each molecule shown in the figures above?

[Facility: 59 % of candidates answered correctly]

Covalent bonds **01**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 178*

(v) If the atomic numbers of the atoms X, Y and Z are less than 10, identify each atom.

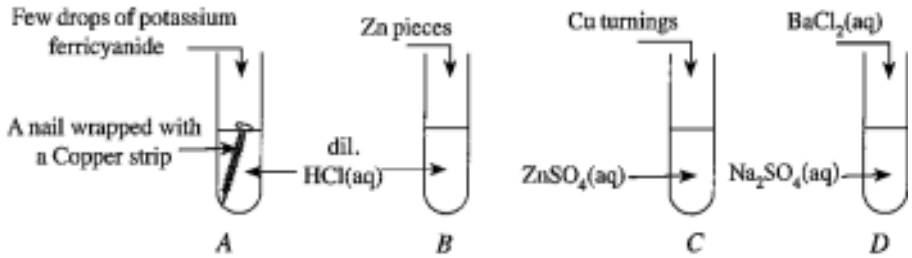
X : ..... Y : ..... Z : .....

[Facility: X 46 %, Y 36 %, Z 32 % of candidates answered correctly]

X : H / Hydrogen (01) Y : C / Carbon (01) Z : N / Nitrogen (01) (No marks H_2 / N_2) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(B) As shown in the following figures, potassium ferricyanide, Zn pieces, Cu turnings and $BaCl_2$(aq) are added to the four test tubes A, B, C and D respectively, which contain different chemicals.



Considering the chemical reactions which may occur in the test tubes, answer the following questions.

(i) (a) In which test tube can gas bubbles be observed clearly?

[Facility: 56 % of candidates answered correctly]

B / Tube with Zn / Zinc pieces **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 97*

(b) In which test tube **cannot** a change be observed?

[Facility: 32 % of candidates answered correctly]

C / Tube with Cu / copper turnings **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 97*

(c) In which test tube does a precipitate form?

[Facility: 26 % of candidates answered correctly]

D / Tube with $BaCl_2$ / Barium chloride (01) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 88*

(ii) Write the balanced chemical equation for the reaction that occurs in the test tube B.

[Facility: 25 % of candidates answered correctly]

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

(If the equation is not balanced, no marks) (no need to show the physical states) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(iii) Due to the formation of which ions, could an observation be made in the test tube A, when few drops of potassium ferricyanide are added?

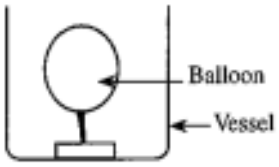
[Facility: 19 % of candidates answered correctly]

Ferrous / Fe^{2+} / Fe^{++} **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 88*

(C) An experiment planned by Grade 11 students in a school is given below.

- A balloon filled with a gas, is fixed to the bottom of a vessel as shown in the figure and kept at room temperature. After that, the vessel with the balloon is kept in a refrigerator which is at a temperature of 10 °C.



(i) What happens to the volume of the gas in the balloon after keeping it in the refrigerator?

[Facility: 53 % of candidates answered correctly]

Decreases **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 21*

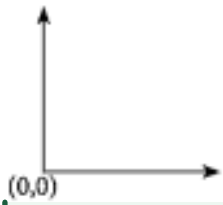
(ii) State the name of the law of gases that can be explained by this experiment.

[Facility: 29 % of candidates answered correctly]

Charles' law **01**

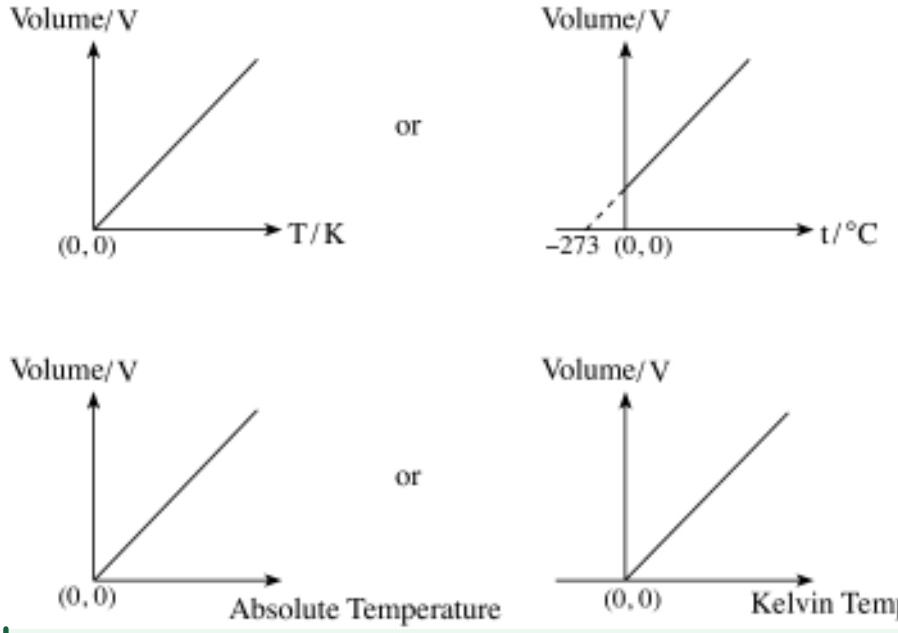
▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 168*

(iii) According to the experiment, draw the graph relevant to the law of gases mentioned by you in (ii) above, on the axes given. Label the axes.



[Facility: 16 % of candidates answered correctly]

Any one of the following graphs (volume directly proportional to absolute temperature): **01**



Total marks 15

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 21*

Question 4 — Forces, circuits and devices in a school

(A) If each of the following statements is correct, mark (✓) and if it is incorrect, mark (×) in the brackets in front of the statement.

(i) A door can be opened more easily by applying a force perpendicular to the surface of the door very close to the hinge. (.....)

[Facility: 58 % of candidates answered correctly]

× **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 189*

(ii) When an electric current flows through a conductor, a magnetic field is formed around it. (.....)

[Facility: 82 % of candidates answered correctly]

✓ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 120*

(B) Five activities being performed in a school at a certain time are given below.

Place	Activity
Main Hall	The prefects, decorating the hall using curtains made of thick material.
Library	An office assistant, photocopying pictures using the photo copying machine.
Biology Laboratory	Students, observing the cells of onion tissue using compound microscope.
Home science Laboratory	A labourer, pushing a cupboard placed on the floor by applying a force of 150 N on the cupboard parallel to the floor.
Physics Laboratory	In the science seminar held for grade 11 students, a teacher explaining the way of verifying Ohm's Law with a circuit.

(i) In which place was an activity done with an instrument which uses electrostatic charges?

[Facility: 53 % of candidates answered correctly]

In the Library **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 141*

(ii) Which place has a strategy used to prevent the echo?

[Facility: 78 % of candidates answered correctly]

Main Hall **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 63*

(iii) What are the special names used to identify the two convex lenses in the microscope which was used to identify the cells of onion tissue?

(a) lens closest to the onion tissue : .....

[Facility: 41 % of candidates answered correctly]

Objective lens **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 135*

(b) lens closest to the eye : .....

[Facility: 43 % of candidates answered correctly]

Eye piece (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 135*

(iv) If the frictional force between the floor and the cupboard is 135 N, what was the unbalanced force acting on the cupboard when it was pushing?

[Facility: 50 % of candidates answered correctly]

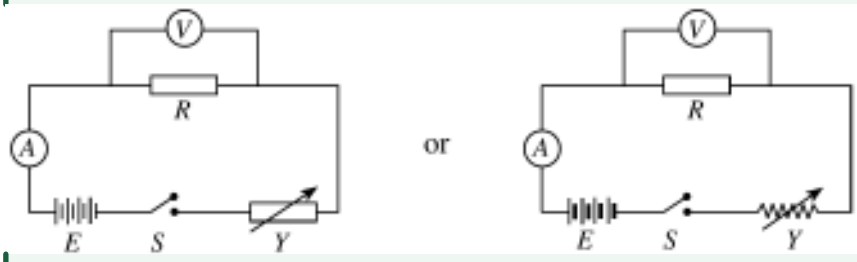
(150 N − 135 N) = 15 (N)

Give marks only for the final answer **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 99*

(v) (a) With usual notations, draw the standard circuit used by the teacher in the physics laboratory.

[Facility: 17 % of candidates answered correctly]



If (V) is connected parallel to R **01**

If (A) is connected in series with R **01**

Give marks if a bulb is used instead of R

For all six circuit symbols (01) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 161*

(b) When using the circuit drawn in (a) above to verify Ohm's law, the teacher has stated that after taking one reading the switch should be kept open for some time before taking the next reading. What is the reason for making this statement by the teacher?

[Facility: 8 % of candidates answered correctly]

To minimize the increase of temperature / heat dissipation in the resistor / circuit when a current flows / To minimize the heating of the resistor **01**

Readings should be taken under constant temperature **01**

(Give 2 marks for any one of above) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 151*

(C) Telephone and computer have become the most popular electrical equipment in the present world.

(i) Name the **two** main parts (two main circuits) of a mobile phone.

[Facility: 2 % of candidates answered correctly]

Transmitter circuit (01) Receiver circuit (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 79*

(ii) Logical gate circuits are used to perform various activities inside computers. Inside the given box draw the symbol of a 2-input OR gate which is used for such purposes.

[Facility: 31 % of candidates answered correctly]



Correct shape of the symbol is essential **01**

Total marks 15

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 64*

4

Essays with answers

Paper II Part B, 2025 to 2015 (newest first)

- Answer any three of five (20 marks each)
- Every question retyped, answer under each part
- Official schemes with marks
- Prepared answers for 2016, 2017 and 2020

How this section is arranged

Each Part B question (answer three of five; 2015 and 2017 old syllabus: one each from Biology, Chemistry and Physics) is retyped in full, with the answer and marks under each sub-part in a green box. Where the official answer is a diagram, the diagram from the scheme is shown.

Paper	Answers
2025 (2026)	Official marking scheme
2024 (2025)	Official marking scheme
2023 (2024)	Official marking scheme
2022 (2023)	Official marking scheme
2021 (2022)	Official marking scheme
2020	Prepared answers (textbook-based)
2019	Official marking scheme
2018	Official marking scheme
2017 (new syllabus)	Prepared answers (textbook-based)
2017 (old syllabus)	Prepared answers (textbook-based)
2016	Prepared answers (textbook-based)
2015 (old syllabus)	Official answers: Evaluation Report

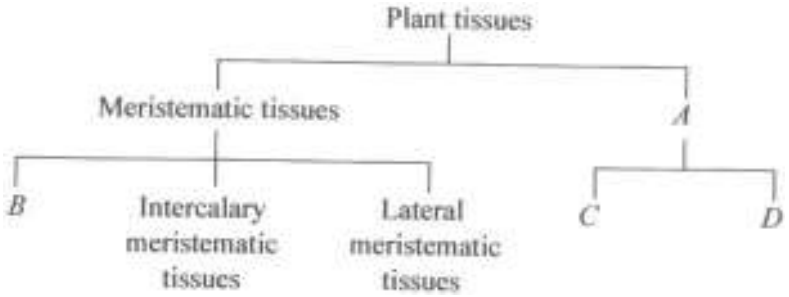
Paper II • 2025 (2026)

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — Plant tissues and vertebrates

(A) A chart regarding the classification of plant tissues is shown below.



(i) Name the tissue types indicated as A, B, C and D.

A - permanent tissues (01); B - apical meristem (01); C - simple permanent tissues (01); D - complex permanent tissues (01) — C and D may be interchanged **04**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 4*

(ii) In which locations of a plant is the tissue type B found?

stem apex, root apex, axial buds / apical bud, axillary buds, root tip (any two) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 3*

(iii) Mention the **two** tissues affecting the growth of plant stems in height and girth respectively.

growth in height - apical meristem (of the stem) **01**

growth in girth - lateral meristem / cambium tissue (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 3*

(iv) Name the tissue contributing to the grafting of dicotyledonous plants and state to which type of meristematic tissues it belongs.

cambium tissue (01); lateral meristem (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 3*

(B) A group of students engaged in an educational trip to the national zoological gardens, listed a few external features of some animals they observed as follows.

P – streamlined shape of the body
Q – moist and bare skin
R – dry skin with scales all over the body
S – skin covered with hair

(i) Name the common group to which the animals displaying the above features belong.

Vertebrates / Vertebrata **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 23*

(ii) Mention the **two** classes to which the animals possessing feature P belong.

Pisces (fish) (01); Aves (birds) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(iii) Of the features stated above, write the features displayed by toad and crocodile separately.

toad - Q / moist and bare skin (01); crocodile - R / dry skin with scales (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(iv) Write **two** features common to animals belonging to the classes showing feature Q and feature R.

pentadactyl limbs; bilateral symmetry; presence of lungs; cold blooded; laying eggs; presence of vertebral column (back bone); having 4 legs / limbs — any two correct answers **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

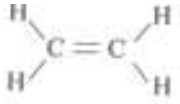
(v) Mention **three** other external features common to animals showing feature S.

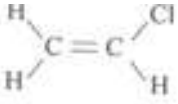
external ears / pinna; testes lying in scrotal sacs outside the body; mammary glands; sweat glands; sebaceous glands; eyes with eyelids; eyelids with eyelashes — any three of these **03**

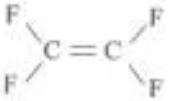
▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 23*

Question 6 — Polymers and purification of salt

(A) P, Q and R are three organic compounds which are monomers of three polymers.


(P)


(Q)


(R)

(i) A widely used polymer polythene is produced by polymerizing P.

(a) To which group of hydrocarbons does P belong?

alkenes **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 159*

(b) The relative molecular mass of a typical polythene molecule is 1 120 000. How many repeating units does a typical polythene molecule contain? (H = 1; C = 12)

C_2H_4: 12 × 2 + 1 × 4 = 28 **01**

1 120 000 ÷ 28 = 40 000 (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 159*

(ii) (a) Why are Q and R not considered hydrocarbons?

because other elements are present in addition to C and H / because they contain C and F / because hydrocarbons are compounds containing C and H only **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 152*

(b) Write the name of the polymer formed by the polymerization of Q.

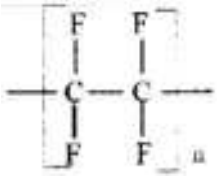
polychloroethene / polyvinyl chloride / PVC — the part "poly" may be given within brackets **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 161*

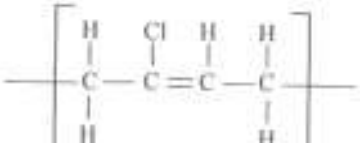
(c) The polymer teflon is formed by the polymerization of R. Draw in standard form the structure of teflon.

repeating unit —CF_2—CF_2— in brackets with subscript n **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 161*



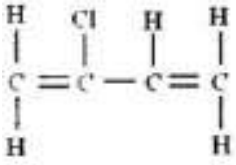
(B) The synthetic rubber neoprene with the structure indicated by the figure is produced by the polymerization of the organic compound chloroprene. It has a carbon chain similar to the carbon chain of isoprene, the monomer of natural rubber.



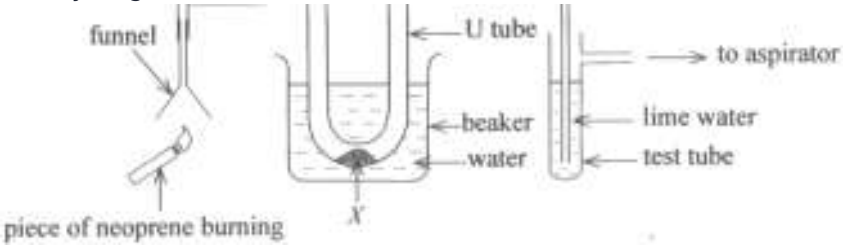
(i) Draw the structural formula of the monomer chloroprene.

$CH_2=CCl—CH=CH_2$ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 155*



(ii) The figure illustrates a set of apparatus arranged to demonstrate that neoprene contains carbon and hydrogen.



(a) Name X.

anhydrous copper sulphate / $CuSO_4$ / anhydrous $CuSO_4$ / anhydrous cobalt chloride / anhydrous $CoCl_2$ **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 13*

(b) Mention an error in the set up of apparatus.

there is no stopper in the test tube (containing lime water) / not sealed / no lid — when the problem is identified **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 108*

(c) What is the function of water in the beaker?

to condense water vapour (in the "U" tube) / for cooling **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 163*

(d) Write **two** observations which you would expect to make when the apparatus is operated after rectifying the error.

anhydrous $CuSO_4$ - (white colour) turning blue / anhydrous cobalt chloride - (blue colour) turning pink

lime water turning milky / turbid / turning milky and becoming colourless again

liberation of air bubbles at the end of the delivery tube / deposition / formation of liquid (water) droplets in the 'U' tube — any two **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 153*

(e) Indicate by a balanced chemical equation, the chemical change which causes one of the two observations which you stated in (d) above.

$CuSO_4(s) + 5H_2O(l) \rightarrow CuSO_4.5H_2O(s)$ or $CoCl_2 + 6H_2O \rightarrow CoCl_2.6H_2O(s)$ or

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$ or

$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$ — physical states not required **01**

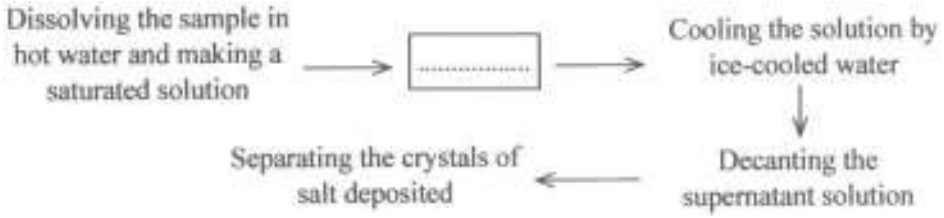
▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 163*

(iii) What is the structural difference at the molecular level resulted in vulcanization of natural rubber?

forming cross bonds / links (via S) — a diagram is possible **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 164*

(C) The procedure adopted by a student to obtain purer salt from a sample of unwashed common salt (sodium chloride) bought from the market is as follows.



(i) What is the above procedure called?

recrystallisation **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 106*

(ii) Write the step relevant to the blank.

filtering (while hot) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 106*

(iii) Water-soluble magnesium chloride which is present as an impurity in salt is not removed by the procedure described above. Reacting the aqueous solution of salt with a sodium hydroxide solution and filtering off the precipitated, insoluble magnesium hydroxide is a method that can be used to remove magnesium chloride. The incomplete chemical equation for this is given below.

$$MgCl_2(aq) + \text{.....} \rightarrow \text{.....} + 2NaCl(aq)$$

(a) Complete the above equation and write it in the answer script (Physical states should be indicated.).

$MgCl_2(aq) + 2NaOH(aq) \rightarrow 2NaCl(aq) + Mg(OH)_2(s)$

writing 2NaOH(aq) correctly (01); writing $Mg(OH)_2(s)$ correctly (01) — physical states essential **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 91*

(b) Of the four types of reactions you have learnt, to which type does the above reaction belong?

double displacement **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 91*

(c) If sodium hydroxide essential for the above reaction is not available in the school laboratory, suggest a method to make a sodium hydroxide solution using common salt.

electrolysing (an aqueous) solution of NaCl (using carbon / graphite electrodes) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 112*

Question 7 — Motion, force, energy and power

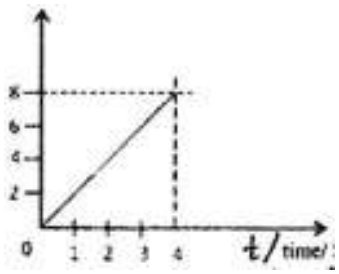
(A) The values of velocity of an object obtained by a student from a displacement - time graph relating to the motion of that object during 4 seconds are indicated in the following table.

time (t) / s	**0**	**1**	**2**	**3**	**4**
velocity (v) / m s^{-1}	0	2	4	6	8

(i) Using the data in the table, draw a sketch of the velocity-time graph of the object in your answer script.

straight line through the origin to 8 m s^{-1} at 4 s — for naming axes (01); for drawing the graph correctly (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*



(ii) Describe how you estimate the acceleration of the object using the velocity-time graph you have drawn.

The gradient gives the acceleration / change in velocity ÷ time / (final velocity − initial velocity) ÷ time **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(iii) Using the graph, find the displacement of the object at the end of 4 seconds.

½ × 4 × 8 (01) — area of the triangle or describing it in words

= 16 (m) (01) — just 16, give 02 marks **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 36*

(B) In order to extinguish a fire broken out in a building, water was gushed into the building very fast with a hose from a water bowser belonging to the urban fire extinguishing unit.

(i) At the time of squirting water from the hose, a fire fighter should put in a great force to hold it in position.

(a) What is the reason for it?

Because water exerts a force in the opposite direction **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 92*

(b) What is the law applicable to explain the above phenomenon?

Newton's third law (give marks for writing the law also) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 97*

(ii) Within 25 seconds, 100 kg of water were pumped to a floor of the building located at a height of 10 m. What is the power of the water pump?

Power = mgh/t / energy ÷ time / work ÷ time; = (100 × 10 × 10) ÷ 25 — for equation or substitution **01**

= 400 (W) — for final answer (01); just 400 (02) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 137*

(iii) Struck by a spurt of water, a washing machine of mass 20 kg in the building moved on the floor with an acceleration of 2 m s^{-2}. How much was the force applied on the washing machine by the spurt of water?

F = ma; F = 20 kg × 2 m s^{-2} — for equation or substitution **01**

F = 40 (N) — for final answer (01); just 40 (02) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 90*

(iv) Under a force of 8 N applied by the water spurt, the washing machine displaced 3 m. If the force remained constant during the entire displacement, how much was the work done on the washing machine?

work = force × distance = 8 N × 3 m — for equation or substitution **01**

= 24 (N m) / (J) — for final answer (01); just 24 (02) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 125*

(C) A driver mass 60 kg, drives a motor car on a horizontal road at a constant speed of 36 km h^{-1}.

(i) How much is the energy possessed by the driver by virtue of the motion of the motor car?

E = ½mv^2; E = ½ × 60 kg × 10 m s^{-1} × 10 m s^{-1} — for equation or substitution **01**

= 3000 (J) — for final answer (01); just 3000 (02) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 9 Resultant force, page 156*

(ii) At the foot of a hillock in the road, the driver knocked off the engine and cut off the force provided from it to the car. The car drew forward and stalled after reaching a plateau at the top of the hillock. What is the height of the hillock? (Assume g = 10 m s^{-2})

½mv^2 = mgh / kinetic energy = potential energy; h = v^2/2g — for equation or substitution **01**

h = (10 m s^{-1} × 10 m s^{-1}) ÷ (2 × 10 m s^{-2}) — give full marks for substituting 3 000 J

h = 5 (m) — for final answer (01); just 5 (02) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

(D) The following table presents various electrical appliances available in a house and information regarding their daily usage.

Appliance	Power/kW	Number of appliances	Number of hours used
Electric lamps	0.06	8	6
Electric irons	0.6	1	1
Electric fans	0.4	5	4
Washing machines	1.2	1	1

(i) How much is the electrical energy spent for electric fans per day?

0.4 × 1000 W × 5 × 4 × 3600 s = 28 800 000 (J) / 28 800 (kJ)

or 0.4 kW × 5 × 4 h = 8 kW h **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 48*

(ii) How much is the number of electrical units spent during a month of 30 days?

electric lamps - 0.06 kW × 8 × 6 h × 30 = 86.4 kW h

electric iron - 0.6 kW × 1 × 1 h × 30 = 18 kW h

electric fans - 0.4 kW × 5 × 4 h × 30 = 240 kW h

washing machine - 1.2 kW × 1 × 1 h × 30 = 36 kW h

total number of electric units = 380.4 (kW h)

Give only 01 mark when the calculation is done only for electric fans. Give 01 mark for multiplying the final total by 30 although the calculation for each device is wrong. **02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 47*

Question 8 — Reproduction and sound

(A) (i) What is the hormone which is important in bringing about secondary sexual characteristics of males?

testosterone **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 47*

(ii) Why is it important that the pair of testes in the male reproductive system are located in the scrotum outside the body?

because a temperature below the body temperature is essential for the production of healthy sperms / because the process of sperm production is very sensitive to temperature **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 49*

(iii) Mention a function carried out by each of the following structures of the male reproductive system.

(a) seminiferous tubules

production of sperms **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 49*

(b) epididymis

temporary storage of sperms **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 47*

(c) seminal vesicles

production of the fluid for transportation of sperms and provision of nourishment / supply nutrients / transports sperms **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 48*

(B) (i) Name the locations where the following functions are carried out in the female reproductive system.

(a) production of ova

ovary **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 50*

(b) fertilization

fallopian tube **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 51*

(c) implantation

uterus **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 51*

(ii) Mention briefly and separately the changes taking place in the wall of the uterus during the following two main phases of the menstrual cycle.

(a) menstrual phase

breaking down of the uterine wall **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 54*

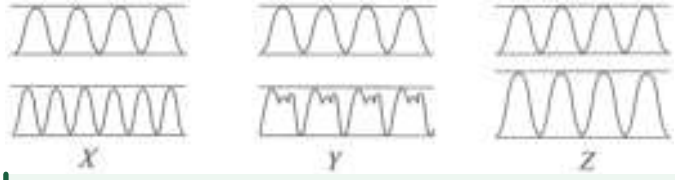
(b) proliferation phase

building up of the uterine wall / increase the thickness of uterine wall / uterine wall becomes vascular **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 54*

(C) The characteristics that help distinguish sounds from one another are called characteristics of sound.

(i) Name separately the **three** characteristics of sound illustrated by the pairs of wave patterns labelled X, Y and Z.



X - pitch (01); Y - timbre / quality of sound (01); Z - loudness (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(ii) Of X, Y and Z above, select and write the pair of graphs that can be used to explain each of the following differences.

(a) the difference felt when you have a face to face discussion with a friend of yours and his voice is heard from a loudspeaker

Z **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(b) the difference felt when a same note is played by the same musical instrument at medium and high pitch

X **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(iii) Write a factor on which the frequency of the sound produced by a violin depends.

tension of the string / length of the vibrating part / mass of unit length (area of cross section) / thickness of the string **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 99*

(iv) Mention **two** characteristics of ultrasound waves.

Frequency is greater than 20 000 Hz / higher in energy / cannot be heard by the human ear / do not transfer from solid to gaseous media **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 95*

(v) Ultrasound waves are used to investigate the location of a tumour (a part with abnormal growth) inside the body. In such a test, the velocity of the wave inside the tumour was 1.7 km s^{-1}. What is the wave length of the wave inside the tumour? The operation frequency of the scanning machine is 4 MHz (1 MHz = 10^6 Hz).

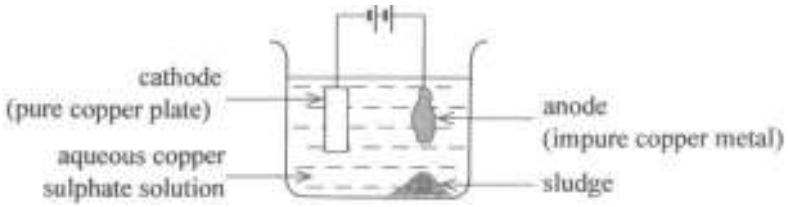
$v = f\lambda$; $\lambda = 1.7 \times 10^3 \div (4 \times 10^6) = (17/4) \times 10^{-4}$

$\lambda = 4.25 \times 10^{-4}$ m / 0.425×10^{-3} / $\lambda = 0.000\ 425$ (m) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 97*

Question 9 — Electrorefining, refraction and heat

(A) In extraction of copper metal, the impure metal obtained by roasting copper ores is purified by an electrolytic method known as electrorefining. In this process, an electrolytic cell with impure copper as the anode and a pure plate of copper as the cathode is used as shown in the diagram and the copper ions entering into the solution from the anode get deposited on the cathode (as in electroplating of iron with copper). Impurities in the impure metal fall to the bottom of the container as sludge and it contains traces of valuable metals such as gold and silver. Metals such as iron and zinc contained in the impure metal are not deposited but pass into the solution as their ions.



(i) Write half reactions occurring at the anode and the cathode separately in respective order.

anodic reaction: $Cu(s) \rightarrow Cu^{2+}(aq) + 2e$ **01**

cathodic reaction: $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(ii) During electrolysis, what can be observed with regard to the intensity of the colour of the copper sulphate solution with the passage of time?

Colour does not change. **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 93*

(iii) Based on the position occupied by the respective metals in the activity series, briefly explain the reasons for the following phenomena.

(a) Metals such as iron and zinc enter the solution in the form of ions without being deposited.

activity is higher relative to copper / lie above Cu in the activity series **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 99*

(b) Gold and silver exist as native (free) metals in the sludge.

activity is less relative to Cu / lie below Cu in the activity series **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(iv) Name a suitable method to separate gold and silver from other impurities of the sludge. (Gold and silver are high-density metals.)

panning / directing to a stream of water **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(v) The purity of copper obtained by the above method is 99.95% by mass. How many copper atoms are there in 100 g of pure copper so obtained? The final answer is **not** required and indicating how the calculation is done is adequate. (Cu = 63.5, Avagardo Constant = 6.022×10^{23} mol^{-1})

number of atoms = $(99.95 \div 63.5) \times 6.022 \times 10^{23}$ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(vi) What is the reason why relative atomic mass of copper assumes a fractional value such as 63.5?

existence of isotopes **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(vii) In electrical conductivity, copper comes next to silver only. State one use of copper that exploits this property.

making wires / electrical cables / electricity conducting parts **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(viii) The following equation indicates a chemical reaction taking place when copper ores are roasted.

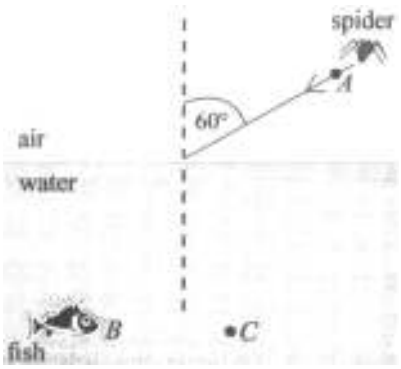
$$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$$

Mention an environmental problem caused by the gaseous product of the above reaction.

acid rains **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(B) The figure shows a spider at point A in the air above the water surface and a fish in a pond at point B. The angle of incidence of the rays coming from the spider to the fish is 60° and the angle of refraction is 40°.



(i) Calculate the refractive index of water relative to air. (Assume Sin 60° = 0.8 and Sin 40° = 0.6)

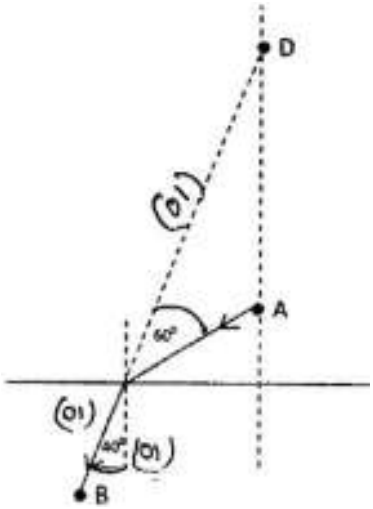
refractive index = sin 60 ÷ sin 40 = 0.8 ÷ 0.6 = 1.333 — for equation or substitution **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 123*

(ii) (a) Indicating the position of the spider and the fish as A and B respectively, illustrate by a rough ray diagram the path of the ray from A to B.

for drawing ray correctly (01); for marking angles correctly (60°, 40°) (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 138*



(b) On the perpendicular drawn to the water surface passing through point A, mark as D, the position of the spider's image as seen by the fish.

For marking D as in the above diagram (on the extension of the refracted ray, above A) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(iii) If the fish swims in water towards a point C, how will the location of the spider's image seen by the fish relative to point D change?

Location of the image does not change / forms on D. **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 138*

(C) A water-filled, open metal container with 1 m^2 area of cross section and a black-coated outer surface is kept outdoor exposed to sunlight. After 4 hours it was observed that its water level has dropped by 5 cm.

(i) Mention the method of heat transfer relevant to each of the following instances.

(a) transfer of heat to the outer surface of the container

radiation **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(b) transfer of heat from the outer surface to the inner surface of the container

conduction **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(ii) What is the reason for the drop of the water level in the container?

evaporation / vapourisation **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 119*

(iii) If the outer surface of the container is white-coated, how will the drop of the water level differ relative to the drop when it is black-coated after 4 hours? Mention the reason for your answer.

Drop of the water level is less.	**01**
Amount of heat reflected by white surfaces is greater / heat absorbed is less. Therefore, amount of heat absorbed is less. / Black colour absorbs more heat than white (01)	**02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

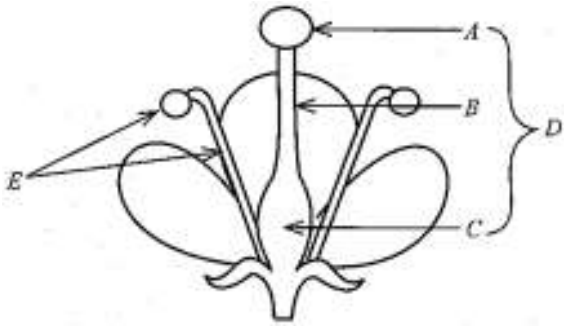
Paper II • 2024 (2025)

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — The flower and coordination in humans

(A) The figure shows a longitudinal section of a typical flower.



(i) Name the parts A, B, C, D and E in it.

A - stigma; B - style; C - ovary; D - gynoecium; E - stamen / androecium / anther and filament

If all are correct - 03 marks; if 4 are correct - 02 marks; if 3 or 2 are correct - 01 mark; if 1 is correct - 0 **03**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 35*

(ii) What is pollination?

Deposition of mature pollen of a certain flower on the stigma of a flower of the same species — 02 or 00 **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 37*

(iii) Write an adaptation of this flower to prevent self-pollination as illustrated in the figure.

Occurrence of extrose stamens / turning of stamens away from stigma / occurrence of stigma above stamens / heterostyly / herkogamy / hercogamy **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 38*

(iv) After pollination a male gamete and an ovum fuse to form a zygote.

(a) What is the name of the process described in above (iv)?

fertilization **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 41*

(b) Name separately the haploid (n) and diploid (2n) cells related to the above process.

haploid - male gamete and female gamete / gametes / pollen (grains) and ova (01);

diploid - zygote (01) — 01 × 2 **02**

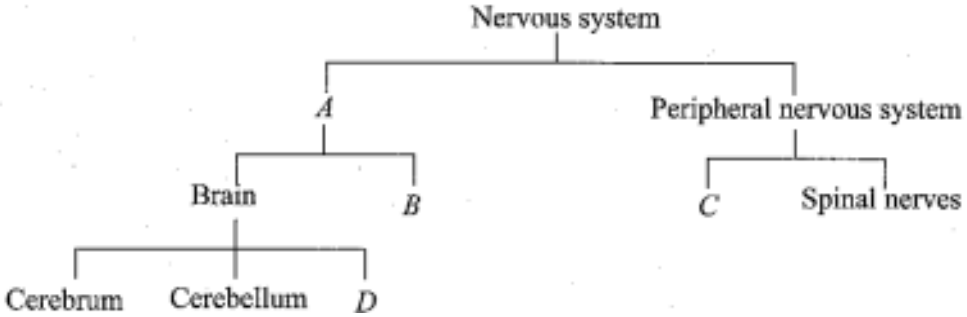
▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 41*

(c) By what name is the phenomenon of fruiting without a combination of a male gamete and an ovum known?

parthenocarpy **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 41*

(B) (i) One system that operates for the coordination of the human body is the nervous system. The structure of the nervous system can be illustrated by the following sketch.



(a) Name the structures indicated by the letters A, B, C and D.

A - central nervous system; B - spinal cord; C - cranial nerve; D - brain stem / medulla oblongata

If 3 or 4 are correct - 02 marks; if 1 or 2 are correct - 01 mark **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 174*

(b) State **two** functions of the cerebellum.

Maintaining the equilibrium of body / controlling the action of voluntary muscles / contributing to execute body movements properly **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 176*

(ii) The secretions of the endocrine system, the other system essential to maintain coordination are known as hormones.

(a) State **three** characteristics of hormones.

being organic compounds / transported by blood / produced in one place and acting at another place / stimulating target organs / sufficiency in very small concentrations — any three **03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 179*

(b) Name the gland secreting the growth hormone and mention the location of that gland.

pituitary (gland) (01); below the hypothalamus in cerebrum (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(c) Deficiency of a mineral nutrient essential to produce a certain hormone is the cause for goitre. What is this nutrient?

free mark (01) — total marks **20**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 173*

Question 6 — Extraction of iron and sodium

(A) On large scale iron is produced by heating a finely powered mixture of haematite (Fe_2O_3), limestone ($CaCO_3$) and coke (C) to a high temperature in a blast furnace.

(i) What is the advantage of crushing the mixture into fine powder?

increasing surface area of reactants / increasing rate of the reaction **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(ii) The main reactions taking place in the blast furnace during this process are given below. Letters x, y and z in them represent three chemical compounds.

$$CaCO_3 \xrightarrow{\Delta} x + y \text{ ——— } 1$$
$$C + O_2 \rightarrow y \text{ ——— } 2$$
$$C + y \rightarrow 2z \text{ ——— } 3$$
$$Fe_2O_3 + 3z \rightarrow 2Fe + 3y \text{ ——— } 4$$
$$SiO_2 + x \rightarrow CaSiO_3 \text{ ——— } 5$$

Write in respective order the chemical formulae of the compounds represented by letters x, y and z.

x - CaO (01) y - CO_2 (01) z - CO (01) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(iii) Of the above reactions, which can be considered an acid-base reaction?

5 / $SiO_2 + x \rightarrow CaSiO_3$ / $SiO_2 + CaO \rightarrow CaSiO_3$ **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(iv) $CaSiO_3$ formed in the reaction 5 above, floats as slag on extracted, molten iron. What is the advantage brought about by this?

Preventing (extracted) iron from coming into contact with air / oxygen OR preventing oxidation of iron **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(v) According to equation 4, how many tons of haematite are needed to extract 70 tons of iron? (Fe = 56, O = 16)

Amount of Fe_2O_3 required to get 2 mol of Fe = 1 mol

Mass (parts by weight) of Fe_2O_3 required to obtain 112 p.b.w. of Fe = 160

Mass of Fe_2O_3 required = (160 / 112) × 70 (ton) (01);

= 100 (ton) (01) — for correct fraction or final answer 01 mark **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(vi) Name a gas that is issued to the atmosphere when extracting iron by the above method and state an unfavourable effect of it on the environment.

CO_2 / CO (in words also) (01);
CO_2 - increasing global warming / CO - poisonous gas; for the correct effect of the gas (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(vii) A type of electricity conducting wires is made of an alloy with copper, magnesium and iron in the molar ratio of 7:2:1 respectively.

(a) What is the mole fraction of iron in this alloy?

1/10 or 0.1 **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 43*

(b) Suggest a method to separate metal copper from a piece of this alloy.

Dissolve in a (dilute) acid (01) and filter (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(viii) Scholars have estimated that, according to the present pattern of consumption of iron, the resources of iron in Earth will be adequate only for 240 years more. Suggest a measure that can be taken to assure the sustainable use of iron as a remedy for this.

Recycling / Minimizing corrosion (award marks for methods which retard corrosion) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(ix) Why metal sodium **cannot** be extracted by a method such as the above used to extract iron?

Sodium is a very reactive metal or it is located much above in the activity series **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 101*

(B) Sodium metal is extracted in Downs cells by the electrolysis of fused (molten) sodium chloride. A graphite anode and an annular steel cathode are used here.

(i) Why sodium chloride should be fused in this task?

To make the ions mobile / because solid sodium chloride doesn't conduct electricity **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 87*

(ii) Indicating the relevant physical states, write the ion-electron half reaction relevant to the discharge of the sodium metal on the cathode.

$Na^+(l) + e \rightarrow Na(l)$ / $Na(s)$ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(iii) Why a graphite anode is more suitable for this than a steel anode?

because graphite doesn't react with chlorine / iron reacts with chlorine / graphite is an inert electrode **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(iv) State **one** application of sodium metal.

to extract gold / silver; to produce sodium amalgam; to extract some metals; to produce dyes such as indigo; for sodium lamps / sodium vapour lamps; as a coolant in nuclear reactors — any one **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

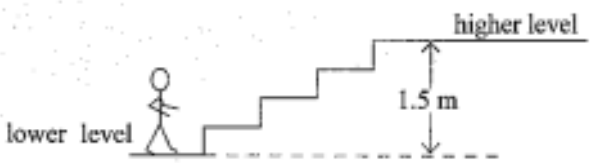
(v) Scientist Humphry Davy discovered sodium metal by electrolysing fused sodium hydroxide. Write the ion-electron half reaction that occurred on the anode here. (Hint: Recall electrolysis of acidulated water.)

$4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e$ / $4OH^-(aq) - 4e \rightarrow 2H_2O(l) + O_2(g)$ (award marks even though the state symbols are missing) (01) — total marks **20**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

Question 7 — Energy, forces and motion

(A) A student, mass 40 kg staying at a lower level in the school premises climbs a flight of steps of 1.5 m vertical height and enters a building at a higher level.



(i) How much is the increase in the potential energy of the student who reached the higher level from the lower level? (Assume g = 10 m s^{-2}).

Potential energy = mgh

= 40 × 10 × 1.5

= 600 J / kg m^2 s^{-2} — for equation or substitution (01); for the final answer (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

(ii) How much is the amount of work done by the student here?

600 (J) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 138*

(iii) If the student took 4 s to climb the steps, what is the power of the student in climbing the steps?

Power = Work / Time

= 600 J / 4 s

= 150 (J s^{-1}) / (W) — for equation or substitution (01); for the final answer (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 136*

(B) A uniform wooden block of mass 1 kg is kept at rest on a rough, horizontal table as shown in Figure (1).

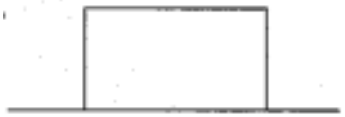


Figure (1)

(i) (a) Under how many forces does the wooden block stay at equilibrium?

two (02) forces **01**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 203*

(b) Name what those forces are.

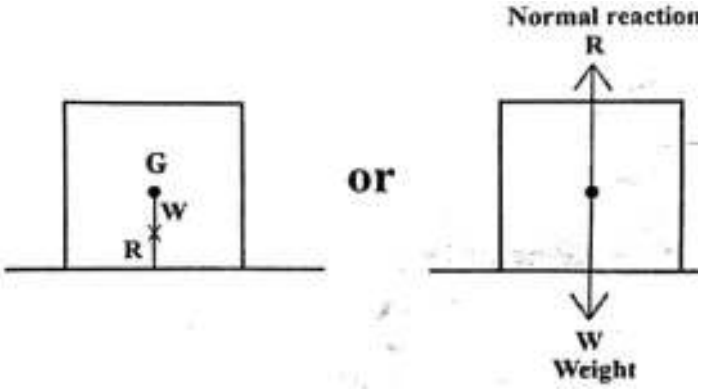
Weight of the block of wood and normal reaction / W and R **02**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 203*

(c) Copy Figure (1) above in your answer script and mark those forces in it.

Either of the following diagrams (W acting downwards, R / normal reaction acting upwards) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 203*



(d) What is the magnitude of each of those forces?

W = 10 (N), R = 10 (N) or 10 (N) each **01**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 203*

(ii) Another identical wooden block is kept on the above wooden block as shown in Figure (2).



Figure (2)

(a) Of the instances shown in Figures (1) and (2), in which instance is the limiting frictional force between the surface of the table and the wooden block is greater?

figure 2 / at instance 2 **01**

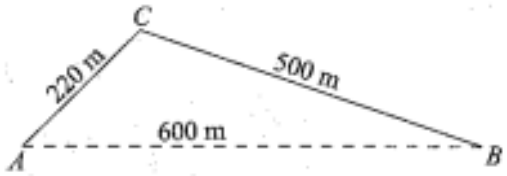
▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 103*

(b) Explain the reason for your answer for part (ii) (a) above.

increase in normal reaction — 02 or 00 **02**

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 203*

(C) AC and CB shown in the figure are two rectilinear (straight line) roads. Their lengths are 220 m and 500 m respectively. The shortest distance between the places A and B is 600 m.



A motor car starts from the state of rest at A, moves along the roads AC and CB and comes to rest at B. It took 120 seconds for this motion. Taking the motion of the car into consideration, calculate the following.

(i) The distance travelled by the car

720 (m) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 48*

(ii) Average speed of the car

= 720 (m) / 120 (s) — for equation or substitution (01);

= 6 (m s^{-1}) — for final answer (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 29*

(iii) Displacement of the car

600 (m) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(iv) Average velocity of the car

= 600 (m) / 120 (s) — for equation or substitution (01);

= 5 (m s^{-1}) — for final answer (01) (02) — total marks **20**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

Question 8 — Classification of animals and the convex lens

(A) (i) A group of students going on a field trip found an animal with the following characteristics.

- has an exoskeleton in the body
- has jointed limbs
- the body is segmented and those segments have joined to form tagmata

Name the following taxa to which this animal belongs.

(a) Domain

eukarya **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 4*

(b) Kingdom

animalia **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 14*

(c) Phylum

arthropoda **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 17*

(ii) (a) What is the invertebrate phylum which shows closest relationship to phylum chordata?

echinodermata **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

(b) State the following characteristics of the animals of that phylum.

I. living environment

sea water / brine **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

II. symmetry

(penta) radial **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

III. method of locomotion

by tube feet / swimming (01) **03**

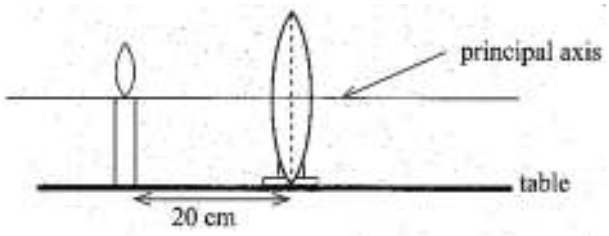
▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

(iii) Of vertebrates, what are the classes to which cold-blooded animals belong?

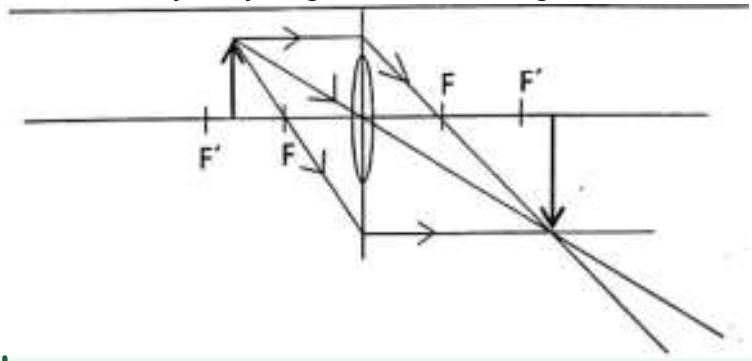
Pisces, Amphibia, Reptilia (01 × 3) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(B) The focal length of a convex lens is 15 cm. The lens is mounted on a stand, kept on the laboratory table and at a distance of 20 cm a lighted candle is placed in front of it.



(i) (a) Indicate by a ray diagram how the image of the candle flame is formed.



for any two correct rays (02); for construction of the image (away from F′) (01) — the object may be drawn as a candle **03**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 131*

(b) Mention **three** characteristics of that image.

Real; Inverted; Magnified; Formed away from 2F′ (01 × 3) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 131*

(c) Mention an equipment which makes use of such an image.

Projectors (OHP / slide projector) / light microscope / special telescope — give marks for other suitable answers also **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 134*

(ii) Consider an instance in which this lens is used as a hand lens to observe a small insect.

(a) Here, at what distance range should the insect be placed from the lens?

Up to 15 cm from the lens / at the distance less than the focal length / up to 15 cm from the optical centre (C) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 129*

(b) Can the image of the insect that is observed be obtained on a screen?

No **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 140*

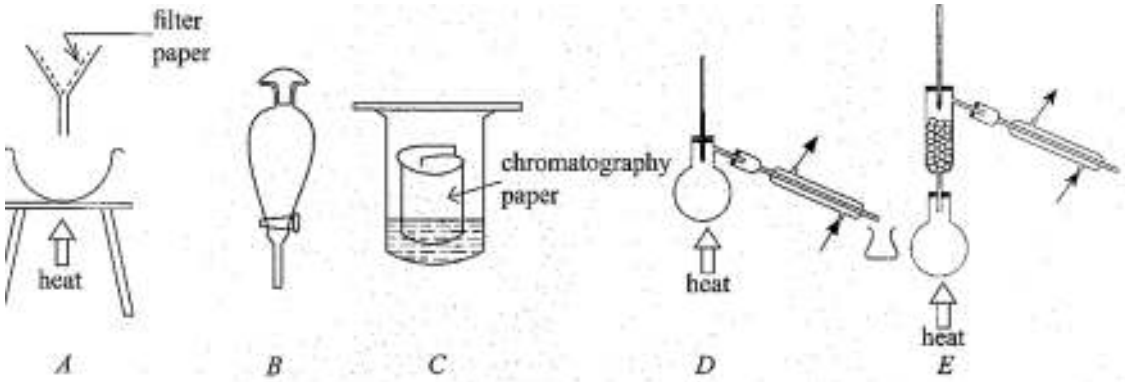
(c) Give the reason for your answer in (ii) (b) above.

Because the image is virtual / refracted rays do not meet / image is formed on the same side of the object (01) — total marks **20**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 140*

Question 9 — Separation of mixtures and effects of current

(A) Shown by the figures below are five sets of apparatus that can be used to separate the components of mixtures.



(i) Identify the set of apparatus that can be used for each of the following need of separation and write the letter that corresponds to it. (The same letter can be used more than once.)

(a) Obtaining pure crystals of salt from a mixture of salt and sand

A **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 56*

(b) Identifying the pigments of a food colouring separately

C **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 69*

(c) Extracting iodine dissolved in water into the liquid cyclohexane which is immiscible with water

B **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 69*

(d) Obtaining miscible ethanol (boiling point 78 °C) and acetic acid (boiling point 118 °C) separately from a solution of them

E **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(e) Separating the components of chlorophyll

C **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 53*

(ii) (a) Why is acetic acid known as a weak acid?

Because it doesn't ionize fully (01) in water (01) / it partially ionized (01) in aqueous solution (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 42*

(b) How do you experimentally verify that ethanol separated by the method you stated in part (i) (d) above does **not** contain acetic acid?

When ethanol is tested with a blue litmus paper, it doesn't turn red / when tested with a pH paper, colour corresponding to pH less than 7 is not given / when methyl orange indicator is added it doesn't turn red / no effervescence is observed when a carbonate is added — for test (01); for observation (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 42*

(iii) Under special conditions acetic acid reacts with ethanol according to the following chemical equation.

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + x$$

What can be the product indicated by the letter x here?

water / H_2O **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(B) Heating effect and magnetic effect are two physical effects resulted when an electric current flows through a conductor.

(i) Describe briefly and separately what is (a) heating effect and (b) magnetic effect of an electric current.

(a) heating effect

Thermal effect - Conversion of electrical energy (01) into heat due to resistance (01) when an electric current flows **02**

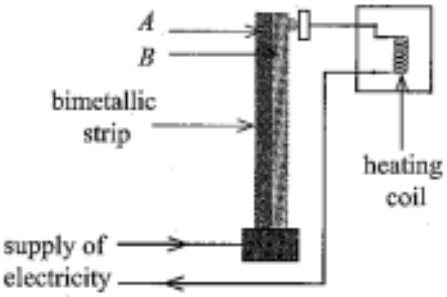
▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(b) magnetic effect

Magnetic effect - Creation of a magnetic field / area / effect around a conductor carrying an electric current **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(ii) The figure illustrates an arrangement installed to disconnect the electric current when the temperature of an electrical device producing heat rises beyond a certain value.



(a) Of the two metals labelled A and B from which the bimetallic strip is made, which metal should expand more?

metal B **01**

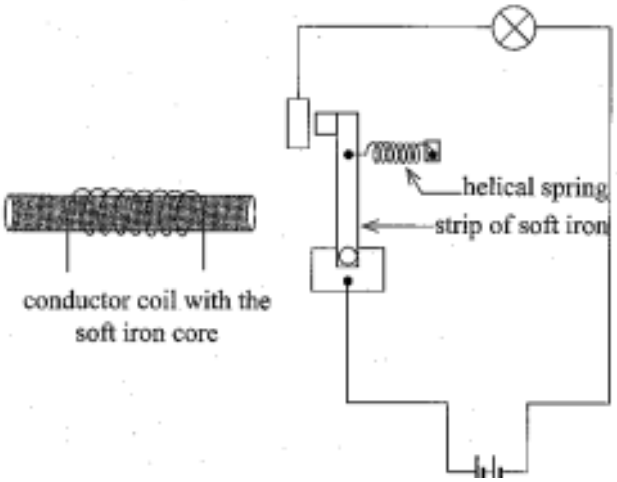
▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(b) Explain how the electric current gets disconnected by this arrangement.

When temperature increases the metal strip bends to the left because it expands. Then the circuit gets disconnected and flow of the current ceases. (Give marks for the correct idea.) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(iii) The following figure illustrates a circuit constructed to close when an electric current flows through the conductor coil with a soft iron core and open when no current flows through the coil.



Explain how the circuit is closed when a current flows through the coil and the circuit opens when no current flows through it.

When the circuit closes - When the current flows through the coil, it becomes an electromagnet (01). Then it attracts the soft iron strip (01). Thus, the circuit is completed and the current flows. (02);

When the circuit opens - When the current ceases to flow through the coil, it is demagnetized. Then the spring pulls the strip of iron breaking the circuit (01), so the current stops flowing. (02) (04) — total marks **20**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 142*

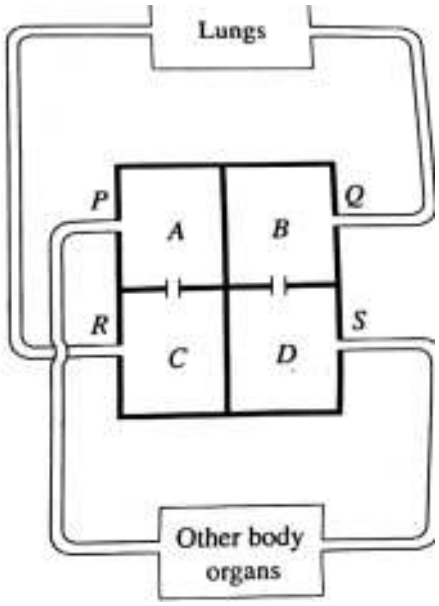
Paper II • 2023 (2024)

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — Circulation and tissues

(A) Indicated below is a diagram drawn to depict double circulation of blood in humans. A, B, C and D indicate chambers of the heart while P, Q, R and S indicate the blood vessels connected to those chambers.



(i) Why is the human blood circulation known as double blood circulation?

Blood flows twice through the heart while flowing once through the body **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 168*

(ii) P represents two vessels. Of them, name the vessel bringing blood from the inferior parts of the body.

Inferior vena cava **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(iii) Name the following blood vessels.

(a) blood vessel R starting from chamber C

Pulmonary artery **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(b) blood vessel S starting from chamber D

Systemic aorta / artery **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 168*

(iv) Indicate a difference in the composition of blood contained in vessels R and S.

Oxygen (O_2) concentration in S is higher than that in R / Carbon dioxide (CO_2) concentration in S is lower than that in R / R contains deoxygenated blood while S contains oxygenated blood — any one **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(v) Name the valve located between the chambers B and D.

Bicuspid valve / mitral valve **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(vi) (a) By what name is the pressure exerted when D contracts and pushes blood into S known?

Systolic blood pressure **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 169*

(b) What is the value of that pressure of a healthy adult?

110-120 mm Hg / 110 mm Hg / 120 mm Hg **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 169*

(c) Even in a healthy adult, that value can change from time to time. State a factor affecting it.

Mental stress / Tiring heavily / exercising / being afraid / excitement **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 200*

(B) Muscle tissue can be identified as a main tissue type contributing to build up the human body. There are three main types of muscle tissues. One of them is the smooth muscle tissue.

(i) Name the other **two** main types of muscle tissues found in the human body.

Skeletal muscles, Cardiac muscles **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(ii) What is the muscle tissue type having multinucleate cells?

Skeletal muscles **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(iii) What is the muscle tissue type that acts voluntarily and rhythmically?

A free mark for any answer **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(iv) Name a place where smooth muscle tissues occur.

Esophagus / Stomach / small intestine / large intestine / alimentary canal / blood vessels / urinary bladder / uterus (any one) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

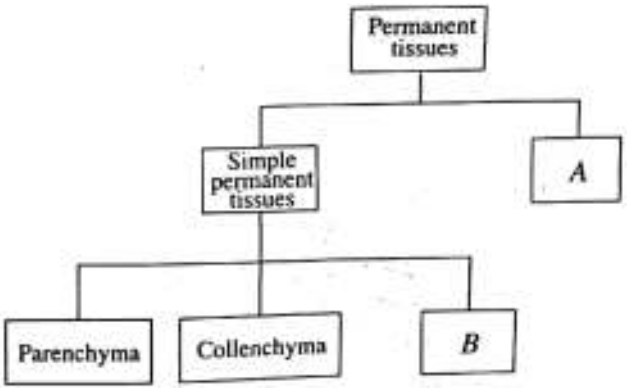
(v) Draw a sketch of a cell of the smooth muscle tissue.

Marking the nucleus (01); indicating the shape correctly (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*



(C) A figure on classification of plant tissues is given here.



(i) Name A and B.

A – complex permanent tissues; B – sclerenchyma tissue **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 4*

(ii) What is the simple permanent tissue type most abundantly seen in a plant body?

Parenchyma **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 4*

(iii) State a function of the collenchyma tissue.

Mechanical support / photosynthesis **01**

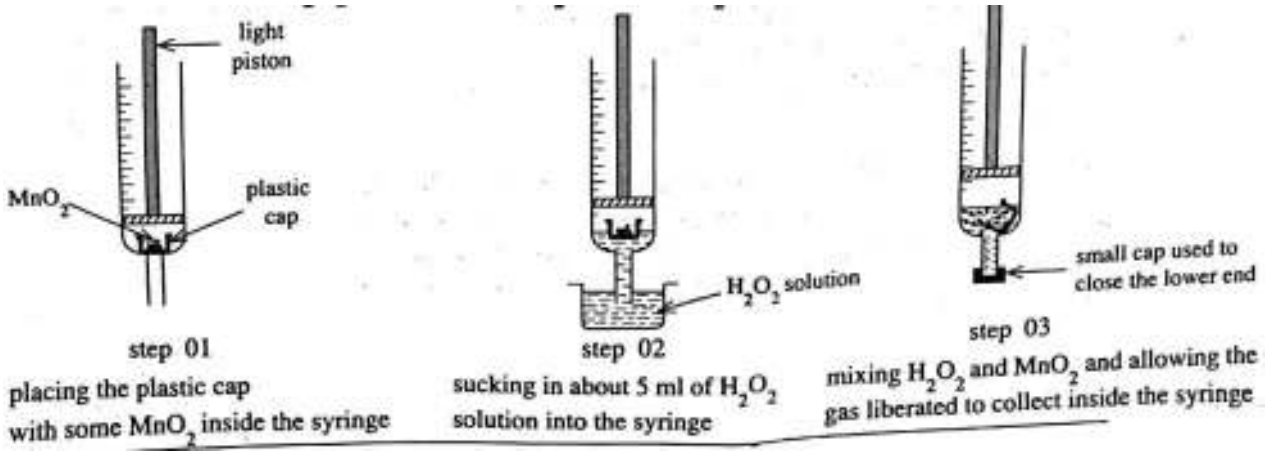
Total marks 20

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 6*

Question 6 — Decomposition of H_2O_2 and rusting

(A) The figures illustrate the steps of an experiment conducted by a group of students who studied the following reaction of hydrogen peroxide (H_2O_2).

Reaction : $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$



(i) According to the classification of reactions you learned, what type of a reaction is the above reaction?

(Chemical) decomposition reaction **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 89*

(ii) What is the function of manganese dioxide (MnO_2) in the above reaction?

Acting as a catalyst / Increasing the rate of the reaction (for any one) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 17 Rate of reactions, page 121*

(iii) From the moment the gas started collecting inside the syringe, the volumes of the gas produced were measured in six successive 10 second time intervals. The following table shows the results.

Time interval	**1**	**2**	**3**	**4**	**5**	**6**
Volume of gas collected /ml	14	9	5	3	1	0

(a) Calculate the rate of production of gas during the first time interval.

Rate = volume of gas collected / time

= 14 ml / 10 s = 1.4 ml s^{-1}

(for equation or substitution, 01; for the answer with the unit, 01) (If the final answer is written with the unit, 02) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 30*

(b) How has the rate of production of the gas changed with passage of time?

Decreased **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 30*

(c) Explain the reason for the variation you stated in (b) above.

decrease in the concentration of reactants / decrease in the amount of reactants / spending of reactant / H_2O_2 (for any one) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(iv) In the step 03 above, when the piston was removed after the collection of the gas and a glowing splint was introduced into the syringe, it lighted brightly. What property of the gas collected was the reason for this observation?

A supporter of combustion **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(v) State an industrial use of the gas collected in the syringe.

Welding metals / Oxy-acetylene flame / artificial respiration / Production of nitric acid / HNO_3 / Production of sulphuric acid / H_2SO_4 (for any one) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 106*

(vi) State an advantage of adopting the above method instead of preparing gases as indicated in the textbook.

Only a minimum amount of chemical substances is spent / disposed to the environment / Less equipment is needed / Mixing with ordinary air is minimized / Purer sample of gas can be collected / all the gas liberated can be collected / Less chances for accidents / minimizing the exposure to the chemicals / Less costly / can be done outside the laboratory / Can carry out individually (for any one) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 113*

(B) Figure (1) indicates how a straight cylindrical iron pillar planted on the bottom of a shallow sea has corroded after a few years.

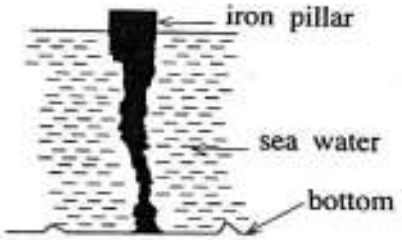


Figure (1)

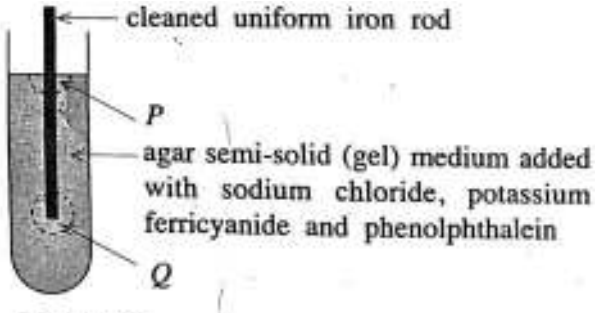


Figure (2)

The following hypothesis was proposed by a student who observed the iron pillar. 'In places where the contact between iron and oxygen is less, the rate of corrosion of iron is high.'

To test this hypothesis, the student assembled the set up shown in figure (2) and observed after a few hours. He could see that the area labelled Q has become blue in colour.

(i) What are the factors necessary for corrosion of iron?

Water / water vapour / H_2O / moisture (01); Oxygen / O_2 / air / O (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 107*

(ii) What species produced by the iron rod caused the blue colour in area Q?

Fe^{2+} / Ferrous (ions) / Iron(II) (ions) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 94*

(iii) (a) What colour could be observed in area P in this experiment?

Pink **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 98*

(b) Write the ion-electron half reaction causing the colour you stated above.

$2H_2O(l) + O_2(g) + 4e^- \rightarrow 4OH^-(aq)$ (state symbols are not compulsory) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(iv) What is the use of adding sodium chloride to the jelly medium?

Increasing conductivity (of the jelly medium) / Increasing the rate of corrosion / rusting / reaction / Creating a condition similar to that of sea water (for any one) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(v) Does the result of the experiment validate student's hypothesis?

Yes **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 24*

(vi) (a) State a method used to protect from corrosion, the iron hulls of ships which frequently come in contact with sea water.

Applying paint / Welding / sticking blocks of magnesium (Mg) or zinc (Zn) on the hull / using Mg or Zn as sacrificial metals / cathodic protection (for any one) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 109*

(b) Explain briefly, how the method you stated above contributes to reduce corrosion of iron.

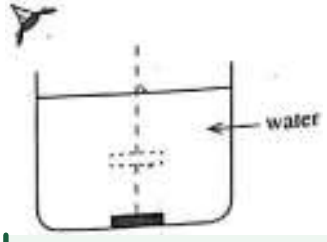
Reason (Applying paint) – Prevents iron from coming into contact with water and oxygen / Reason (Sacrificial metal Mg/Zn) – Iron acts as the cathode (for any one) **02**

Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 107*

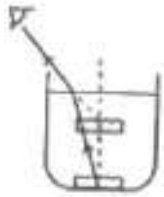
Question 7 — Refraction, electrical energy and motion

(A) (i) When a coin placed on the bottom of a vessel containing water is viewed from top, the coin appears as if it is raised above the bottom. Copy figure (1) in your answer script and draw the ray diagram which shows how the coin appears raised like that.



for refracted ray (01); for producing the ray (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 137*



(ii) Figure (2) below illustrates three instances of the incident angle in the denser medium of a light ray travelling from a denser medium to a rarer medium.

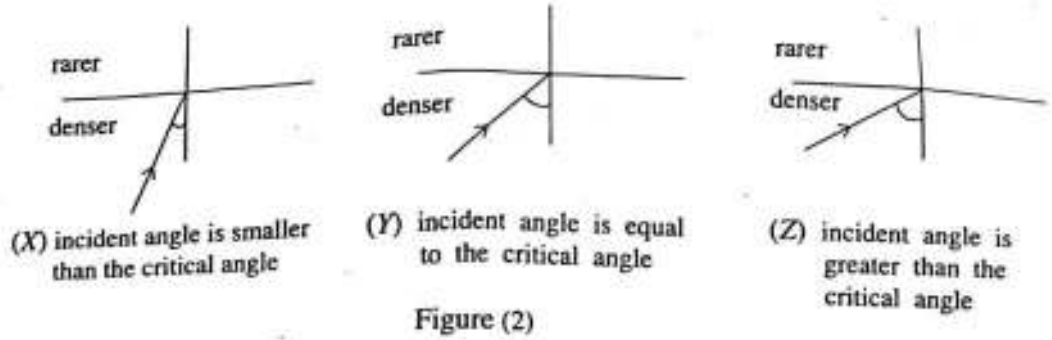


Figure (2)

(a) What is meant by the critical angle?

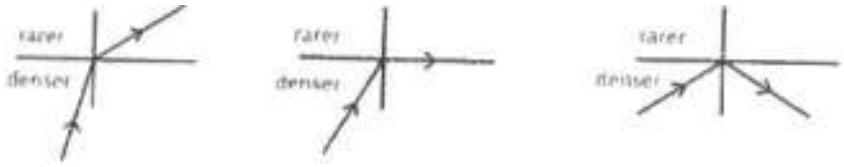
It is the angle of incidence in the denser medium at the instance when the angle of refraction in the rarer medium is 90° / the refracted ray travels along the interface between the two media when a ray of light travels from a denser medium to a rarer medium. **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 141*

(b) Copy figure (2) in your answer script and complete the ray diagrams in instances (X), (Y) and (Z) indicating the continued path of the ray.

(X) ray refracted away from the normal (01); (Y) refracted ray along the interface (01); (Z) ray totally reflected back into the denser medium (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 122*



(c) Name the phenomenon occurring in the instance (Z) in figure (2).

Total internal reflection **01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 125*

(d) Give examples for **two** occasions in which the phenomenon stated in (c) above is made use of.

cutting and polishing gems / prism binocular / endoscopy instrument / optical fibers / decorations / telecommunication / observing internal parts of the body / periscope / reflectors (for any two) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 124*

(B) The time spent for boiling a quantity of water required to prepare four cups of tea using an electric kettle which indicates that its power is 1000 W is three minutes.

(i) Calculate the amount of electric energy spent here.

E = Pt

= 1000 (W) × 3 × 60 (s) (01) (for equation or substitution)

= 180,000 (J) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 136*

(ii) How much is that amount of electrical energy in kWh? (1 kWh = 3.6×10^6 J)

= 180,000 (J) / 3.6×10^6 (J kW-1 h^{-1}) **01**

= 0.05 (kW h) **01**

Or = (watt value × hours) / 1000 **01**

= (1000 × 3) / (1000 × 60) = 0.05 (kW h) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 136*

(iii) How much is the amount of electrical energy wasted in kWh, if an amount of water required to prepare eight cups of tea was boiled to prepare four cups of tea?

Amount of electrical energy for eight cups of tea = 0.05 kW h × 2 = 0.10 kW h

The amount of electrical energy wasted = 0.10 kW h – 0.05 kW h = 0.05 (kW h) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 29*

(C) When a motor car runs with a uniform speed of 10 m s^{-1} (36 km h^{-1}) on a rectilinear road, the driver of the car sees a barrier placed at a distance of 4 m. In this instance, he applies brakes to avoid an accident. The time that elapses from the moment of deciding that brakes be applied to putting the application of brakes into effect, that is his reaction time is 0.2 s.

(i) Find the distance travelled by the car during the time of 0.2 s.

speed = distance / time; distance = speed × time

= 10 (m s^{-1}) × 0.2 (s) = 2 (m) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 28*

(ii) The retardation applied by the brakes was 40 m s^{-2} and the distance travelled under that retardation till the car stopped was 1.25 m.

(a) Could the driver avoid the accident?

Yes / can **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 29*

(b) If the mass of the car was 1000 kg, what was the force applied by the brakes?

F = ma

= 1000 (kg) × 40 (m s^{-2}) **01**

= 40,000 (N) (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 29*

(c) Explain by a calculation, whether the accident could have been avoided by applying the above force in an instance where the reaction time was 0.3 s of a driver who was sleepy or under the influence of liquor.

speed = distance / time; distance = speed × time = 10 (m s^{-1}) × 0.3 (s) = 3 (m)

Distance travelled during reaction time = 3 m; distance travelled with retardation = 1.25 m **02**

∴ Total distance travelled is 4.25 m **01**

(As the barrier is 4 m away) vehicle couldn't be stopped **01**

Total marks 20

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 29*

Question 8 — Biomolecules and electric circuits

(A) Proteins, lipids and nucleic acids are three basic types of organic compounds contained in living matter.

(i) Why are proteins, lipids and nucleic acids called organic compounds?

(because those compounds) contain carbon (C) (as a component) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 1*

(ii) State **two** elements that may be contained in proteins but **not** contained in lipids.

Nitrogen / N, Sulphur / S **02**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 1*

(iii) Name the structural unit of proteins.

Amino acids **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 7*

(iv) State a common function of the compounds proteins and lipids.

Acting as sources of energy / As components of structures / as storage functions / production of hormones **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 1*

(v) There are two major types of nucleic acids. One of them is called DNA. What is the other type?

RNA / (Ribonucleic Acid) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 12*

(vi) In a living cell, name the organelle that contains DNA.

Nucleus / mitochondria **01**

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 1*

(vii) Explain how the genotype of an organism is changed in gene technology.

Removing some parts of DNA from genes **or** introducing parts of DNA to genes / making changes in genes **01**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 188*

(viii) Name the species of micro-organisms used to produce insulin by means of gene technology.

E. coli or bacteria **01**

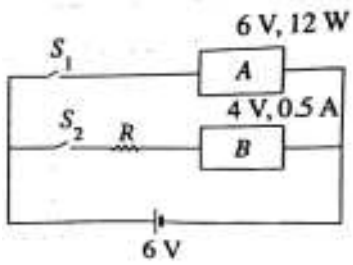
▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 189*

(ix) It is required to verify that a crime was committed by the suspect of that crime using a sample of hair collected from the site of that crime. State how gene technology is used for it.

Comparing the DNA of those hairs with the DNA of the suspect **01**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 189*

(B) The figure shows how two electrical appliances A and B are connected to a 6 V battery. It is indicated that the specifications of A are 6 V, 12 W and the specifications of B are 4 V, 0.5 A. S_1 and S_2 are two switches.



(i) Name the way A and B are connected to the circuit.

In parallel **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 70*

(ii) What is the current flowing through A when switch S_1 is closed?

P = VI

12 (W) = 6 V × I (for equation or substitution 01)

I = 2 (A) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 145*

(iii) What is meant by stating the specifications of B as 4 V, 0.5 A?

When a potential difference of 4 V is applied across B, the current flowing through it is 0.5 A — 02 or 00 **02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 149*

(iv) When switch S_2 is closed, appliance B should operate according to specifications.

(a) For this, what should be the potential difference across R?

2 V **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 149*

(b) What is the current flowing through R in this instance?

0.5 A **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 63*

(c) Calculate the due value for R.

V = IR; R = V/I

= 2 (V) / 0.5 (A)

= 4 (Ω) (for equation or substitution 01; for answer 01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 70*

(v) How much is the current drawn from the battery when both the appliances operate?

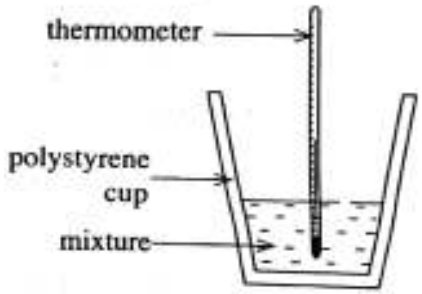
2 A + 0.5 A = 2.5 A (for the answer 01) **01**

Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 63*

Question 9 — Neutralization and electromagnetism

(A) A student added 50 cm^3 of hydrochloric acid (HCl) solution, concentration 0.1 mol dm^{-3} at 30 °C to a polystyrene cup and introduced a thermometer into it. Afterwards, 50 cm^3 of sodium hydroxide (NaOH) solution, concentration 0.1 mol dm^{-3} at 30 °C were added to the same cup.



(i) The maximum temperature, the mixture reached after mixing the two solutions was 38 °C. Explain the reason for the rise in temperature of the mixture.

(Acid-base neutralization) reaction is exothermic. / When the reaction takes place, energy is released to the environment. **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(ii) State,

(a) a change in the above set up

Closing the mouth of the cup with the heat insulating / polystyrene lid / Placing the cup in another cup **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(b) a change in the concentration of reactants

Increasing the concentration of the reactants **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

that should have been done to bring the maximum temperature reached by the mixture to a value above 38 °C.

(iii) It is expected to repeat the experiment using an amount of solid NaOH which contains the same amount of moles of NaOH that was present in the volume of NaOH solution used in the above experiment. A student states that the maximum temperature the mixture reaches will be 38 °C in this case also.

(a) Do you agree with this statement?

No **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 207*

(b) Explain the reasons for your answer.

Evolution of heat when solid NaOH dissolves / Change of heat change with the physical states / Decrease in the total volume of the mixture (for any one) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 207*

(iv) (a) Write the balanced chemical equation for the reaction taking place in this experiment.

$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(aq)$ (Disregard physical states) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(b) Explain the reason why this reaction is called a neutralization reaction.

$H^+ + OH^- \rightarrow H_2O$ / Because H^+ ions and OH^- ions combine to form water / acid and base react and form water and salt (for any one) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(v) Why hydrochloric acid is considered a strong acid?

Because it completely ionises in aqueous solution releasing H^+ ions ($HCl \rightarrow H^+ + Cl^-$) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(vi) State an industrial use of sodium hydroxide.

Production of soap / Production of paper / Production of artificial silk and dyes / Refining petroleum products (for any one correct answer) **01**

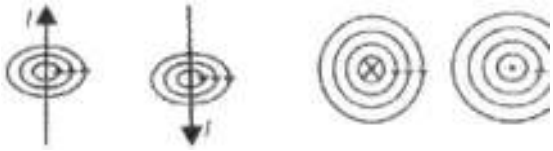
▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 195*

(B) (i) A magnetic field is created around a straight conductor carrying an electric current.

(a) Using a diagram, illustrate the direction of the current flowing through such a conductor and also the shape and direction of the magnetic lines of force created by it.

Concentric circles around the conductor, their direction given by the direction of the current (for drawing any diagram correctly) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 119*

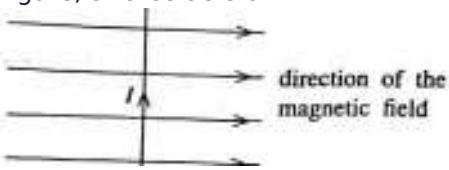


(b) Present examples for **two** instances where electromagnets are made by modifying the conductor as a coil and sending a current.

Electric bell, electric crane, relay switch, door lock, MRI (for any two correct answers 1 × 2) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(ii) When a conductor carrying a current is placed perpendicular to a magnetic field as shown in the figure, a force acts on it.



(a) State **two** factors affecting the magnitude of the force acting on the above conductor.

Strength of the magnetic field / Length of the conductor / Current flowing / magnitude of the current (for any two correct answers 1 × 2) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 122*

(b) Name the rule used to find the direction of the force acting on the conductor.

Fleming's left hand rule (give marks for stating the rule also) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 122*

(c) Present examples for **two** instances in which the force generated as above is made use of.

Electric motor / Speaker / galvanometer / ammeter / voltmeter (1 × 2) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 117*

(C) The production of electricity in a hydroelectricity power plant is based on the principle of electromagnetic induction.

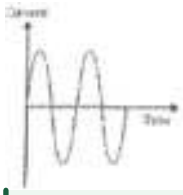
(i) Explain briefly what is electromagnetic induction.

Induction of an electromotive force across a conductor when the magnetic field affecting it changes OR generation of an electromotive force across a conductor when it is kept still in a changing magnetic field or when it moves in a steady magnetic field **01**

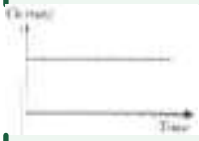
▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 132*

(ii) Illustrate separately and graphically, how the electric current produced by a hydroelectricity power plant and the electric current produced by a solar panel varies against time.

Electric current produced by a hydroelectricity plant: alternating (sinusoidal) current against time **01**



Electric current produced by a solar panel: constant (direct) current against time (01) **02**



Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 141*

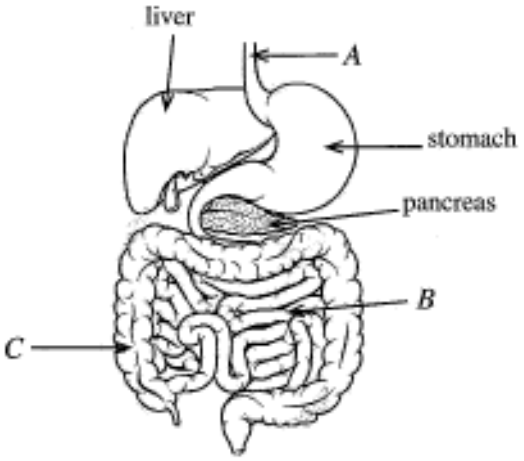
Paper II • 2022 (2023)

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — Digestion, blood and coordination

(A) Given below is a sketch of the human digestive system.



(i) Name the parts A, B and C.

A – Oesophagus (01); B – Small intestine (01); C – Large intestine / Colon (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 144*

(ii) What is the function of the bile produced in the liver in the process of food digestion?

Emulsification (of lipids / fats) / breakdown of lipids into small droplets / makes the medium basic **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(iii) What is the protein digestive enzyme contained in pancreatic juice?

Trypsin **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(iv) State **three** adaptations in structure B to absorb digested end products of food to blood efficiently.

Being a long tube; presence of circular folds in the inner wall; presence of villi (on the circular folds); presence of microvilli (in villi); walls (of villi) becoming thin; (villi are) highly vascularized — any three of the above **03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 148*

(v) What is the function performed by C?

Absorption of water **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 144*

(vi) Inflammation of inner lining of mucosa of stomach is a common disease. What is the name of that disease?

Gastritis **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 149*

(B) Blood is a specialized connective tissue.

(i) State **one** function of connective tissues.

Provide a connection between tissues and various organs / provide support / rigidity / connect tissues — 01 mark for any of the above **01**

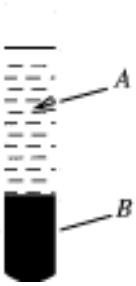
▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

(ii) A main feature seen in other connective tissues is not seen in the blood tissue. What is this feature?

The matrix (plasma) is not secreted by the blood cells / fibres are not found under normal condition — for one of the above **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

(iii) When blood is centrifuged, it separates into two parts as shown in the diagram.



(a) In this, by what name is part A known?

(Blood) plasma **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

(b) By what name are the nucleated, irregular cells contained in part B commonly known?

White blood cells / WBC / leukocytes **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 164*

(c) State a function performed by the cells you mentioned in (b) above.

Destroying germs (such as bacteria by phagocytosis) / engulfing germs / producing antibodies / providing immunity — for one of the above **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

(C) Two systems in the human body operate to maintain coordination and homeostasis. One of them is the nervous system.

(i) What is the other system relevant to the maintenance of coordination and homeostasis?

Endocrine system / ductless gland system **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 184*

(ii) State briefly the meaning of homeostasis.

Maintaining internal environment of the body unchanged **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 184*

(iii) What is the structural unit of the nervous system?

Neurone / nerve cell **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 184*

(iv) In a reflex action, the pathway taken by the impulses is called the reflex arc. State in the form of a flow chart, the reflex arc from the receptor to the effector in sequential order.

Receptor → sensory neuron → intermediate neuron (relay neuron / interneuron) → motor neuron → effector

Give two marks if all the steps are correct; only one mark if receptor and effector are missing (02) — total 20 marks

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 177*

Question 6 — Hydrocarbons and carbon dioxide

(A) At present light automobiles are run mainly by burning fossil fuels such as petrol (gasoline). The hydrocarbon octane (C_8H_{18}) is the main component contained in petrol.

(i) Explain briefly what hydrocarbons are.

Compounds containing the elements carbon / C and hydrogen / H **only** (02/00)

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 152*

(ii) (a) Based on the common formula of alkanes, verify that octane is an alkane.

CnH_{2n+2} **01**

$C_8H_{2\times8+2} = C_8H_{18}$ (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 154*

(b) Name a hydrocarbon that belongs to the alkane series and exists in the gaseous state at room temperature.

CH_4 (methane) / C_2H_6 (ethane) / C_3H_8 (propane) / C_4H_{10} (butane) — any one **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 155*

(iii) The balanced chemical equation relevant to the complete combustion of octane is given below.

$$2\ C_8H_{18}\ (l) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O\ (l)$$

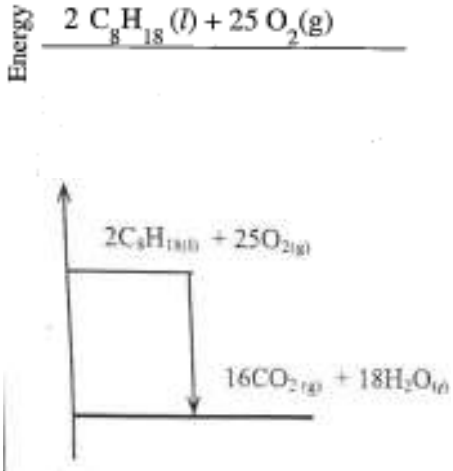
(a) Calculate the mass of carbon dioxide released to the environment by complete combustion of one mole of octane (Relative Molecular Mass of CO_2 = 44).

Amount of moles of CO_2 / carbon dioxide = 16/2 or 8 (mol) **01**

Mass of CO_2 / carbon dioxide = 8 × 44 g = 352 (g) (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 7 Quantification of elements and compounds, page 134*

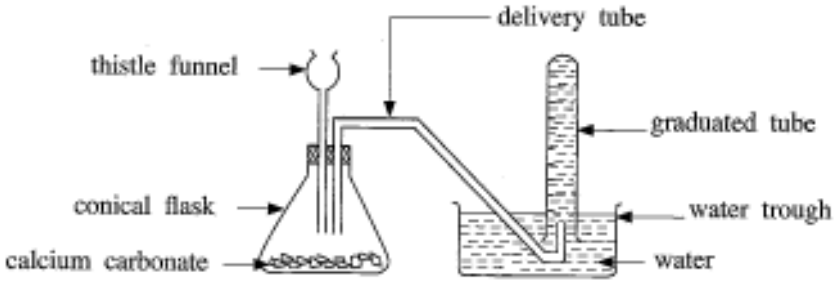
(b) An incomplete energy level diagram relating to complete combustion of octane is given below. Copy it in your answer script and complete.



Products 16 CO_2(g) + 18 H_2O(l) shown at a lower energy level than the reactants: indicating reactants and products correctly with state symbols (01); arrow pointing downwards (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(B) An apparatus set up by a student to collect a specifically measured volume of carbon dioxide gas using the method of downward displacement of water is given below.



Dilute hydrochloric acid is allowed to drip on the pieces of calcium carbonate through the thistle funnel and carbon dioxide gas is produced by the reaction between those two.

(i) What change should be made in this set up to prevent the escape of the gas produced through the thistle funnel?

Lowering the thistle funnel / lowering the thistle funnel till its end is below the acid level — give marks for correct diagram also **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(ii) What is the advantage of using a small conical flask rather than a large conical flask here?

Obtaining a more pure sample of the gas / more reactants are not required / gas can be collected in a shorter period of time (as pressure increases when the volume decreases) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(iii) Write the balanced chemical equation indicating the reaction between calcium carbonate and hydrochloric acid.

$CaCO_3 + 2\ HCl \rightarrow CaCl_2 + H_2O + CO_2$

Indicating reactants and products correctly (01); balancing the equation (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(iv) If an equal mass of powdered calcium carbonate was used instead of pieces of calcium carbonate, required volume of the gas can be collected in a shorter period of time. Explain briefly the reason for this.

Surface area increases when powder is used compared to the use of chips	01
Hence, the rate of the reaction increases (because the number of collisions increases) (01)	02

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(v) (a) Name another method for collecting carbon dioxide gas when the measurement of the volume of the gas is **not** required.

Upward displacement of air	01

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 108*

(b) What physical property of carbon dioxide gas is made use of in the method you stated in part (a) above?

Density / density is higher than that density of air	01

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(vi) State a test that can be used in the school laboratory to identify carbon dioxide gas and the observations of it.

Passing / bubbling carbon dioxide / CO_2 gas into lime water	01
(Colourless) lime water turning milky / white (01)	02

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

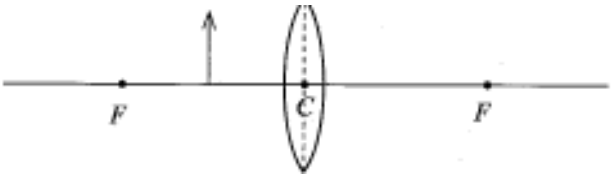
(vii) State an instance where non-combustible property of carbon dioxide is made use of.

Extinguishing fires (01) — total 20 marks	

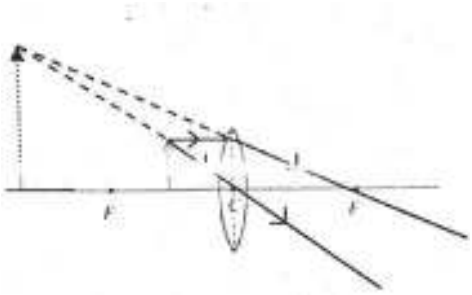
▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

Question 7 — Lenses, resistors and heating

(A) The following diagram illustrates how an object is placed between the optical centre and the focus of a glass convex lens.



(i) (a) Copy this diagram in your answer script and draw a ray diagram to construct the image formed.



Drawing correct ray diagram disregarding arrow heads (01); drawing the image correctly (01)	02

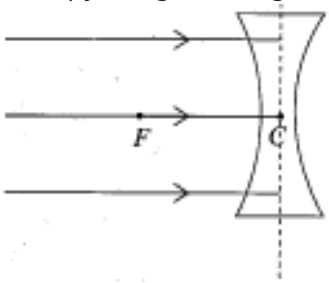
▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 137*

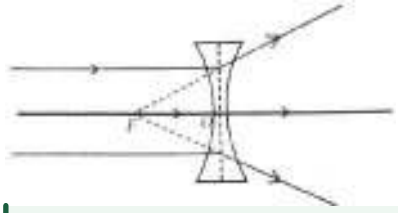
(b) State **two** characteristics of that image.

Upright / erect; virtual; larger than the object / magnified; the image is formed in the same side where the object is placed — give 01 mark for a correct answer (01 × 2)	02

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 137*

(ii) (a) Copy the given diagram in your answer script and complete the ray diagram.





Drawing the ray going through the principal axis with arrow heads (01); drawing the other two rays with arrow heads, as diverging from the focus (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 130*

(b) Whatever is the distance of placing an object in front of a concave lens, the image that can be seen has the same characteristics. State **two** characteristics of that image.

Upright / erect; virtual; image smaller than the object / reduced / diminished; object and the image are on the same side — give 01 mark for a correct answer (01 × 2) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 134*

(B) (i) Assume that you are provided with four resistors, each with a resistance of 2 Ω.

(a) Draw a diagram indicating, how those can be connected to obtain the highest equivalent resistance.



The four 2 Ω resistors connected in series (either symbol) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 162*

(b) What is the name used to identify the way the resistors are connected as mentioned above?

Series arrangement **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 161*

(c) What is the equivalent resistance of that arrangement of resistors?

8 (Ω) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 162*

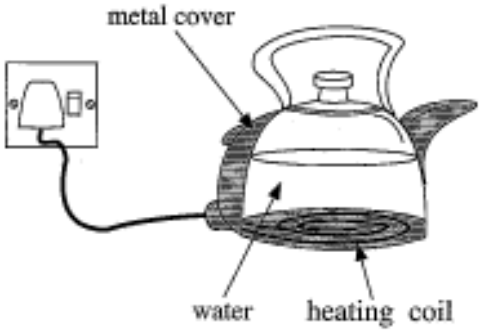
(d) If this arrangement of resistors was connected to a battery with an electromotive force of 8 V, what is the current flowing through the circuit?

V = IR or 8 (V) = I × 8 (Ω) **01**

I = 1 (A) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 163*

(C) The diagram shows a kettle with a heating coil. The kettle contains 1 kg of water.



(i) What is the main method of transmission of heat produced by the heating coil throughout the entire mass of water?

Convection **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 12*

(ii) Calculate the amount of heat received by water when water in the kettle was heated from 25 °C to 50 °C. (Specific heat capacity of water = 4200 J kg^{-1} $°C^{-1}$)

Q = mcθ or Q = 1 (kg) × 4200 (J kg^{-1} $°C^{-1}$) × 25 (°C) **01**

Q = 105 000 (J) / 105 (kJ) (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(iii) State **two** properties which a metal used to make the heating coil should necessarily have.

High resistance / high resistivity; high melting point; resisting corrosion — give one mark for each correct answer (01 × 2) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 13*

(iv) When using this kind of a kettle, using a three pin plug is a must. State the reason for it.

To earth the current (01) in case where a leakage of current occurs to the metallic cover (01) / to prevent electric shocks (01) — give marks for a similar answer (02) — total 20 marks

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 44*

Question 8 — Plants, animals and an electric bicycle

(A) A study was conducted by a student on the home garden and the outer environment of his home situated in a rural area. Answer the following questions related to the phenomena identified by him therein.

(i) Both the papaw plants in the garden had produced flowers. But, of the two plants, always only one plant produced fruits. Explain the reason for this.

The plant that didn't produce fruits has only staminate flowers / is dioecious **01**

The plant which sets fruits has pistillate flowers (01) — award marks for a similar idea **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 36*

(ii) Though the jasmine plant grown in the garden produces many flowers, those flowers do not produce fruits. Hence, state an artificial vegetative propagation method that could be adopted to obtain a new sapling from a jasmine plant.

(Ground) layering **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 59*

(iii) It was observed that the stamens of the flowers of a Clerodendrum paniculatum (pinna/pagoda plant) plant in the garden are turned away from the stigma. What is the importance of that adaptation?

To prevent self-pollination / to effect cross pollination **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 37*

(iv) When a small animal staying on a plant leaf was observed by a hand lens, jointed appendages and a segmented body could be seen. Name the phylum to which that animal belongs.

Arthropoda **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 168*

(v) In a fallen plant leaf, the fleshy parts were decayed while the veins were left. A diagram of it is given here.



(a) By what name is this venation known?

Reticulate venation **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 14*

(b) Describe briefly the nature of the root system of the plant with these leaves.

Presence of a tap root and lateral roots arising from it / presence of a tap root system — only "tap root": 01 mark **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 14*

(vi) It was observed that an animal with four limbs staying on a decayed log had a moist skin without scales. What is the class of vertebrates to which this animal belongs?

Amphibia **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(B) The diagram illustrates an improved bicycle. It is constructed in such a way that it can be pedalled by a man as well as run by an electric motor.



(i) (a) Write the transformation of energy that occurs when a man pedals the bicycle.

Chemical energy → kinetic energy **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(b) Write the transformation of energy that occurs when the bicycle is run by the motor.

(Chemical energy) → electrical energy → kinetic energy **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(ii) (a) The voltage supplied to the motor by the battery is 50 V while the maximum power of the motor is 250 W. What is the current drawn from the battery when the motor operates with this power?

P = VI or 250 W = 50 V × I **01**

I = 5 (A) (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 33*

(b) The capacity of the battery is indicated as 10 A h (10 Ampere hours). This means that the battery gets fully discharged in one hour when a current of 10 A is drawn from it. When the current calculated in (a) above is drawn, what time is taken by the battery to discharge completely?

02 (hours) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(c) Find the total distance that can be travelled if the bicycle is to run only by the motor at a constant speed of 30 km h^{-1}, at its maximum power, until the fully charged battery becomes completely discharged.

60 (km) — if the above answer (b) is incorrect, 01 mark for correctly using it **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(iii) Suggest two eco-friendly methods that could be used to charge the battery of this bicycle without using the national electricity grid.

Solar cells / solar panels; wind power / wind mill; charging during the pedalling of the bicycle (kinetic energy of the bicycle moving — should explain how a dynamo works) — for any two (01 × 2) (02) — total 20 marks

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

Question 9 — Salt extraction and Archimedes' principle

(A) Extraction of common salt (sodium chloride) from sea water is a chemical industry carried out in Sri Lanka.

(i) State **two** environmental factors that should be present in a location suitable to install a saltern.

A flat land; closer to a coastal area to obtain sea water easily; presence of a clayey soil with minimum percolation of water; prevalence of dry and hot climate with wind; presence of bright sunlight throughout the year; an area with minimum rainfall — give marks for any two (01 × 2) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 64*

(ii) Name the **two** separating techniques relating to the extraction of salt from sea water.

Evaporation, crystallization (01 × 2) **02**

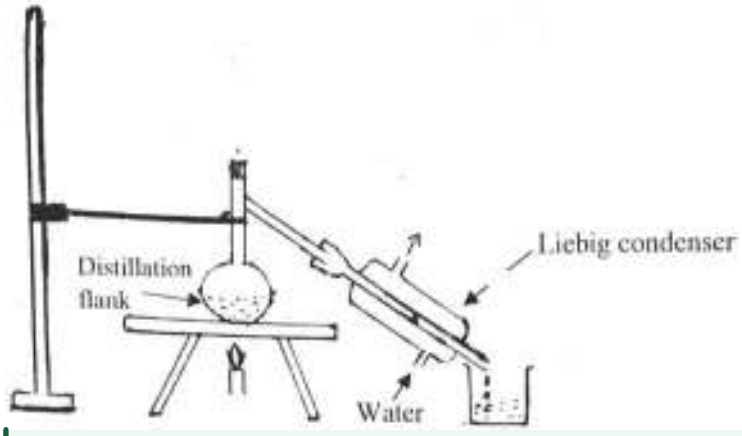
▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 64*

(iii) Salt taken out from the saltern is heaped as prismatic piles and kept for about six months. What is the reason for this?

To remove magnesium (Mg) salts / to remove $MgCl_2$ / $MgSO_4$ **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 65*

(iv) Some countries in the world obtain drinking water by simple distillation of sea water. Draw a labelled sketch of an apparatus suitable to demonstrate that separating technique in the school laboratory.



Indicating heat or a heating device (01); connecting a Liebig condenser (01); naming at least one piece of equipment (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 58*

(v) During the electrolysis of acidulated water, it was observed that gas bubbles liberate at the electrodes.

(a) At which electrode is a greater volume of gas evolved here?

Cathode / negative electrode / (–) electrode **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 113*

(b) What is the gas evolved at that electrode?

Hydrogen / H_2 **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 113*

(B) (i) Write Archimedes' principle.

When an object is partially or completely immersed in a fluid / liquid / water (at rest) the up-thrust acting on it is equal to the weight of the fluid / liquid / water displaced by the object **01**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 79*

(ii) When a rubber ball pressed to the bottom of a reservoir with water at rest was released, it could be observed that the ball moved to the surface of water.

(a) Action of which force on the ball is the reason for the above observation?

Upthrust / upthrust force **01**

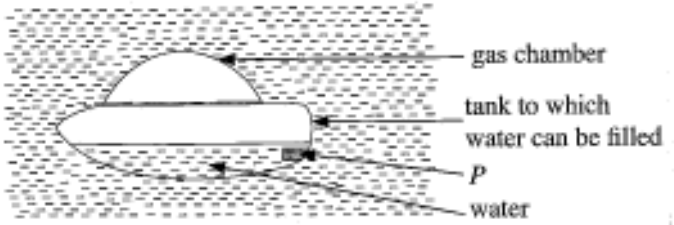
▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 79*

(b) State **two** factors on which the magnitude of the force you mentioned above depends.

Density (of liquid) (01); volume (of the object or ball) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 83*

(iii) The figure illustrates an equipment with a gas chamber and a tank to which water can be filled. Using the device P, water can be filled into and removed from the tank. The figure shows how it stays floating in water when water is filled to a certain volume of the tank.



(a) Based on the forces acting on the equipment, explain the reason why the equipment stays floating in water.

The up thrust acting on the object and the weight of the object are equal in magnitude and (opposite in direction) / weight of the object = up thrust acting on the object (W = U) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(b) What change in the position of the equipment will occur if an extra amount of water is added to the tank?

Equipment moves downward / equipment sinks more in the water **01**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 75*

(c) In terms of the forces acting on the equipment, explain the reason for the change you stated in (b).

The weight of the equipment is greater than the up thrust exerted by water on the object **02**

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(d) Name a craft that has been created to travel on the surface of water and inside water using an arrangement such as the one given above.

Submarine / submersible (01) — total 20 marks

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 75*

Paper II • 2021 (2022)

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — Respiration and photosynthesis

(A) Respiration is a biological process. The system organized for it is called the respiratory system.

(i) Write **two** changes occurring in inhaled air when it passes through the nasal cavity of man.

Moisturizing or humidifying inhaled air; bringing inhaled air to the body temperature; removal of impurities or foreign bodies from inhaled air — for any two **02**

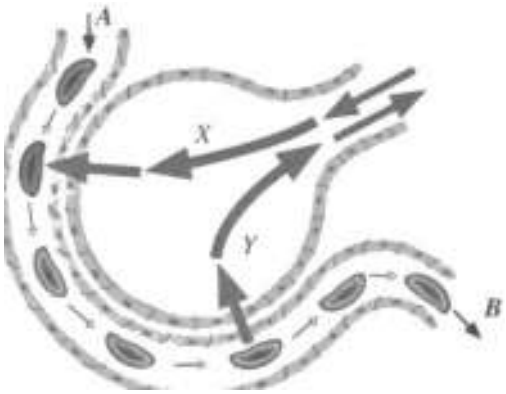
▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 152*

(ii) Name the **two** structures which contain muscles contributing to increase the volume of the thoracic cavity during inspiration.

Diaphragm (01); ribs — give marks even for inter-costal muscles (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 152*

(iii) A sketch of an alveolus in which gas exchange takes place in the respiration of man is given below. Indicated as X and Y in the figure are two types of gases that exchange in the alveolus.



(a) Name gas X and gas Y in respective order.

X - O_2 / oxygen (01); Y - CO_2 / carbon dioxide — give marks even for H_2O or water vapour (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 154*

(b) By what process does gas exchange occur between alveoli and blood capillaries?

Diffusion **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 153*

(c) What is the main difference between the blood that enters the capillary at A and the blood that leaves the capillary at B?

A - oxygen concentration is low, B - oxygen concentration is high / A - deoxygenated blood, B - oxygenated blood / A - CO_2/HCO_3^- concentration is high, B - CO_2/HCO_3^- concentration is low — for any one **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 153*

(d) State an adaptation of alveoli to make the gas exchange efficient.

Alveolar walls being thin / alveolar walls being wet / alveolar walls being permeable / presence of a blood capillary network around alveoli / presence of a large number of air sacs — for any one **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 154*

(e) By what name is the ailing condition of gradual destruction of alveoli due to accumulation of compounds based on silica in alveoli known?

Silicosis — [total for (A) 10] **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 153*

(B) The process of producing food in green plants is called photosynthesis.

(i) Write the energy transformation occurring in the process of photosynthesis.

Light energy → chemical energy **01**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 28*

(ii) State how atmospheric carbon dioxide necessary for photosynthesis enters plant leaves.

Diffuses (01) into leaves through stomata (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 21*

(iii) "It is not possible to show water is an essential factor for photosynthesis by a simple laboratory experiment." Do you agree with this statement? Give a reason to validate your answer.

Yes **01**

Because without water the plant will die / cannot set up a control experiment without water (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 2 Photosynthesis, page 26*

(iv) The water essential for photosynthesis is absorbed by roots and transported to plant leaves through the xylem tissue.

(a) Of the cells that form the xylem tissue, what are the types of cells that contribute to transport water?

Xylem vessels (01); tracheids (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 8*

(b) In addition to water, name another substance that is transported through the xylem tissue.

Minerals **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 8*

(c) In addition to transport function, state the other function carried out by the xylem tissue.

Providing mechanical strength / support / rigidity to the plant **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 7*

(d) Describe briefly how the cells in the xylem tissue are adapted to fulfil the function you stated in (c) above.

Lignification (of cell wall) or (cell walls) are lignified — [total for (B) 10; total 20] **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 9*

Question 6 — Sodium hydroxide and polymers

(A) Sodium hydroxide (NaOH) is a basic chemical compound. It acts as a strong base in an aqueous solution.

(i) Explain what is a base according to the way it behaves in an aqueous solution.

Compounds that increase the OH^- ion concentration (in an aqueous solution) or compounds that release OH^- ions (to an aqueous solution) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 194*

(ii) Why is sodium hydroxide called a strong base?

Because NaOH completely dissociates / ionizes (in an aqueous solution) or $NaOH(aq) \rightarrow Na^+(aq) + OH^-(aq)$ — physical states are **not** essential **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 194*

(iii) Name an industrial use of sodium hydroxide.

In the production of soap / paper / artificial silk / dyes / medicine or refining petroleum products — for any one **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 195*

(iv) For a laboratory experiment, a student prepared 500 cm^3 of a sodium hydroxide solution with concentration of 1.00 mol dm^{-3}.

(a) Name **two** laboratory glassware required to prepare the above solution.

Volumetric flask / watch glass / funnel — for any two **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 47*

(b) How much is the mass of sodium hydroxide required to prepare the above solution? (H = 1, O = 16, Na = 23)

Molar mass of NaOH = 23 + 16 + 1 = 40 (g mol^{-1}) **01**

Number of moles of NaOH = (1/1000) × 500 = 0.5 mol **01**

Mass of NaOH = 0.5 × 40 = 20 g (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 46*

(c) It was experimentally found that the concentration of the solution prepared by the student was a little less than 1.00 mol dm^{-3}. State **two** errors that would have happened in the preparation of the solution causing that defect.

Weighing NaOH less than the amount required / not transferring all NaOH to the flask / overlooking errors in the balance / not weighing accurately / addition of water in excess / not using distilled water — for any two — [total for (A) 10] **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

(B) The following flow chart indicates the manufacturing process of a commonly used polymer P starting from crude oil.

crude oil → (A) →	**naphtha → (chemical synthesis) →**	**ethene (C_2H_4) → (polymerisation) →**	**P**

(i) (a) The letter A indicates a separating technique. Name that technique.

Fractional distillation **01**

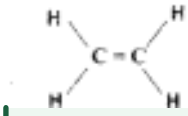
▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(b) State a solid component that can be separated from crude oil using the technique you mentioned in (a) above.

Wax (paraffin) / bitumen / tar / asphalt / grease — for any one **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(ii) Draw the structural formula of the ethene molecule.



Two C atoms joined by a double bond, each bonded to two H atoms (02); for $CH_2 = CH_2$ (01) only

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 156*

(iii) Name the polymer indicated by the letter P.

Polythene / polyethylene / polyethene **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 160*

(iv) Ethene can be polymerised. But, ethane cannot be polymerised. What is the reason for this?

Absence of double bond in ethane / presence of only single bonds in ethane / ethane is an alkane / presence of a double bond in ethene / ethene is an alkene — for any one **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 157*

(v) The equation relevant to the complete combustion of ethene is given below.

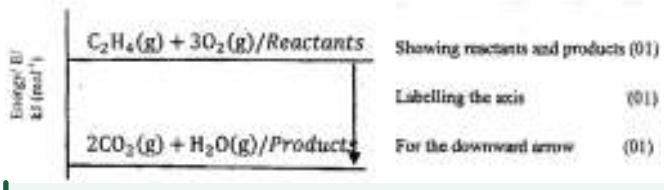
$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + \mathbf{x}\ H_2O(l) + \text{heat}$$

(a) What is the value relevant to × in the above equation?

x = 2 or $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l) + (heat)$ **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(b) Sketch the energy level diagram relevant to the complete combustion of ethene indicating the levels where reactants and products exist.

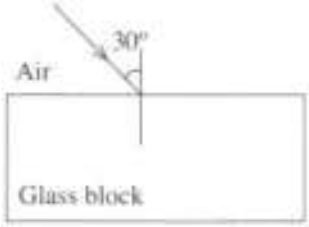


Showing reactants (upper level) and products (lower level) (01); labelling the axis (energy / kJ mol^{-1}) (01); for the downward arrow (01) — [total for (B) 10; total 20] **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

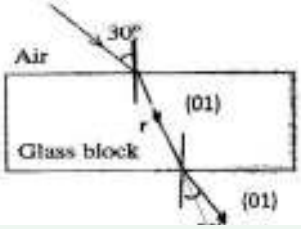
Question 7 — Refraction of light and heat

(A) The diagram shows how a ray of light coming through air falls on a block of glass. That ray of light travels through the glass block and emerges into the air again.



(i) Draw the rough sketch of the complete path of the light ray on your answer script.

(ii) In the sketch, mark the angle of refraction 'r' relevant to the first refraction of the ray.



(i) ray bending towards the normal inside the block (01); emergent ray parallel to the incident ray (01)	**02**
(ii) showing 'r' in the diagram	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(iii) Write the equation which shows the relationship between the angle of incidence and angle of refraction. (Consider that the refractive index of glass with respect to air is n.)

n = sin i / sin r or n = sin 30° / sin r or sin r = sin 30° / n or sin r = 1/(2n)	
or n = (sin value of angle of incidence) / (sin value of angle of refraction)	**02**

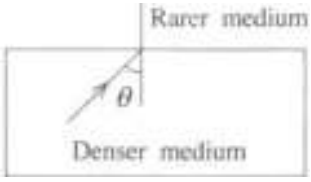
▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 123*

(iv) What is the value of the angle of emergence of the light ray?

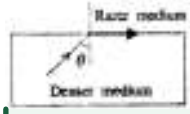
30° or showing 30° in the diagram	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 121*

(v) The following diagram indicates how a light ray travelling from a denser medium to a rarer medium falls on the interface.



(a) What is the path of the refracted ray when the angle of incidence θ in the denser medium is equal to the critical angle?



the refracted ray grazes the surface (as drawn) or travels along the interface	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 141*

(b) By what name is the phenomenon happening known when the angle of incidence θ in the denser medium is greater than the critical angle?

Total internal reflection	**01**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 141*

(c) Write **two** examples for instances where the phenomenon in (b) above is made use of.

Optic fibres / internet connections / periscope / endoscope / telephone communication technology / decorations / binocular — for any two — [total for (A) 10]	**02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 124*

(B) Water of mass 1 kg is contained in an electric kettle used in a house.

(i) What is the amount of heat required to raise the temperature of 1 kg of water from 20 °C to 100 °C? (**Specific heat capacity** of water is 4200 J kg^{-1} $°C^{-1}$.)

Q = mcθ — for the equation	**01**
= 1 (kg) × 4200 (J kg^{-1} $°C^{-1}$) × 80 (°C) — for the substitution	**01**

= 336 000 J or 336 kJ — answer with unit (01) **03**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(ii) Find the amount of heat absorbed by the kettle when the temperature of the water in the kettle was increased from 20 °C to 100 °C. (**Heat capacity** of the kettle is 160 J $°C^{-1}$.)

Q = Cθ = 160 (J $°C^{-1}$) × 80 (°C) **01**

= 12 800 J or 12.8 kJ (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(iii) The power of the heating coil used to heat the kettle is 1000 W. What is the time taken to heat the water in the kettle from 20 °C to 100 °C?

E = Pt or t = E/P; calculating total energy (336 000 + 12 800) or 348 800 J **01**

t = (336 000 + 12 800) / 1000 or 348 800 / 1000 — for the equation or substitution **01**

t = 348.8 seconds or 5.81 minutes — for the answer with unit (01) **03**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 34*

(iv) The following measures have been taken to prevent the loss of heat from the kettle to the outer environment.

(a) closing the kettle with a lid

(b) polishing the outer surface of the kettle well

State the method of heat transfer controlled by each of the above measures.

(a) Convection (01) (b) Radiation (01) — [total for (B) 10; total 20] **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 22*

Question 8 — Plant propagation and induced current

(A) Some phenomena faced and identified by a farmer maintaining a mixed crop cultivation are given below. Answer the questions asked on them.

(i) The passion fruit cultivation produces flowers but does not set fruits. Therefore the flowers need to be artificially pollinated. How are the passion fruit flowers artificially pollinated?

Depositing the pollen of a flower artificially on the stigma of the same flower or on the stigma of a different flower of the same species with fingers or with a brush — free mark **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 40*

(ii) Cocoyam (gahala/shembu) plants grow again after a certain period of time following the death of their aerial parts. What is the term used to describe this process by which the Cocoyam plants ensure their survival?

Survival in unfavourable time / perennation / dormant period / dormancy **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(iii) In the farmland, one bush of banana trees gives a greater yield. The plants in that bush are highly resistant to diseases. Name an artificial vegetative propagation method suitable to obtain a large number of banana plants with those traits at once.

Tissue culture **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 34*

(iv) The farmer intends to use a woodapple plant growing in the farmland as the stock and graft an orange twig to it. State **two** characteristics of the woodapple plant which would have caused its selection as the stock.

Having a strong root system / being resistant to diseases and pests / withstanding unfavourable environmental conditions / having uniform growth / both woodapple and orange are plants showing affinities — for any two **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 31*

(v) The farmer cultivated in the farmland a garden pea plant which was rare in the area where his farmland is situated. That garden pea plant bears round seeds. A majority of the new pea plants grown from that garden pea plant bear round seeds. But the rest bears wrinkled seeds. Based on your knowledge in genetics explain this phenomenon using the Punnett square.

	R	**r**
R	RR	Rr
r	Rr	rr

For showing gametes (01); for the Punnett square (01) — any letter can be used instead of R (r)

Indicating the ratio between round seeds and wrinkled seeds as 3 : 1 **01**

Deduct 1 mark for any other explanation without the Punnett square — [total for (A) 10] **03**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 176*

(B) In Figure 1, AB and CD indicate two metal rails. PQ is a conductor rod which can be slid on the two rails. The resistance of the rails and the rod are negligibly small. A uniform magnetic field is applied into the plane perpendicular to it on which the metal rails are placed. When the rod PQ is moved to right, an electric current is induced in it.

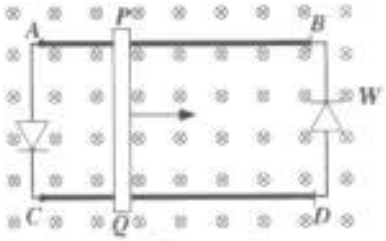


Figure 1

(i) Name the rule which can be used to decide the direction of the induced current in PQ.

Fleming's right-hand rule **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(ii) According to the rule stated in (i) above, does the current flow from P to Q or from Q to P?

Q to P **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(iii) Due to the induced current in PQ, only one of the LEDs labelled Y and W lights.

(a) What is the LED that lights?

Y **01**

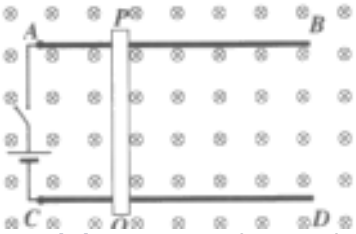
▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(b) State the reason why the other LED does not light.

Because LED W is reverse biased — give only 1 mark for stating LED W does not allow the current to flow **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(iv) Figure 2 shows how a battery and a switch are connected between A and C after removing the two LEDs in Figure 1.



(a) State an observation made when the switch in the circuit is closed (put on).

(PQ conductor rod) moves towards the right — for stating that 'PQ moves' give only 1 mark **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

(b) Name a device made by using the phenomenon associated with the observation mentioned in (iv) (a) above.

(DC) motor or speaker (loudspeaker) / galvanometer / ammeter / voltmeter — [total for (B) 10; total 20] **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 134*

Question 9 — Reactivity of metals and sound equipment

(A) The following table gives some chemical properties of the metal copper (Cu) and two other metals X and Y. (X and Y are not their standard symbols.)

Metal	Reaction with water	Reaction with dilute hydrochloric acid
Cu	No reaction	No reaction
X	Reacts fast with cold water	Reacts violently
Y	No reaction with cold water but reacts with hot water	Reacts very fast

Answer the following questions using the above symbols where necessary.

(i) Write the above three metals in the decreasing order of their reactivity.

X, Y, Cu or X > Y > Cu **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(ii) It is required to include hydrogen also in the series you made in (i) above according to its reactivity. Here, the place between which two metals does hydrogen occupy?

In between Y and Cu **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 99*

(iii) Of the metals given in the table, state the metal relevant to each of the following statements.

(a) Stored in paraffin oil or kerosene without bringing into contact with air.

X **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(b) Extracted by reducing the metal oxide.

Cu **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 112*

(iv) Y is a bivalent metal. Y reacts with dilute hydrochloric acid giving the metal chloride and a certain gas as products. Write the balanced chemical equation for this reaction.

$Y + 2HCl \rightarrow YCl_2 + H_2$

For correct reactants and products (01); for the balanced equation (01); if Mg is used instead of Y marks will be awarded **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(v) A blue coloured aqueous solution of the sulphate of the metal copper was electrolysed using carbon electrodes.

(a) Write the half reaction taking place on the cathode during electrolysis.

$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$ — award marks even without physical states **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 112*

(b) What kind of a colour change occurs in the electrolytic solution during the above electrolysis?

(Intensity of) blue colour decreases / becomes colourless **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 112*

(vi) A simple cell is made using a copper metal plate and a zinc metal plate as electrodes and a dilute sulphuric acid solution as the electrolyte.

(a) Which metal acts as the anode of the simple cell?

Zn / zinc plate **01**

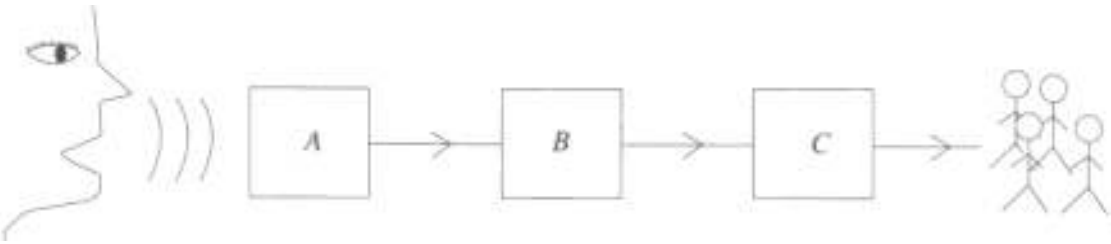
▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 111*

(b) In which type of ion does the concentration remain constant in the solution of the electrolyte when the simple cell operates?

SO_4^{2-} / sulphate ion — [total for (A) 10] **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 99*

(B) Equipment A converts the sound waves sent out by a speaker addressing a public meeting to an electrical signal of low amplitude. Equipment B converts the electrical signal of low amplitude to an electrical signal of high amplitude. Equipment C converts the electrical signal of high amplitude to sound waves again.



(i) Name the equipments A, B and C.

A - Microphone (01); B - Amplifier (01); C - Loudspeaker / speaker (01) **03**

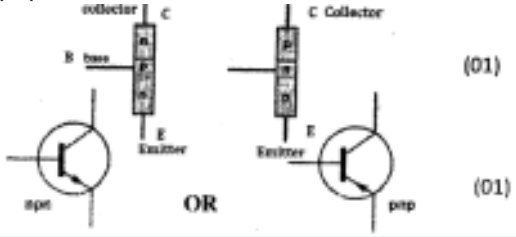
▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(ii) Explain briefly the process taking place in equipment A.

Sound waves vibrate the diaphragm and induce an electromotive force / a current **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(iii) Draw the structure and the circuit symbol of the transistor, the main electronic device in equipment B and name its terminals.



Structure with terminals labelled (01); circuit symbol (npn or pnp) (01) — it is compulsory to label terminals (collector, base, emitter) either in the structure or the symbol **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(iv) Name **two** main parts in the equipment C.

Coil / magnet / paper / cardboard cone / diaphragm — for any two **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 123*

(v) In which characteristic of sound do the sound waves sent out by the speaker's mouth and the sound waves emitted by the equipment C differ from each other?

Loudness **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(vi) When another speaker addresses the meeting in place of the first speaker, what characteristic of sound is different in the sound sent out by him?

Pitch / loudness / quality of sound — [total for (B) 10; total 20] **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

Paper II • 2020

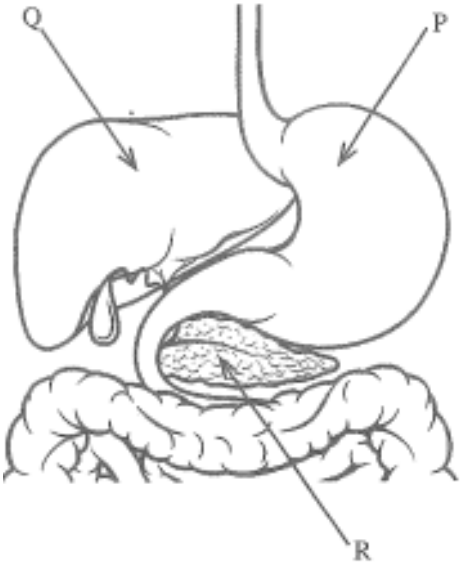
PREPARED ANSWERS (TEXTBOOK-BASED)

Part B • essay questions • answer three • 20 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 5 — Digestion and excretion

(A) Given below is a sketch of a part of the human digestive system.



(i) Name the parts labelled P, Q and R.

P - stomach; Q - liver; R - pancreas

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 144*

(ii) Describe briefly how food is subjected to mechanical digestion in P.

The muscular wall of the stomach contracts and relaxes rhythmically (churning / peristalsis), breaking the food into small particles and mixing it with gastric juice to form chyme.

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 146*

(iii) A secretion essential for the emulsification of lipids contained in food is produced by Q. Name that secretion.

Bile

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(iv) (a) What is the enzyme which is secreted by R and contributes to digest lipids?

Lipase (pancreatic lipase)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(b) State the **two** products formed by the action of that enzyme on lipids.

Fatty acids and glycerol

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(v) The pair of hormones insulin and glucagon produced by R contributes to regulate the internal environment of the body.

(a) What is the factor that is regulated in the internal environment of the body by the action of those hormones?

Blood glucose level (blood sugar concentration)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 181*

(b) Explain briefly how those hormones contribute to regulate the factor you stated in (a) above.

When the blood glucose level rises, insulin is secreted; it makes cells take up glucose and converts excess glucose into glycogen in the liver and muscles, so the level falls.

When the blood glucose level falls, glucagon is secreted; it converts stored glycogen back into glucose, so the level rises. Thus the level is kept nearly constant.

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 181*

(B) Kidneys are considered the main organs which perform nitrogenous excretion in humans.

(i) What is excretion?

Removal of the waste products of metabolism from the body

▸ *Textbook: Science Grade 10 Part I, Unit 8 Characteristics of organisms, page 153*

(ii) Name a nitrogenous excretory product removed by kidneys.

Urea / uric acid / creatinine

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 158*

(iii) What is the structural and functional unit of the kidneys?

The nephron

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 159*

(iv) One step in the process of forming urine in the structural and functional unit of the kidneys is known as **secretion**.

(a) Describe briefly how secretion occurs.

Some substances (e.g. H^+, K^+, creatinine, certain drugs) are actively transported from the blood capillaries surrounding the tubule into the filtrate in the (distal convoluted) tubule.

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 159*

(b) State the other **two** steps in the formation of urine.

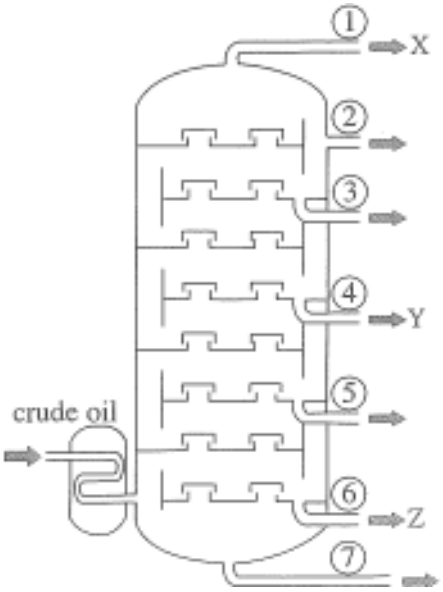
Ultrafiltration (in the glomerulus / Bowman's capsule) and selective reabsorption

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 160*

(20 marks)

Question 6 — Crude oil and neutralisation

(A) A longitudinal section of a fractionating tower used for refining crude oil is given below. Contained in abundance are the compound X in the fraction released from the outlet (1), compound Y in the fraction released from the outlet (4) and the compound Z in the fraction released from the outlet (6).



(i) By what common name is the group of organic compounds contained in abundance in crude oil known?

Hydrocarbons

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(ii) Name the crude oil refining technique employed in the tower.

Fractional distillation

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(iii) The boiling points of the compounds X, Y and Z are T_X, T_Y and T_Z respectively. Write them in the ascending order.

$T_X < T_Y < T_Z$

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(iv) X is a compound with a single carbon atom and containing carbon and hydrogen only. Draw the dot and cross diagram of a X molecule.

X is methane, CH_4: the C atom in the centre shares one pair of electrons (one dot and one cross) with each of the four H atoms placed around it (four bond pairs, no lone pairs).

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(v) Write the balanced chemical equation relevant to the complete combustion of one mole of compound X in oxygen gas.

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(vi) The substance released from outlet (7) of the tower is used to construct roads. Name that substance.

Bitumen (asphalt / tar)

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(vii) State an environmental problem caused by the gaseous components that would be released to the environment during refining of crude oil.

Air pollution: acid rain (from SO_2) / global warming (from CO_2 and hydrocarbon vapours such as methane) — any one

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 60*

(B) A is a strong acid and B is a strong base. Two products are produced in the reaction between A and B. One of those products is sodium chloride (NaCl).

(i) Write the chemical formulae of the compounds A and B.

A - HCl; B - NaOH

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 91*

(ii) Name the compound that is produced as the other product during the reaction between A and B.

Water (H_2O)

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 197*

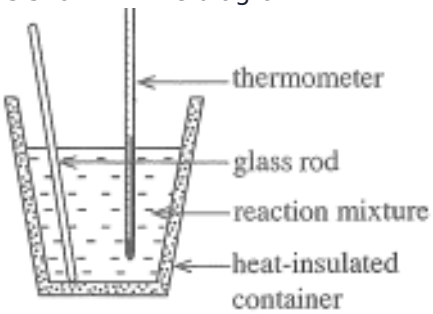
(iii) Describe briefly how the compound you stated in (ii) above is formed during the reaction between A and B.

The H^+ ions released by the acid combine with the OH^- ions released by the base to form water molecules:

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 198*

(iv) An apparatus set up to determine the heat change associated with the reaction between A and B is shown in the diagram.



(a) In the apparatus, what measure has been taken to reduce the heat loss?

A heat-insulated container (e.g. a polystyrene cup) is used.

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(b) Suggest a course of action which can be taken to reduce further the heat loss in this apparatus.

Cover the container with an insulated lid (with holes for the thermometer and the glass rod) / place it inside another insulated container

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 205*

(v) 50 cm^3 each of A acid solution and B base solution of equal concentration were taken and mixed in the above apparatus. The temperature change occurred here was determined to be 10 °C.

(a) What are the readings that should be taken to determine the above temperature change?

The initial temperature of each solution (acid and base) before mixing (take the mean), and the highest (maximum) temperature reached by the mixture after mixing

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 206*

(b) Calculate the heat change associated with the above reaction. (The specific heat capacity of the reaction mixture is 5000 J kg^{-1} $°C^{-1}$ and its density is 1 g cm^{-3}.)

Volume of mixture = 50 + 50 = 100 cm^3; mass = 100 cm^3 × 1 g cm^{-3} = 100 g = 0.1 kg

Q = mcθ = 0.1 kg × 5000 J kg^{-1} $°C^{-1}$ × 10 °C

= 5000 J (5 kJ) of heat released

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 206*

(vi) Sketch an energy level diagram to illustrate the energy change occurring in the chemical reaction between A and B above.

Energy (vertical axis): HCl(aq) + NaOH(aq) drawn at a higher energy level; NaCl(aq) + H_2O(l) at a lower level; a downward arrow between them marked "heat released" (ΔH negative) — the reaction is exothermic.

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 203*

(20 marks)

Question 7 — Lenses and energy in vehicles

(A) The following activities were done by a student at home using a glass hand lens.

Activity 1 - Reading a label with very small letters

Activity 2 - Burning a piece of dry cotton wool by solar rays

Activity 3 - Obtaining an image of a tree in the compound on a wall in the house

(i) Name the type of the lens that is used as the hand lens.

Convex lens (converging lens)

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 134*

(ii) Between which two points related to the lens should the label be placed in Activity 1?

Between the optical centre (the lens) and the principal focus

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 127*

(iii) Indicate by a ray diagram how light rays travel through the lens in Activity 2.

Ray diagram: parallel rays from the Sun fall on the convex lens, are refracted and converge to the principal focus F on the other side of the lens; the cotton wool is placed at F.

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 128*

(iv) Instead of the hand lens, what type of a mirror can be used to carry out Activity 2?

Concave mirror

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 113*

(v) State **two** characteristics of the image formed in Activity 3.

Real / inverted / diminished (smaller than the object) — any two

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 132*

(vi) Name **two** instruments that are made using lenses of the type used for hand lenses.

Compound microscope / telescope / camera / projector / spectacles for long sight (hypermetropia) — any two

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 126*

(B) When brakes are applied to a normal motor vehicle at run, its kinetic energy is lost due to friction.

(i) Brakes are applied to a motor vehicle of mass 1000 kg when running at a speed of 20 m s^{-1}.

(a) Calculate the kinetic energy of the vehicle at the instance just before applying brakes.

KE = ½mv^2

= ½ × 1000 kg × (20 m s^{-1})^2

= 200 000 J (2 × 10^5 J)

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 129*

(b) Name **two** forms of energy to which the kinetic energy lost gets converted when applying brakes.

Heat energy and sound energy

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

(ii) A part of the kinetic energy lost when applying brakes to an electric motor vehicle is converted to electrical energy and its battery is charged.

(a) Name the equipment that converts kinetic energy to electrical energy here.

Generator (dynamo)

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 139*

(b) Name and describe briefly the phenomenon of converting lost kinetic energy of the vehicle to electrical energy.

Electromagnetic induction: the rotating wheels turn a coil relative to a magnet (in a magnetic field); the change of magnetic flux linked with the coil induces an e.m.f., and the current produced charges the battery.

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 139*

(c) Name the equipment that converts the electrical energy supplied by the battery to kinetic energy required to run the vehicle.

Electric motor

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(d) The electromotive force of a battery used in electric motor vehicles is about 400 V. This is composed of a set of cells where the electromotive force of one cell is 4 V. What is the minimum number of cells required to make this battery?

400 V ÷ 4 V = 100 cells (connected in series)

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 129*

(20 marks)

Question 8 — Animals in a cultivation and a water tank

(A) A student recorded as follows three animals and features of two animals indicated as P and Q as their names were unknown to him found in an okra (bandakka/vendi) cultivation.

- snail
- lizard
- greater caucal (etikukula/chenpakam)
- P - Has a thin, long and vermiform body. The body is divided into equal segments.
- Q - Bears jointed legs and wings.

Write answers to the following questions related to the animals observed.

(i) (a) Name the two vertebrate animals.

Lizard and greater coucal

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(b) What is the main characteristic on which the inclusion of those animals in the vertebrate group based?

Presence of a vertebral column (backbone)

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 19*

(ii) According to the above observations, what is the animal phylum to which P belongs?

Annelida

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 17*

(iii) State another common characteristic specific to the animal species of the phylum to which Q belongs.

Body covered with a chitinous exoskeleton / segmented body (divided into head, thorax and abdomen in insects)

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

(iv) State a favourable effect and an unfavourable effect which can be expected to have caused by Q on the crop.

Favourable: pollination of okra flowers

Unfavourable: acting as a pest by feeding on the leaves, flowers or fruits (spreading plant diseases)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 32*

(v) State a primary consumer and a secondary consumer respectively in a food chain that contains animals observed in the okra cultivation.

Primary consumer: Q (the insect) / snail; secondary consumer: lizard / greater coucal (e.g. okra plant → Q → lizard)

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 175*

(vi) A newspaper has printed greater coucal's scientific name as Centropus Sinensis. According to the rules of binomial nomenclature, state **two** errors seen in it.

The species name (second word) should begin with a simple letter — sinensis, not Sinensis

The name should be printed in italics (or each word underlined separately when hand-written) — Centropus sinensis

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 24*

(B) A cylindrical water tank is kept on the roof of a two storeyed house.

(i) Consider an occasion in which two identical water taps in the upper floor and the ground floor of the house are kept fully open at the same time.

(a) From the tap in which floor does water flow out with higher speed?

From the tap in the ground floor

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 65*

(b) Give the reason for your answer.

The ground-floor tap is at a greater depth below the water surface in the tank, so the water pressure there is greater (pressure = hρg).

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 75*

(ii) The inner cross sectional area of the tank is 1 m^2 and its height is 1 m. (Density of water is 1000 kg m^{-3} and acceleration due to gravity is 10 m s^{-2}.)

(a) What is the mass of water in the tank when it is completely filled with water?

Volume = 1 m^2 × 1 m = 1 m^3

Mass = volume × density = 1 m^3 × 1000 kg m^{-3} = 1000 kg

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 75*

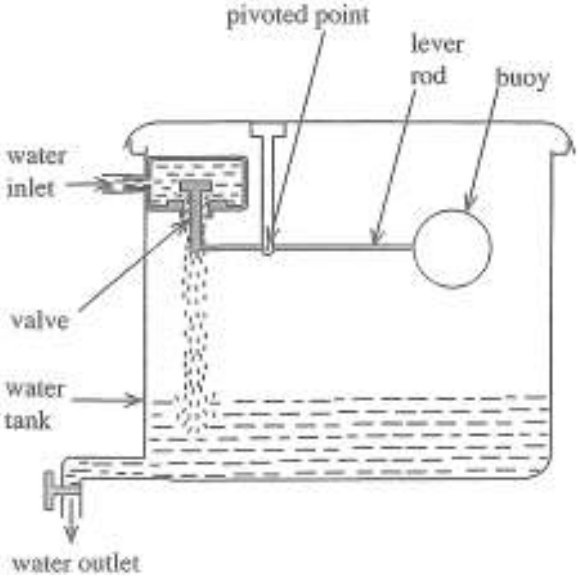
(b) What is the pressure exerted by water on the bottom of the tank when it is completely filled with water?

P = hρg = 1 m × 1000 kg m^{-3} × 10 m s^{-2}

= 10 000 Pa (N m^{-2})

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 71*

(iii) The diagram shows a lever arrangement made to prevent the overflow of water entering the tank. When water gets filled, the buoy lifts closing the valve and the entry of water stops.



(a) What is the force acting on the buoy at the position shown in the diagram?

The weight of the buoy (gravitational force, acting downwards)

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(b) What is the extra force acting on the buoy from the time at which the water level rises and the buoy starts to submerge in water.

Upthrust (buoyant force) of the water, acting upwards

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(c) State another advantage gained from this lever arrangement in addition to the prevention of overflow of water.

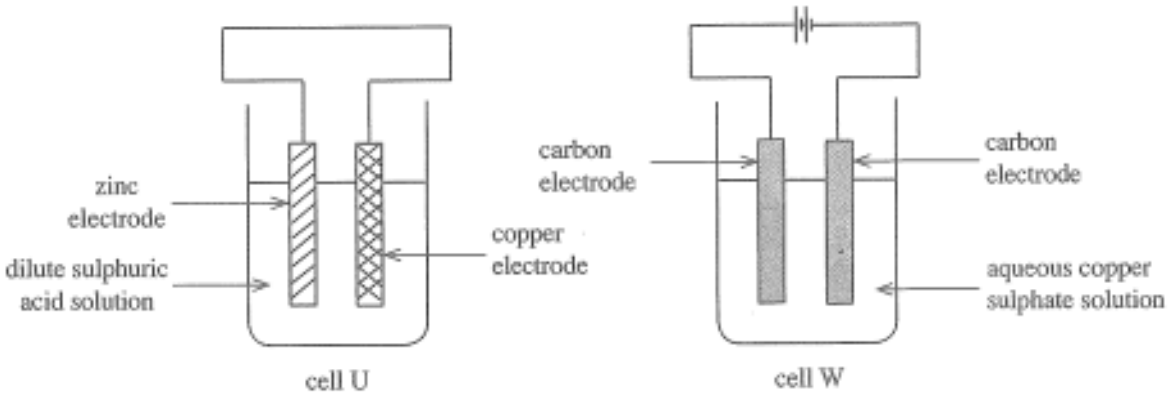
The tank is filled automatically — the valve opens by itself when the water level falls, so no one has to attend to it; also the lever magnifies the force, so a small upthrust on the buoy closes the valve firmly.

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 205*

(20 marks)

Question 9 — Electrochemical cells and a power supply

(A) The cell U shown below is an electrochemical cell while the cell W is an electrolytic cell.



(i) In which cell above is chemical energy converted to electrical energy?

Cell U

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 79*

(ii) What is the name by which the anode reactions occurring in the two cells are known in common?

Oxidation (reactions)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(iii) Indicate the half reaction occurring at the anode of the cell U by a chemical equation.

$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^{-}$

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(iv) State the convention used to identify the anode and cathode in cell W.

The electrode connected to the positive terminal of the battery (external source) is the anode; the electrode connected to the negative terminal is the cathode.

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 83*

(v) (a) What change in colour occurs in the electrolytic solution when cell W operates?

The blue colour of the solution fades (becomes paler / colourless)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 88*

(b) Explain the reason for it.

Cu^{2+} ions (which give the blue colour) are reduced and deposited as copper on the cathode ($Cu^{2+} + 2e^{-} \rightarrow Cu$); as the carbon anode is inert they are not replaced, so the Cu^{2+} concentration falls.

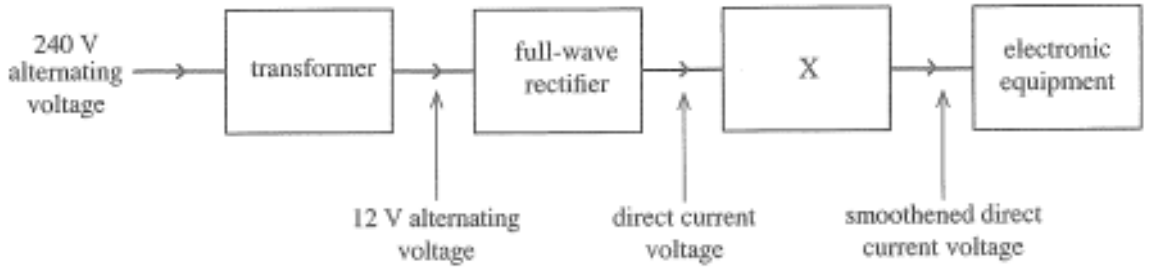
▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 93*

(vi) Which electrode is dissolved when the above cells operate?

The zinc electrode (of cell U)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 85*

(B) In order to operate a certain household electronic equipment, the domestic electricity supply has to be converted to a low voltage, direct current electrical supply. For that, an arrangement consisting of the following parts is used.



(i) (a) What type of a transformer is connected to the above arrangement?

Step-down transformer

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 58*

(b) In what coil in this transformer should wires of higher diameter be used? State the reason for it.

The secondary coil — a larger current flows through it, so thicker wire (lower resistance) is used to reduce heating (energy loss).

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 146*

(ii) The number of turns in the primary coil of the above transformer is 1800. What should be the number of turns in the secondary coil?

Vs / Vp = Ns / Np

Ns = Np × Vs / Vp = 1800 × 12 V / 240 V

= 90 turns

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 144*

(iii) Illustrate graphically how the 12 V alternating voltage supplied by the transformer varies with time.

Graph of voltage (vertical axis) against time (horizontal axis): a sine wave that rises above and falls below the time axis alternately, with equal positive and negative peak values (constant amplitude).

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 140*

(iv) Draw using standard symbols, how the four diodes are connected in the full-wave rectifier circuit.

Bridge rectifier: four diodes connected in a diamond (bridge) arrangement; the 12 V a.c. input is applied across one pair of opposite corners and the d.c. output is taken from the other pair (the two diodes meeting at the positive output corner both point towards it).

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 62*

(v) Name the device indicated by X.

Capacitor (smoothing capacitor)

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 63*

(20 marks)

Paper II • 2019

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — The heart, cell division and inheritance

(A) Figure I presents a sketchy line diagram which shows the internal structure of the human heart.

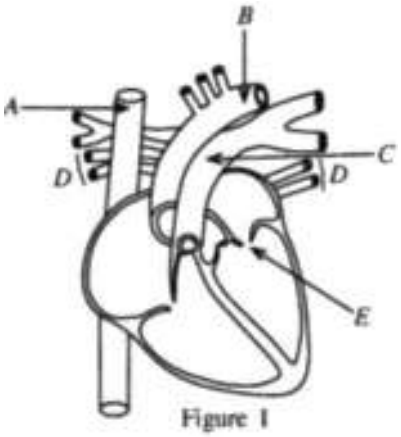


Figure I

(i) Name the blood vessels A, B, C and D in Figure I.

A - Superior vena cava (01); B - Aorta (01); C - Pulmonary artery (01); D - Pulmonary veins (01) **04**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(ii) When comparing with the composition of the blood flowing through D, what is the main difference in the composition of blood flowing through C?

(In blood flowing through C) O_2 concentration is low / CO_2 concentration is high / deoxygenated blood **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(iii) What is the valve named E?

bicuspid valve / mitral valve **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 167*

(iv) Describe briefly how the characteristic 'lub' and 'dup' sounds heard during the heart beat are generated.

'lub' sound — when bicuspid and tricuspid valves close **01**

'dub' sound — when semilunar valves close (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 169*

(v) Figure II indicates the changes in the potential corresponding to the three stages of the cardiac cycle of a healthy person's E.C.G. Which stage of the cardiac cycle is denoted by T in that Figure?

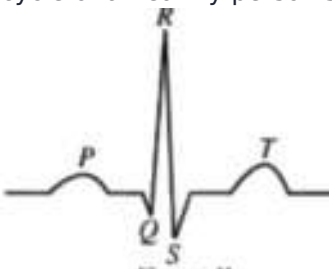


Figure II

atrial ventricular relaxation / complete cardiac diastoale / intervennig **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 168*

(vi) Heart muscles are weakened by the blockage of the blood vessel supplying blood to them by blood clots. By what name is this ailing condition known?

(coronory) thrombosis **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 172*

(B) The number of chromosomes in a somatic (body) cell of a mammalian animal species X is 40.

(i) What is the number of chromosomes contained in the daughter cells produced by the meiotic division of gamete mother cells of X?

20 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 119*

(ii) Name a daughter cell type formed by the meiotic division of gamete mother cells of X.

Sperm / ovum (egg) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 119*

(iii) How does a daughter cell formed by the mitotic division differ from a daughter cell formed by meiotic division?

(In mitotic cell division) number of chromosomes in daughter cells is equal to that of the mother cell / daughter cells are identical with the mother cells / the changes in chromosomes are rare **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 119*

(C) (i) The garden pea plant seeds have two shapes, round and wrinkled. The gene giving rise to round seeds is R while the gene giving rise to wrinkled seeds is r. The genotype of the plant with dominant, homozygous genes for the seed shape is RR. Write the genotype for each of the following plant with regard to the seed shape.

(a) Plant with recessive, homozygous genes

rr **01**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 179*

(b) Plant with heterozygous genes

Rr (01) — total **02**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 179*

(ii) When a pure breeding garden pea plant with round seeds was crossed with a pure breeding garden pea plant with wrinkled seeds, all the F_1 generation plants had round seeds. In the F_2 generation obtained by crossing two plants in the F_1 generation, the ratio of the plants with round seeds to the plants with wrinkled seeds was 3:1.

(a) Write the genotype of the F_1 generation plants.

Rr **01**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 174*

(b) Construct the Punnett square to indicate the genotype of the plants of the F_2 generation.

Gametes: ♂ R, r and ♀ R, r — for mentioning gametes **01**

Punnett square: ♀R × ♂R → RR; ♀R × ♂r → Rr; ♀r × ♂R → Rr; ♀r × ♂r → rr — for completing the table correctly **01**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 176*

(c) Write the genotype ratio of the F_2 generation plants.

RR : Rr : rr **01**

1 : 2 : 1 (01) — if the Punnett square is written correctly award two marks for the ratio; total for (ii) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 174*

Question 6 — Acids, bases and salts

(A) Acids, bases and salts are three main groups of compounds found in the laboratory.

(i) Explain what an acid is based on how it behaves in water.

compounds that release H^+ / compounds which ionise giving H^+ / dissociate giving H^+ (in an aqueous medium) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 191*

(ii) Hydrochloric acid (HCl) is a strong acid while acetic acid (CH_3COOH) is a weak acid. What is the difference between a weak acid and a strong acid?

Strong acids ionise / dissociate completely (in water) **01**

Weak acids ionise / dissociate incompletely / partially / slightly (in water) (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 191*

(iii) By what name is the process of forming a salt and water by the reaction of an acid and a base known?

Neutralisation **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 198*

(iv) (a) Write the balanced chemical equation for the reaction between the base sodium hydroxide and hydrochloric acid.

$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$ — reactants (01), products (01); physical states are not necessary **02**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 197*

(b) Write an observation that can be made when the above reaction occurs.

increase in temperature / heating of the vessel / emission of heat **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 198*

(B) Gastric juice contains hydrochloric acid. Antacid tablets given to relieve the discomforts caused by the high acidity in the stomach contain the base magnesium hydroxide ($Mg(OH)_2$).

(i) What is the salt formed during the reaction between hydrochloric acid and magnesium hydroxide base?

$MgCl_2$ / magnesium chloride **01**

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 197*

(ii) What is the amount of moles of water formed when one mole of magnesium hydroxide completely reacts with hydrochloric acid?

2 (mol) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 43*

(C) A bottle contains 500 cm^3 of an acetic acid solution. The density of the solution is 1.04 g cm^{-3} and the mass of acetic acid contained in this solution is 26 g.

(i) Calculate the mass of the acetic acid solution contained in the bottle.

$d = m/v$ / $m = dv$

or

$m = 1.04\ (g\ cm^{-3}) \times 500\ (cm^3)$ (01) = 520 g (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 42*

(ii) Calculate the percentage of acetic acid by mass in the above solution.

(26 (g) ÷ 520 (g)) × 100 **01**

= 5 (%) (01) **02**

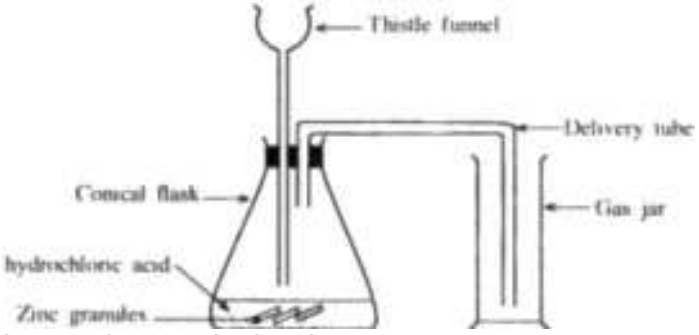
▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 42*

(iii) Vinegar is an aqueous solution which contains about 5% acetic acid by mass. The boiling point of acetic acid is 118 °C. Name a technique that can be used to obtain a solution that contains about 10% acetic acid by mass using a sample of vinegar.

vapourisation / evaporation / simple distillation / fractional distillation **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(D) A set of apparatus arranged by a student to prepare a sample of hydrogen gas using dilute hydrochloric acid and zinc (Zn) metal is shown below.



(i) Write **two** errors that can be seen in the above set up.

thistle funnel is not immersed in the solution / above the liquid level

keeping the gas jar upright / using upward displacement of air (downward delivery) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 104*

(ii) Suggest **two** measures that can be adopted to increase the rate of the reaction taking place in the conical flask.

increasing the concentration of acid; using Zn powder instead of Zn granules / increasing the surface area of Zn; heating (the vessel); using a catalyst — any 2 of them	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 103*

(iii) State a test and the relevant observation to confirm that the gas produced by the reaction is hydrogen.

Inserting a lighted ekel / lighted splinter	**01**
Burns with a 'pop' sound / the flame blows off with a 'pop' sound (01)	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 104*

Question 7 — Convex lenses and electrical energy

(A) Figure I below illustrates how a ray of light coming parallel to the principal axis of a glass convex lens travels after refraction. The points A, B, C, D, and E are marked on the principal axis of the lens so that AB = BC = CD = DE.

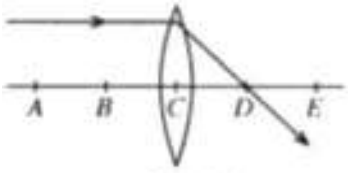


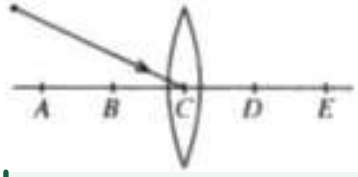
Figure I

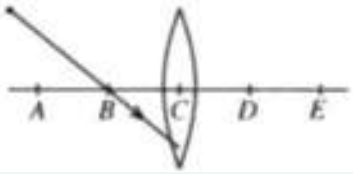
(i) Name point C and point D.

C - Optical centre (01); D - Focus (01)	**02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 127*

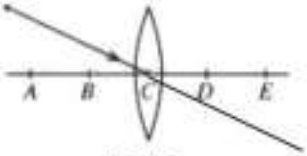
(ii) Copy the Figures II and III below in your answer script and complete the ray diagrams.



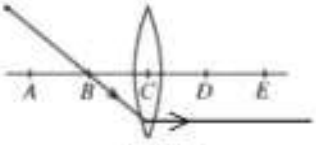


Completed ray diagrams (Figure II: 02/00; Figure III: 02/00)	**04**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 130*



(02/00)



(02/00)

(iii) Consider the image formed of an object placed between the points A and B in the principal axis of the lens. State **two** characteristics of that image.

Inverted / magnified / real / located beyound E or beyond 2f or beyond twice the focal length — any 2 of them	**02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 131*

(iv) Describe briefly an activity that could be done to find the focal length of a convex lens approximately.

Obtain a clear image (01) of a distant object (01) on to a wall / screen. Measure the distance between wall / screen and the lens	**01**
or	
Focus a beam of sunlight (01) until you get a small sharp patch of light on to a paper (01). Measure the distance between the lens and the patch	**01**
(If this is illustrated by a diagram give marks for parallel rays (01), focusing rays (01) and marking the focal lenght (01))	**03**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 129*

(B) A domestically used filament electric lamp is marked 240 V, 60 W while an LED electric lamp lighting with equal brightness to it is marked 240 V, 10 W.

(i) Calculate in joules (J) the amount of electrical energy consumed if the filament electric lamp was switched on for 10 hours.

E = Pt	**01**
= 60 × 60 × 60 × 10 / 60 W × 10 h	**01**
= 2160000 (J)	**01**
(give all 3 marks for the answer and the substitution without the equation)	**03**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 34*

(ii) How much is the electrical energy in joules (J) consumed if the LED lamp was switched on for 10 hours?

10 × 10 × 3600 / 10 W × 10 h	**01**
= 360000 (J) (01) — give 02 marks even for the final answer	**02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 34*

(iii) From the above calculations show that the LED lamp is more advantageous for domestic use.

LED consumes less electrical energy.	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 35*

(iv) The LED lamp mentioned above was lighted for 30 days 10 hours each. Find in kilowatt hours (kWh) the amount of electrical energy supplied to the lamp during this period. (1 kWh = 3.6×10^6 J)

$(10 \times 3600 \times 10 \times 30) \div (3.6 \times 10^6)$ / (10 ÷ 1000) × 10 × 30	**01**
= 3 (kWh) (01)	**02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 47*

(v) Of the electrical energy supplied to a filament electric lamp, 40% is lost as heat. In that case what is the efficiency of the lamp?

60%	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 36*

Question 8 — Pond ecosystem and heat

(A) The following observations were recorded by a group of students conducting a field study on a sunny day in relation to a pond ecosystem.

- The aquatic plants Hydrilla, Vallisnaria, Aponogeton (Kekatiya) and Salvinia are found in abundance in the pond.
- Gas bubbles are liberated by plants growing submerged in water.
- Fish in the pond swim moving their fins.
- A kingfisher catches a fish and flies.
- A species of small insects comes to the water surface from time to time and moves down again.

(i) Name **two** characteristics of the living organisms according to the above observations.

Movement / nutrition / respiration — any 2 of them	**02**

▸ *Textbook: Science Grade 10 Part I, Unit 8 Characteristics of organisms, page 140*

(ii) (a) Name the gas present in abundance in the gas bubbles liberated by the plants growing submerged in water.

Oxygen / O_2	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(b) What is the process relevant to the production of that gas?

Photosynthesis (01) — total	**02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 80*

(iii) (a) Of the aquatic plants observed, which is the dioecious plant?

Vallisnaria	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 194*

(b) Why is it called a dioecious plant?

Staminate and pistillate flowers are born separately.	**01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 36*

(c) What is the pollinating agent of that plant?

Water (01) — total	**03**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(iv) From the interactions observed by the students, construct a food chain with three links.

Aquatic plants → fish → kingfisher / Aquatic plants → insect → fish / Aquatic plants → insect → kingfisher — any one of the above food chains (give marks if any plant mentioned in the question is written instead of aquatic plants) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 177*

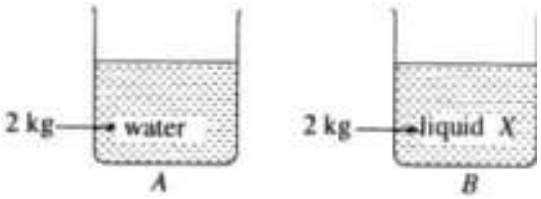
(v) As regards the above observations, present **two** facts to justify that the pond can be considered an ecosystem.

There are living and non living components **01**

There are interactions among them (living, living / non-living, non-living / living, non-living) (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 169*

(B) A and B are two identical vessels of negligibly small thermal capacity. A contains 2 kg of water of specific heat capacity 4200 J kg^{-1} $°C^{-1}$ while B contains 2 kg of a liquid X of specific heat capacity 2100 J kg^{-1} $°C^{-1}$. Each vessel is supplied with 8400 J of heat.



(i) Calculate how much will be the increase in the temperature of water contained in vessel A when supplied with the above amount of heat?

$Q = mc\theta$

or

8400 (J) = 2 (kg) × 4200 (J kg^{-1} $°C^{-1}$) × θ **01**

θ = 1 °C (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(ii) How much will be the increase in the temperature of liquid X contained in vessel B when supplied with the above amount of heat?

2 °C **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(iii) Which of the above liquids is more suitable to be used as a cooling agent? Give reasons for your answer.

Water **01**

Rise in temperature is smaller when the same amount of heat is supplied / the specific heat capacity of water is greater (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(iv) A thermometer was introduced into the vessel A. Later, when the vessel was heated continuously, the thermometer reading stopped rising further after the water reached a certain temperature.

(a) By what name is that constant temperature known?

Boiling point **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(b) At that instance, what can be observed in the water?

Bubbling (air) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(c) What is the change of state occurring at that instance?

Liquid water turns into water vapour / vapourisation / liquid → gas **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(d) By what name is the heat absorbed at that instance known?

Latent heat (of vapourisation) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 15*

(e) State the reason why the temperature of the liquid stopped rising though heat was supplied continuously.

Heat is absorbed for doing work against the intermolecular attractive forces / to break intermolecular bonds / to break hydrogen bonds (01) — total **05**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 15*

Question 9 — Electrolysis and a public address system

(A) Figure I and II below illustrate two electrolytic cells arranged to electrolyse fused sodium chloride and an aqueous solution of sodium chloride respectively using carbon (graphite) electrodes.

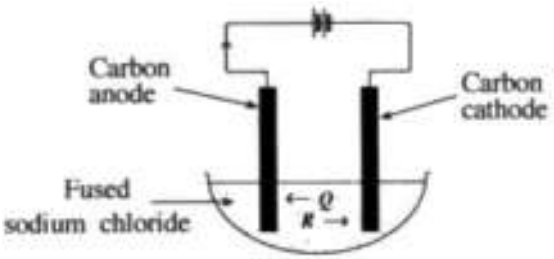


Figure I

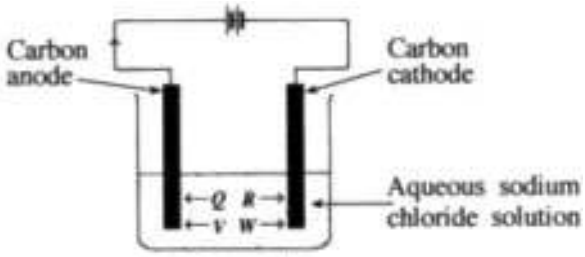


Figure II

The ions Q, R, V and W move in the directions indicated by the arrows during electrolysis. Of these the ions Q and R are common to both cells.

(i) Write the chemical symbols of the ions Q, R and W in order.

Q - Cl^- (01); R - Na^+ (01); W - H^+ (01) **03**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 80*

(ii) (a) Write the half reaction occurring at the cathode of the cell in Figure I.

$Na^+(l) + e \rightarrow Na(l)$ — physical states are not necessary **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(b) Why is that reaction known as a reduction?

(Na^+) accepts an electron / it involves gaining electrons (01) — total **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(iii) Write the half reaction occurring at the anode of the cell in Figure II.

$2Cl^-(aq) \rightarrow Cl_2(g) + 2e$ or $Cl^-(aq) \rightarrow \frac{1}{2}Cl_2(g) + e$

Give marks even for writing $2Cl^-(aq) - 2e \rightarrow Cl_2(g)$. Physical states are not necessary. **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(iv) What metallic electrode can be used instead of the carbon electrodes in the above cells?

Pt / Platinum **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 89*

(v) In the cell indicated by which Figure does the reaction taking place in the Down's cell during the extraction of sodium happen?

In Figure I **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 82*

(vi) (a) A few drops of phenolphthalein were added to the solution contained in the cell in Figure II when electrolysis happens in it. State the observation that can be made at that moment.

(Colourless) solution turns pink **01**

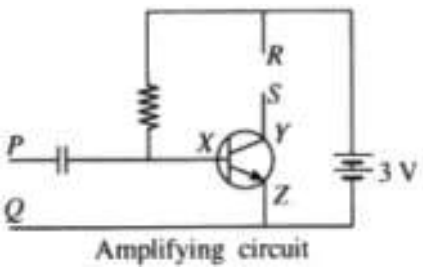
▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(b) Explain the reason for the observation you stated.

Formation of NaOH / increase in the OH^- concentration (01) — total **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 96*

(B) Parts of a public address system are given below.



Amplifying circuit


Microphone


Loudspeaker

(i) What type of transistor is connected to the amplifying circuit?

npn **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 68*

(ii) Name the terminals marked X, Y and Z in the transistor.

X - base / B / b (01); Y - collector / C / c (01); Z - emitter / E / e (01) **03**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 68*

(iii) To which terminals of the amplifying circuit should the microphone be connected?

P and Q **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 69*

(iv) Name the phenomenon which converts the sound waves received by the microphone to an electrical signal.

Electromagnetic induction **01**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 132*

(v) To which points of the amplifying circuit should the loudspeaker be connected?

R and S **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 69*

(vi) What physical quantity connected with the signal given by the microphone is amplified by the amplifying circuit?

Amplitude / (signal) voltage **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 71*

(vii) Briefly explain how sound is produced by the loudspeaker when the amplified signal is given to the loudspeaker.

A force is created on either side of the coil when the coil (in the magnetic field) gets signals. Then the cone vibrates and sound waves are produced. Give marks if this idea is expressed in other words. **02**

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 123*

Paper II • 2018

OFFICIAL MARKING SCHEME

Part B • essay questions • answer three • 20 marks each

Question 5 — Coordination and tissues

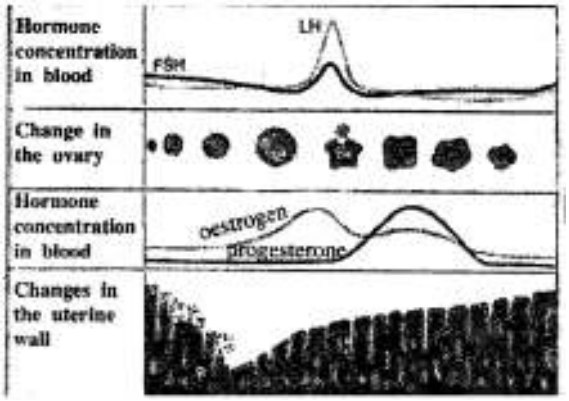
(A) Human reproductive process is coordinated by chemical substances known as hormones associated with the reproductive system.

(i) State separately in relation to each system, a hormone secreted by the male and female reproductive systems which coordinates their functioning.

male: testosterone (01); female: oestrogen / progesterone (01) — give marks even for writing answers in order **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

Figure 1 shows the phases of the female reproductive cycle. It separately illustrates how the changes of hormone concentration in blood, changes in the ovary and changes in the uterine wall occur during 28 days of the cycle.



(ii) According to the Figure, from which day does the menstrual phase of the female reproductive cycle start?

from the day 01 or at the end of the day 28 **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

(iii) Name a hormone secreted by the pituitary gland that affects the functioning of this cycle.

FSH / Follicle Stimulating Hormone / LH / Luteinizing Hormone — for one answer **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

(iv) What is the main phenomenon that occurs in the ovary by about the 14th day of the cycle?

ovulation **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

(v) During which time interval of the cycle is there a greater chance for the fertilization of the ovum?

between day 14 and day 21 **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

(vi) Write in **two** steps, what happens in the course of a fertilized human ovum becoming an embryo.

cell division / cell differentiation (01); becoming a morula / implantation (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 55*

(vii) State a common disease caused by a species of bacteria that is sexually transmitted and has become a social menace.

syphillis / gonorrhoea **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 52*

(B) (i) A person scared by a snappy dog starts running. Which **two** systems do the electrical and chemical coordination relevant to this?

nervous system (01); endocrine system (system of ductless glands) (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 173*

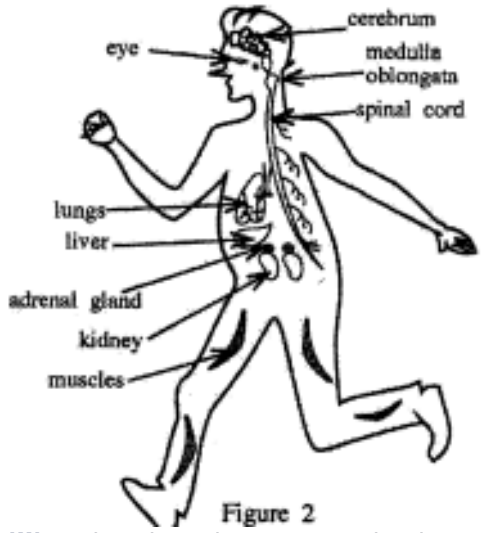


Figure 2

(ii) Using the relevant parts in Figure 2, write schematically using arrows, the connection from the receptor to the effector in the system relating to electrical coordination in (i) above.

eye → cerebrum → spinal cord → muscles

when all steps are written completely — 03 marks; when cerebrum / spinal cord of the above steps are not mentioned — 02 marks; for any other answers — 00 marks **03**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 174*

(iii) State one function carried out by the adrenal gland in relation to the coordination process.

secretion of adrenaline hormone **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(C) (i) Given as A, B, C and D in Figure 3 are optical microscope diagrams of some plant and animal tissues you have studied. Write the names of the tissues A, B, C and D correctly, identifying their structural features.

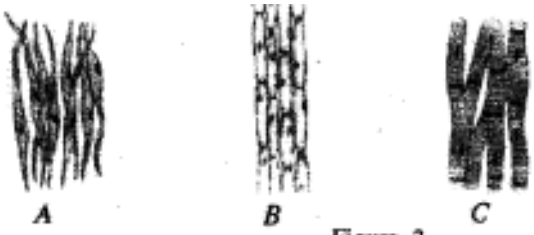


Figure 3

A - smooth muscle (tissue) (01); B - parenchyma (plant tissue) (01); C - cardiac muscle (tissue) (01); D - skeletal muscle (01) **04**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(ii) What common feature could be seen in a tissue when various plant and animal tissues are observed?

consisting of identical cells (mostly) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 1*

Question 6 — Polymers, hydrocarbons and separation

(A) Natural rubber is a polymer.

(i) Name the monomer which natural rubber is made up of.

isoprene **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 163*

(ii) Natural rubber is vulcanized by heating rubber with sulphur to a certain temperature.

(a) Mention the structural change that occurs in natural rubber during vulcanization.

formation of cross links (among linear chains) of rubber (through sulphur), or a sketch showing the cross links **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 164*



(b) State **two** changes in the properties of natural rubber brought about by the structural change you stated in part (a) above.

increasing the hardness / decreasing the elastic nature; increasing the melting point / resistant to wear and tear — 01 mark for each answer **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 164*

(c) Name one pollutant causing global warming and one pollutant causing acid rain which are added to air when vulcanized tyres are bunt in air (**The pollutants causing respective effects should be written clearly and separately**).

increasing global warming — carbon dioxide / CO_2 (01); acid rains — sulphur dioxide / SO_2 (01) — give marks even when these answers are written in order **02**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 191*

(B) The LP gas cylinders used for domestic cooking mainly contain propane and butane; both belonging to the hydrocarbon group.

(i) What is meant by 'hydrocarbons'?

(organic) compounds which contain carbon and hydrogen only **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 152*

(ii) (a) To which series of hydrocarbons do propane and butane belong?

alkane (group) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 155*

(b) What is the common formula related to the hydrocarbon series you stated above?

C_nH_{2n+2} **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 154*

(iii) The balanced chemical equation relevant to the complete combustion of butane is as follows.

$$x\ C_4H_{10}(g) + 13O_2(g) \rightarrow y\ CO_2(g) + 10H_2O(l)$$

Write the values relevant to 'x' and 'y' in the above equation.

x = 2 (01) y = 8 (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 155*

(iv) The balanced chemical equation for the combustion of propane is given below.

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) + 2220\ kJ$$

(a) Is the above reaction exothermic or endothermic?

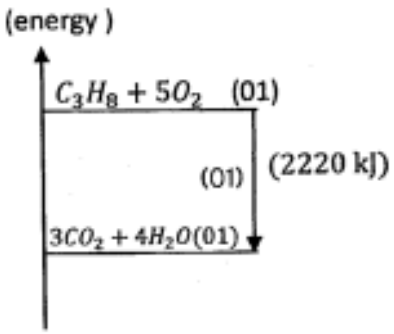
exothermic **01**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 209*

(b) Sketch an energy level diagram for the above reaction indicating clearly the relative positions of the reactants and products.

energy level diagram: $C_3H_8 + 5O_2$ at the higher level (01); $3CO_2 + 4H_2O$ at the lower level (01); downward arrow showing (2220 kJ) released (01) **03**

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 203*



(C) Given in the box below are several techniques used to separate components in mixtures.

Sifting • Recrystallisation • Fractional distillation
Filtration • Solvent extraction • Steam distillation
Crystallisation • Simple distillation • Chromatography

Write separately, which technique given in the above box is most suitable to fulfil the requirements (i), (ii), (iii) and (iv) given in the first column of the following table.

	Requirement	Chemicals provided	Extra information
(i)	Obtaining pure potassium chlorate crystals from a sample of potassium chlorate salt contaminated with a small amount of common salt	water	Potassium chlorate is more water-soluble at higher temperatures than at lower temperatures.
(ii)	Obtaining most of the iodine dissolved in a volume of water as pure crystals of iodine	diethyl ether	Diethyl ether is a volatile solvent immiscible with water. Iodine is more soluble in diethyl ether than in water.
(iii)	Identifying three colourings supposed to have been added to a food material	ethanol	The relevant food colourings are soluble in ethanol.
(iv)	Separating hexane and octane from a mixture formed by mixing the liquids hexane and octane	—	Hexane and octane are miscible liquids. Boiling point of octane is higher than the boiling point of hexane.

(i) recrystallisation (01); (ii) solvent extraction (01); (iii) chromatography (01); (iv) fractional distillation (01) **04**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 57*

Question 7 — Force, friction and moments

(A) A tall, cuboidal block of wood of mass 800 g was placed on a horizontal table.

(i) (a) Calculate the weight of this block of wood. (Consider acceleration due to gravity, g = 10 m s^{-2}.)

weight of the block of wood W = mg

= 800/1000 (kg) × 10 (m s^{-2}) **01**

= 8 N (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 104*

(b) The force exerted by the block of wood on the table is equal to the weight of the block of wood. How much is the reaction exerted on the block of wood by the table?

8 N **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 104*

(c) Name the Newton's law of motion that is relevant to the phenomenon by which the answer for (b) above was obtained.

Newton's third law / writing the law correctly **01**

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 96*

(ii) (a) Of points A and B, which is suitable to apply a force in order to move the block of wood horizontally on the table as shown in Figure 1?

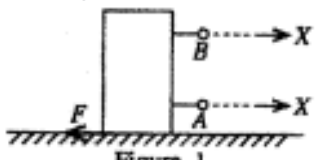


Figure 1

A **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(b) State the reason for your answer above.

(The more colinear the applied force and the frictional force against it) the tendency for toppling the block of wood is less. **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(iii) Of A and B above, a Newton balance was connected to the suitable point and a gradually increasing horizontal force X was applied. The frictional force F exerted on the block of wood was plotted against the force X. Then, the graph shown in Figure 2 was obtained.

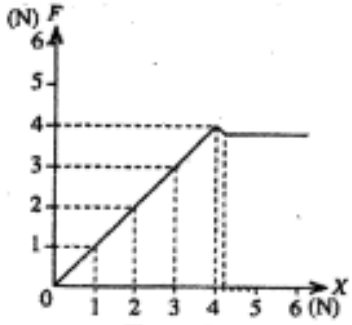


Figure 2

(a) By what name is the frictional force exerted on the block of wood known, when the force X exerted on it is 3 N?

static frictional force **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(b) What is the limiting frictional force exerted on the block of wood as indicated in the graph?

4 N **01**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 102*

(iv) It was required to drag a large block of wood along a flat, rough surface. State **two** different methods that can be used to reduce the friction between those surfaces.

smoothening the surface / applying a lublicant (oil / grease) between surfaces / inserting ball bearings or roller bearings between the contact surfaces — for any two answers **02**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 105*

(v) The mass of the block of wood mentioned in (iv) above is 200 kg. Calculate the acceleration of the block of wood in the direction of the force when an unbalanced force of 100 N is applied on it.

F = ma **01**

a = F/m = 100 (N) / 200 (kg) **01**

= 0.5 m s^{-2} (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(vi) That block of wood moved through a distance of 4 m under the unbalanced force mentioned in (v) above. How much is the effective work done in this motion?

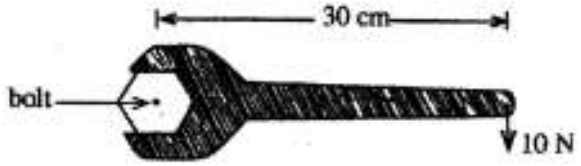
W = Fd or work done = force × distance travelled in the direction of force **01**

= 100 (N) × 4 (m) **01**

= 400 J / N m (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 100*

(B) The Figure below illustrates an instance where a bolt is tightened using a spanner.



(i) (a) Calculate in SI units, the moment of force exerted on the shaft of the spanner using the data given in the Figure.

moment of force = force × perpendicular distance (to the axis of rotation)

moment of force = 10 (N) × 30/100 (m) **01**

= 3 N m (01) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 200*

(b) In which direction does the head of the bolt rotate in the instance given in the above Figure?

clockwise **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 194*

(ii) Suggest a suitable method to increase that moment of force, while using the same spanner and applying the same force of 10 N.

increasing the length of the shaft of the spanner / for a method to increase the length **01**

▸ *Textbook: Science Grade 10 Part I, Unit 11 Turning effect of a force, page 196*

Question 8 — Classification and electric circuits

(A) Cockroach and gecko can be identified as two common organisms living in the homes of Sri Lanka.

(i) In classification, cockroach and gecko have been classified into two main groups of animals. What is the main internal feature that has been used for this classification?

vertebral column / endoskeleton / backbone **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 2*

(ii) (a) Cockroach is an arthropod. Apart from having jointed appendages, state another morphological feature belonging to that group of organisms.

having an exoskeleton / (segmented body parts collectively join) forming a tagma **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 18*

(b) Gecko is a reptile. What is the specific feature seen in this group of organisms as an adaptation to the terrestrial life?

dry skin / skin without glands — give marks even for writing the features: respiration by lungs, pentadactyl limbs, internal fertilization **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(iii) In the skeleton of these two organisms, state

(a) a difference in the way it is positioned,

cockroach - exoskeleton; gecko - endoskeleton **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 20*

(b) a similarity by function.

support / protection **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 26*

(B) Fungi are classified as a separate kingdom.

(i) How does the fungal cell wall differ from the plant cell wall?

made of chitin **01**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 113*

(ii) What is the mode of nutrition in fungi?

heterotropic / saprophytic — give a free mark for this part **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 7*

(C) Scientific name of the paddy plant is written as Oryza sativa.

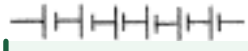
As illustrated in this, write **two** rules adopted when naming organisms scientifically.

writing in two words / writing the generic name first and specific name second / only the first letter of the generic name is capitalized / printing both words in italics / writing both words in Roman (English) script — for any two **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 24*

(D) It is stated that the voltage of a motor car battery is 12 V. This battery comprises six electrical cells; voltage of each is 2 V.

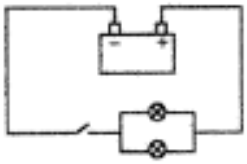
(i) Using circuit symbols, draw how the six cells are combined to make the battery.



six cells connected in series (all 6 cells) — give marks even if the cells are not connected **01**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 161*

(ii) The two head lamps of the motor car are identical and the Figure indicates how they are connected to the battery.



(a) Name how the two lamp bulbs are connected.

in parallel	**01**

▸ *Textbook: Science Grade 10 Part I, Unit 9 Resultant force, page 163*

(b) Show in a diagram, the other way of connecting the two lamp bulbs.



two bulbs in series — for this part or for the whole circuit with this part	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 70*

(c) What is the advantage of connecting the two lamp bulbs as shown in the given Figure?

One bulb lights up even if the other bulb is blown off.	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 60*

The resistance of each lamp bulb shown in the Figure is 2 Ω.

(iii) Calculate the equivalent resistance of the two lamp bulbs.

$1/R = 1/r_1 + 1/r_2$ or $= 1/2 + 1/2$	**01**
∴ R = 1 Ω (01)	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 162*

(iv) Find the electric current flowing through one lamp bulb when the circuit is put on closing the key.

total current I = V/R = 12 (V) / 1 (Ω) = 12 A — using the equation or obtaining 12 A	**01**
∴ current flowing through one bulb = 12 (A) / 2 = 6 A (01)	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 163*

(v) Calculate the current flowing through the other bulb if one bulb gets burnt.

I = V/R / 12 (V) / 2 (Ω)	**01**
= 6 A (01)	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 152*

Question 9 — Corrosion and sound waves

(A) (i) **L** and **M** are two metals which form only dipositive cations. When metal **L** is added to an aqueous solution of the sulphate of metal **M** (**MSO_4**), metal **L** gradually diminishes while metal **M** precipitates. (**L** and **M** are not standard symbols. When writing answers, use symbols **L** and **M**.)

(a) Write the balanced chemical equation relevant to the chemical change stated above.

$L + MSO_4 \rightarrow LSO_4 + M$	**02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 93*

(b) Name the type of chemical change to which the reaction written in (a) above belongs.

single displacement (reaction)	**01**

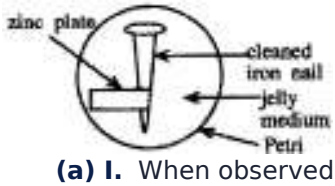
▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 98*

(c) Of the two metals L and M, which metal is placed above in the activity series?

L	**01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 99*

(ii) Figure of a set-up arranged by a student to examine the effect of other metals on the corrosion of iron is given here. The jelly medium in this contains sodium chloride, phenolphthalein, potassium ferricyanide, water and agar.



(a) I. When observed after a few hours, what colour can be observed in the jelly medium near the iron nail?

pink / red	**01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

II. What is the ion which causes that colour change?

OH^- / hydroxyl / hydroxide **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(b) Write the balanced ionic equation for the half-reaction that occurs near the zinc plate.

$Zn \rightarrow Zn^{2+} + 2e$ — give marks also for $Zn - 2e \rightarrow Zn^{2+}$ **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(c) What is the reason for adding sodium chloride to the jelly medium in this experiment?

to obtain observations quickly / to increase the rate of reaction / to increase the conductivity of the medium / to neutralize the medium **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(d) I. Which metal acts as the cathode in this experiment?

iron / Fe **01**

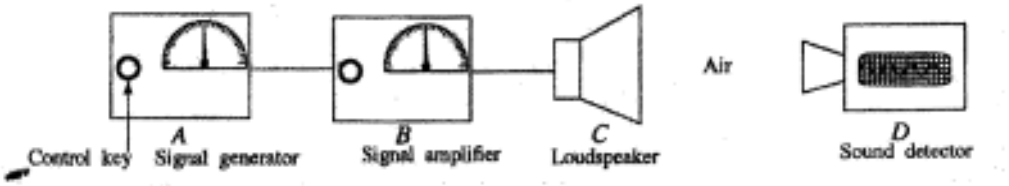
▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

II. State a practical application related to this experiment.

galvanizing iron / give marks for stating that a sacrificing metal is connected to the hulls of ships / underground pipes **01**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(B) A set-up of apparatus arranged to study about sound waves is given in the Figure.



A – Signal generator - Produces electrical signals of various frequencies. Control key changes the frequency of the signal generated.
B – Signal amplifier - Increases the amplitude of the signal received from the generator. Its control key can control the amplification.
C – Loudspeaker - Converts the electrical signal received from the amplifier into sound.
D – Sound detector - Records on the screen, the frequency and the amplitude of sound waves received from the loudspeaker.

(i) Indicate in hertz (Hz), the frequency range that has to be maintained to make the sound received from the loudspeaker sensitive to the human ear.

20 Hz – 20000 Hz **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 95*

(ii) What is the characteristic that changes in the sound heard when the frequency is gradually increased within the above range?

pitch **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 93*

(iii) What is the characteristic of sound that changes, when the amplitude is changed by the signal amplifier control key?

loudness **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 93*

(iv) The sound emitted from the loudspeaker travels to the sound detector through air as a mechanical wave.

(a) To which type of waves does this mechanical wave belong?

longitudinal waves **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 74*

(b) Explain briefly, the behaviour of air particles in the medium when these waves travel.

making rarefactions and compressions (in air particles) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 89*

(v) When the experiment was conducted keeping the detector at a distance of 170 m from the loudspeaker, the sound emitted from the loudspeaker took 0.5 s to reach the detector.

(a) Calculate the velocity of sound in air.

speed = distance / time or = 170 (m) / 0.5 (s) **01**

= 340 m s^{-1} (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(b) State whether the velocity of sound changes or doesn't change in the instances I and II below.

I. Changing the frequency of the signal

Does not change **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 93*

II. Changing the temperature of air

Changes **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

Paper II • 2017 (new syllabus)

PREPARED ANSWERS (TEXTBOOK-BASED)

Part B • essay questions • answer three • 20 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 5 — Blood, grafting and the flower

(A) Some components in the human blood are given below.

- Red blood cells
- White blood cells
- Platelets
- Proteins
- Glucose
- Ca^{2+}
- Urea

(i) Which blood cells are most abundant in blood?

Red blood cells (erythrocytes)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 163*

(ii) Of the components given above,

(a) write **two** components that belong to blood plasma.

Proteins / glucose / Ca^{2+} / urea (any two)

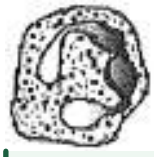
▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 165*

(b) state a nitrogenous waste material present in blood.

Urea

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 165*

(iii) (a) Given below is a diagram of a blood cell that belongs to a certain type. To which component given above, does this cell belong?



White blood cells (a granulocyte with a lobed nucleus)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 61*

(b) State a function of the blood component to which the cell given in (a) above belongs.

Defending the body against pathogens (by phagocytosis / producing antibodies)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 166*

(iv) (a) Write a disease associated with blood circulatory system of the human.

Heart attack / high blood pressure / stroke / atherosclerosis / anaemia (any one)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 169*

(b) In a person suffering from Dengue, which component decreases drastically?

Platelets

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 165*

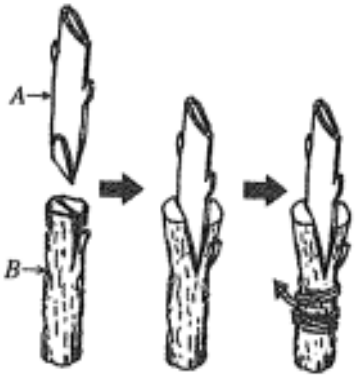
(v) Briefly explain, the process of regulation of blood glucose level in human.

When the blood glucose level rises (e.g. after a meal), the pancreas secretes insulin; insulin makes cells take up glucose and converts excess glucose into glycogen, stored in the liver and muscles, so the level falls.

When the blood glucose level falls, the pancreas secretes glucagon, which converts stored glycogen back into glucose, so the level rises. In this way the level is kept nearly constant (homeostasis).

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 181*

(B) (i) Steps of a plant grafting method are shown in the figure given below.



(a) What is the name given to the above grafting method?

Cleft grafting (wedge grafting)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 32*

(b) Write, respectively, the names given to parts A and B, according to this grafting method.

A – scion; B – stock (rootstock)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 32*

(c) Of the parts A and B, characteristics of which part does the daughter plant get?

A (the scion)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 32*

(ii) Flower is the structure that contributes to sexual reproduction of plants.

(a) Name the **three** parts that the gynoecium of a flower consists of.

Stigma, style and ovary

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 35*

(b) Write **two** changes that take place in a flower after fertilization.

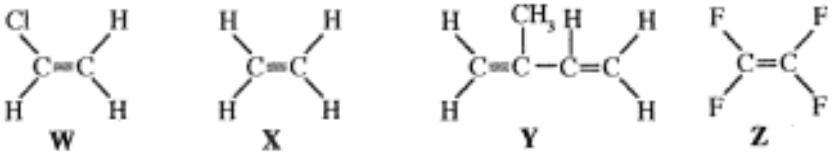
The ovary develops into the fruit / the ovules develop into seeds / the petals, stamens, style and stigma wither and fall off (any two)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 42*

(Total marks 20)

Question 6 — Polymers, cells and separation

(A) The structures **W**, **X**, **Y** and **Z** given below are the monomers of some polymers.



(i) State a derivative of ethene from the monomers **W**, **X**, **Y** and **Z**.

W (chloroethene / vinyl chloride) / Z (tetrafluoroethene)

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 157*

(ii) Name the polymers which are formed by the monomers **W**, **X** and **Y** respectively.

W – polyvinyl chloride (PVC); X – polythene (polyethene); Y – natural rubber (polyisoprene)

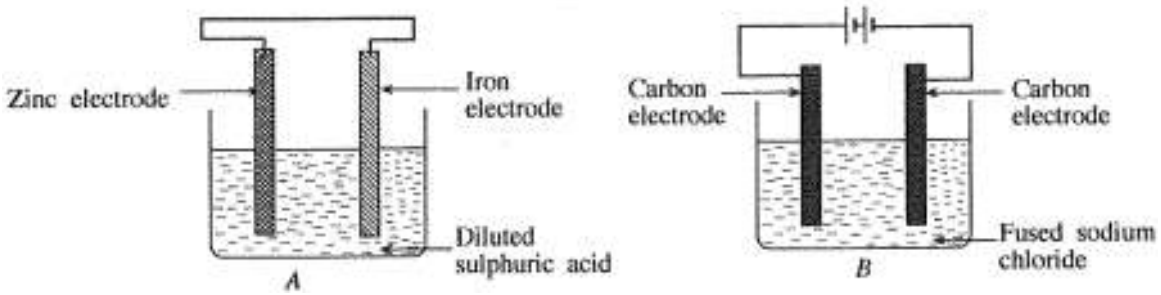
▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 159*

(iii) What is the natural polymer among the polymers that you stated in (ii) above?

Natural rubber

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 163*

(B) In the following figures, two cells are given as A and B.



(i) From the above two cells A and B, which is the electrolytic cell?

B

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 88*

(ii) Write **one** observation that could be obtained when the cell A operates.

The zinc electrode gradually dissolves (wears away) / gas bubbles form at the iron electrode / a current flows in the external circuit (any one)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 85*

(iii) (a) Write the cathodic reaction that takes place in cell B.

$Na^+ + e^- \rightarrow Na$

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 113*

(b) What is the name commonly given to the electrodes where oxidation reaction takes place in both cells?

Anode

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 89*

(iv) What is the reason for **not** using cell B in the production of sodium metal, industrially?

In cell B the sodium and chlorine produced are not kept apart, so they mix and react again (and molten sodium reacts with air); industrially the Downs cell is used, which keeps the products separate and uses $CaCl_2$ to lower the melting point of NaCl

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(C) (i) Three instances relevant to separation of components from mixtures are given below.

① - Separation of various minerals from mineral sands
② - Separation of petroleum by the mineral oil refinery
③ - Obtaining distilled water from well water

Write the separation methods used in the instances ①, ② and ③ above, respectively.

① – magnetic separation (mechanical / physical separation); ② – fractional distillation; ③ – simple distillation

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 59*

(ii) Distilled water is commonly used as a solvent when preparing standard solutions in laboratory.

(a) Calculate the mass of sodium chloride required to prepare a 100 cm^3 of 1.00 mol dm^{-3} sodium chloride solution. (The molar mass of sodium chloride is 58.5 g mol^{-1}.)

Amount of NaCl = 1.00 mol dm^{-3} × 0.100 dm^3 = 0.100 mol

Mass = 0.100 mol × 58.5 g mol^{-1} = 5.85 g

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 47*

(b) Write in order, the steps that are followed in the laboratory when preparing the sodium chloride solution mentioned in (a) above.

Weigh 5.85 g of NaCl accurately → dissolve it in a small volume of distilled water in a beaker → transfer the solution into a 100 cm^3 volumetric flask, adding the washings of the beaker → add distilled water up to the mark → stopper and shake well to mix

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 48*

(Total marks 20)

Question 7 — Motion on highways

It is necessary to be vigilant and obey road rules when using high ways.

(i) It is important for the driver as well as passengers to wear seat belts in the vehicle when travelling on high ways. What is the reason for this?

If the vehicle stops suddenly, the body continues to move forward due to inertia; the seat belt prevents the person from being thrown forward and injured

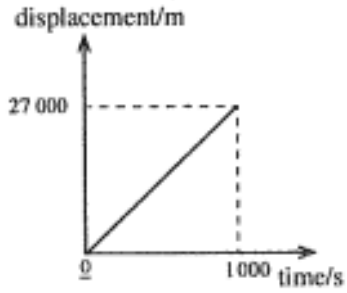
▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 86*

(ii) Write down the Newton's law of motion which is connected to the answer you mentioned in (i) above.

Newton's first law of motion – a body continues in its state of rest or uniform motion in a straight line unless an external unbalanced force acts on it

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 97*

(iii) The displacement-time graph for the motion of the vehicle A, which travelled on an express way from the beginning to the end at the **maximum** permissible **velocity** is given here.



Here, it has been assumed that the express way is horizontal and it is in a straight line.
Answer the following questions using the graph.

(a) What is the length of the express way?

27 000 m (27 km)

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 40*

(b) Calculate the **maximum** permissible **velocity** that a vehicle can be driven in that express way.

v = displacement ÷ time = 27 000 m ÷ 1000 s

= 27 m s^{-1}

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 39*

(iv) In heavy rainy days, the drivers are advised to maintain 15 m s^{-1} as the **maximum velocity** for a vehicle that is driven on the express way mentioned in (iii) above.

(a) What is the main reason for advising the drivers **not** to drive the vehicles at a higher velocity when heavy rain exists?

The friction between the tyres and the wet road is low, so the vehicle may skid and needs a longer distance to stop

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 106*

(b) Explain scientifically, your answer in (a) above.

A film of water between the tyres and the road reduces the (limiting) friction. The force that stops the vehicle comes from this friction, so at a high velocity (large momentum) the small frictional force cannot stop the vehicle within a safe distance / time.

▸ *Textbook: Science Grade 10 Part I, Unit 5 Friction, page 109*

(c) On a heavy rainy day, the motion of the vehicle B which travelled from the beginning to the end of the express way mentioned in (iii) above was as follows.
It started from the rest and uniformly accelerated in the first 10 seconds and acquired **maximum velocity** (15 m s^{-1}). Thereafter it travelled at the same velocity for a certain time and in the last 10 seconds it uniformly decelerated and came to rest at the end of the express way.
Including the given information, draw a rough sketch of the velocity-time graph for the motion of vehicle B.

Velocity (m s^{-1}) against time (s): a straight line rising from 0 to 15 m s^{-1} in the first 10 s; a horizontal line at 15 m s^{-1}; a straight line falling from 15 m s^{-1} to 0 in the last 10 s (a trapezium)

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(d) Find the total time taken by vehicle B to travel on the express way.

Displacement = area under the v-t graph = 27 000 m

(½ × 10 × 15) + 15 t + (½ × 10 × 15) = 27 000, so 15 t = 26 850 and t = 1790 s

Total time = 10 + 1790 + 10 = 1810 s

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(e) If the mass of the vehicle B is 3 000 kg, Find its momentum at the instance when it travelled in the maximum velocity.

$p = mv = 3000\ kg \times 15\ m\ s^{-1} = 45\ 000\ kg\ m\ s^{-1}$

▸ *Textbook: Science Grade 10 Part I, Unit 4 Newton's laws of motion, page 94*

(v) When drivers are driving vehicles, it is important to pay attention to the side mirrors in front of the vehicles for the prevention of accidents.

(a) What type of curved mirrors are used as side mirrors of the vehicles?

Convex mirrors

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 108*

(b) How does paying attention to those mirrors, contribute to prevent road accidents when the vehicles are driven?

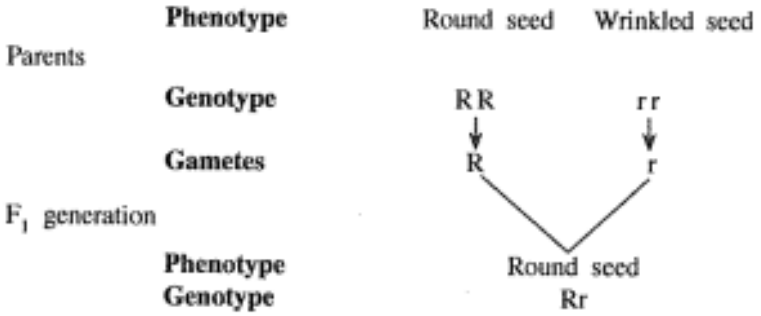
Convex mirrors give a wide field of view (erect, diminished images), so the driver can see vehicles approaching from behind and from the sides before turning, overtaking or changing lanes

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 108*

(Total marks 20)

Question 8 — Inheritance and household electricity

(A) A diagram relevant to the experiment carried out by Mendel on inheritance, using garden pea plant is given below.



(i) What are the contrasting characters used in this experiment?

Seed shape: round seeds and wrinkled seeds

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 175*

(ii) In which step does meiosis occur during this process?

During the formation of gametes

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 120*

(iii) (a) According to the above experiment, show, using a diagram, how characters are inherited in a mono-hybrid cross of F_1 generation.

F_1 parents: Round seed (Rr) × Round seed (Rr)

Gametes: R, r and R, r

F_2 (Punnett square): R + R → RR; R + r → Rr; r + R → Rr; r + r → rr

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 176*

(b) Write the genotypes and corresponding phenotypes of the offsprings obtained in F_2 generation in the above cross.

RR – round seed; Rr – round seed; rr – wrinkled seed

Genotype ratio RR : Rr : rr = 1 : 2 : 1; phenotype ratio round : wrinkled = 3 : 1

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 175*

(iv) Transmission of inherited characters to the next generation as stated above is common to all living organisms. Accordingly, explain briefly, the importance of not having marriages between blood relations.

Blood relatives are more likely to carry the same harmful recessive allele. Their children therefore have a higher chance of receiving two copies (homozygous recessive) and suffering from genetic disorders such as thalassaemia. Avoiding such marriages reduces this risk.

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 187*

(B) Several electric appliances used in a house are given below.

Television, Fluorescent lamp, Microwave oven, Immersion heater, Hot plate, Electric iron

(i) When some appliances mentioned above are used, it is necessary to use three pin plugs.

(a) From these appliances, name one appliance with which a three pin plug must be used.

Microwave oven / immersion heater / hot plate / electric iron (any one with a metal body)

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 32*

(b) What is the importance of using a three pin plug for the appliance you mentioned in (a) above?

The third (earth) pin connects the metal body of the appliance to earth; if the live wire touches the body, the current flows to earth (and the fuse blows), so the user does not get an electric shock

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 44*

(ii) Write down a main energy form that the electric energy converts into, when the television operates.

Light energy / sound energy

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 32*

(iii) Television is operated by a remote control.

(a) As what type of waves are the signals sent to the television by the remote control?

Infra-red waves

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 85*

(b) Write **two** characteristics of the wave type that you have mentioned in (a) above.

Invisible electromagnetic waves / travel in straight lines / can be reflected / travel at 3×10^8 m s^{-1} / need no medium to travel / have a heating effect (any two)

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 81*

(iv) The power of some appliances mentioned above are given in the following table.

Appliance	Power/W
A - Television	125
B - Fluorescent lamp	18
C - Microwave oven	1500
D - Electric iron	1200

In a certain day all these **four** appliances were operated during 1 hour and 30 minutes period.

(a) Arrange A, B C and D in the ascending order of the electric energy consumption during the time of operation. (Calculations are not expected)

B, A, D, C

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 32*

(b) Calculate the electric energy consumed by A during that time.

$E = P \times t = 125\ W \times 1.5\ h = 187.5\ Wh = 0.1875\ kWh$

(or $125\ W \times 5400\ s = 675\ 000\ J$)

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 34*

(Total marks 20)

Question 9 — Acids, bases and natural resources

(A) The three solutions NaOH, HCl and NaCl of concentration 1.00 mol dm^{-3} are put separately into test tubes **A**, **B** and **C**.

(i) The tests carried out by a student to identify the solutions separately, and the observations made are given in the table below.

	Test	Observations
1.	Dipped red and blue litmus papers in the solution in tube **A**	Blue litmus did not show any colour change; Red litmus turned to blue
2.	Dipped red and blue litmus papers in the solution in tube **B**	Red and blue litmus did not show any colour change

Mention the solutions in test tubes **A**, **B** and **C** respectively.

A – NaOH; B – NaCl; C – HCl

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 97*

(ii) When 100 ml of each of the solutions NaOH and HCl stated above were mixed in a thermally insulated vessel, the temperature of the mixture rose up to 5 °C.

(a) Write the balanced chemical equation for the reaction between NaOH and HCl.

$NaOH + HCl \rightarrow NaCl + H_2O$

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(b) Calculate the heat change associated with the reaction mentioned above. (Take the specific heat capacity of water as 4 200 J kg^{-1} $°C^{-1}$ and the density of water as 1 g cm^{-3}).

Mass of the mixture = 200 cm^3 × 1 g cm^{-3} = 200 g = 0.2 kg

$Q = mc\theta$ = 0.2 kg × 4200 J kg^{-1} $°C^{-1}$ × 5 °C = 4200 J (heat released)

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 11*

(iii) Write **two** assumptions that you made when determining the heat change associated with the reaction between NaOH and HCl stated above.

The specific heat capacity of the solution is equal to that of water / the density of the solution is equal to that of water / no heat is lost to the surroundings or absorbed by the vessel (any two)

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 206*

(B) The sun, atmosphere, land and the sea are natural resources.

(i) The sun's surface temperature is approximately 5 800 K.

(a) What is the surface temperature of sun in Celsius?

5800 − 273 = 5527 °C

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 25*

(b) In which heat transferring method does the heat transfer from sun to earth?

Radiation

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(c) Explain scientifically, how the sea breeze is formed in day time due to sun's heat.

During the day the land gets heated faster than the sea (land has a lower specific heat capacity). The air above the land becomes warm, expands, becomes less dense and rises. Cooler, denser air from above the sea moves towards the land to take its place, forming the sea breeze (a convection current).

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 25*

(ii) In a certain day, the atmospheric pressure at sea level was 76 cm Hg and the atmospheric pressure at 10 km above sea level was 20 cm Hg.

(a) Name a laboratory instrument which is used to take the measurements of atmospheric pressure stated above.

Mercury barometer (Fortin barometer)

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 85*

(b) What is the reason for the pressure difference observed above?

The height of the air column above (and the density of air) decreases with altitude, so the weight of air above a unit area is less at higher places

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 85*

(iii) Calculate the hydrostatic pressure at a place 2 km deep from the sea level. Take the density of sea water as 1050 kg m^{-3} and acceleration due to gravity as 10 m s^{-2}.

$P = h\rho g$ = 2000 m × 1050 kg m^{-3} × 10 m s^{-2}

= 2.1 × 10^7 Pa (N m^{-2})

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 25*

(Total marks 20)

Paper II • 2017 (old syllabus)

PREPARED ANSWERS (TEXTBOOK-BASED)

Part B • essay questions • answer three • 20 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 5 — Biology: vegetative propagation and tissues

(A) Students in a school have decided to establish a medicinal garden in the school premises as a project. The following plants have been selected to be planted there.

Karapincha, Ginger, Jasmine, Centella, Turmeric, Nutmeg

(i) From among the above plants, write down respectively, a plant that can be propagated by roots and a plant that can be propagated by runners.

By roots: Karapincha; by runners: Centella (gotukola)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 30*

(ii) (a) Write down **two** plants, from among the above plants, which can be propagated by underground stems.

Ginger and turmeric

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(b) To which type of underground stems the plants you have mentioned in (a) above belong?

Rhizomes

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(c) From the growth of which parts of the underground stem, the new plants are generated?

From the buds (at the nodes) of the rhizome

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(iii) (a) Name a plant from the above plants, that can be propagated by the artificial vegetative propagation.

Nutmeg / Jasmine

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(b) Name the artificial vegetative propagation method that can be used for that plant.

Nutmeg — grafting (budding) / Jasmine — layering

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(c) Write an advantage of propagation of that plant by the artificial vegetative propagation method.

Any one: the desirable characteristics of the parent plant are retained; early yield; (for nutmeg) female, fruit-bearing plants can be obtained

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(iv) Students decided to write the scientific name of each plant according to binomial nomenclature and exhibit it in front of the plants to be planted in the garden. The scientific name of one plant is written as follows.

Centella Asiatica

There is an error in the way of writing that name according to binomial nomenclature. Write down that name correctly.

Centella asiatica — the species name begins with a simple (lower-case) letter; when hand-written, the two words are underlined separately.

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 24*

(B) (i) Three muscle tissues are shown in the figures P, Q and R.



P Q R

(a) Name the muscle tissues P, Q, and R respectively.

P — skeletal muscle; Q — smooth muscle; R — cardiac muscle

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(b) Which of the above tissues function involuntarily?

Q and R

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(c) Which type of the above tissues is present in walls of blood vessels?

Q (smooth muscle)

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 13*

(ii) (a) Name the **two** major types of blood cells in blood tissue.

Red blood cells (erythrocytes) and white blood cells (leucocytes)

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

(b) What is the name given to the fragments of cells present in blood?

Platelets (thrombocytes)

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

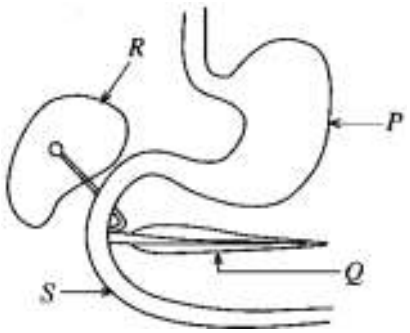
(c) What is the significance of fragments you mentioned in (b) above?

They help in clotting of blood, preventing excessive loss of blood from wounds.

▸ *Textbook: Science Grade 11 Part I, Unit 1 Living tissues, page 12*

Question 6 — Biology: digestion and populations

(A) Some parts of the human digestive system are given in the following diagram.



(i) Name the parts P, Q, R and S.

P — stomach; Q — pancreas; R — liver; S — duodenum

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 144*

(ii) Name **two** enzymes released by Q and state on which type of food each of those enzymes acts.

Any two: trypsin — proteins; (pancreatic) amylase — starch; lipase — lipids (fats)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(iii) (a) Of the parts P, Q, R and S, in relation to which part does gastritis occur?

P (stomach)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 185*

(b) State a reason for that disease.

Any one: excess acid secretion due to irregular meals or stress; Helicobacter pylori infection; long-term use of painkillers; alcohol consumption

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 149*

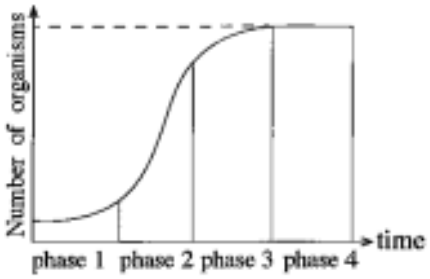
(B) 'Population' is one of the levels of organization in the biosphere.

(i) Define 'population'.

A group of organisms of the same species living in a particular area at a particular time.

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 168*

(ii) Pattern of growth of a natural population is shown in this graph.



(a) Among the phases shown in the graph, name the phase which shows a rapid growth of organisms and give reasons for that rapid growth.

Phase 2 — plenty of food and space, few predators and diseases, and a large number of reproducing individuals

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 170*

(b) What is known as 'carrying capacity'?

The maximum population size that an environment can support (sustainably) with its available resources.

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 170*

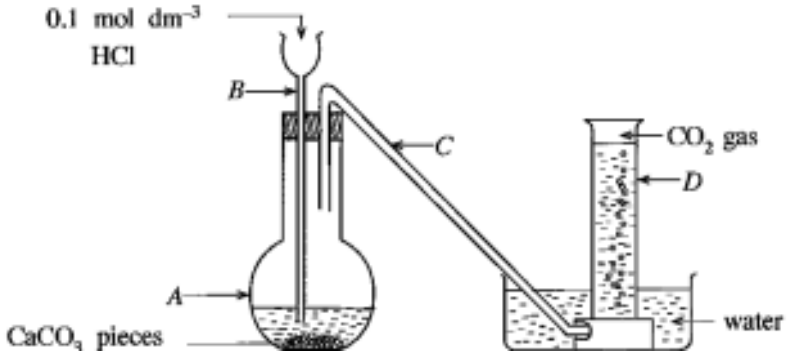
(c) The rate of growth of the human population is higher in developing countries than in developed countries. Write down **three** problems that arise due to this.

Any three: food shortage; unemployment; shortage of housing; overcrowding and spread of diseases; environmental pollution; depletion of natural resources

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 170*

Question 7 — Chemistry: laboratory preparation of CO_2

An experimental set-up used for the preparation of CO_2 gas in the laboratory is given below.



(i) Name the equipment A, B, C and D in the set up above.

A — round-bottomed (flat-bottomed) flask; B — thistle funnel; C — delivery tube; D — gas jar

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 103*

(ii) Write the balanced chemical equation for the reaction takes place in A.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(iii) By increasing the rate of above reaction, CO_2 gas can be produced quickly. How is the rate of reaction increased in this experiment?

Use powdered $CaCO_3$ (larger surface area) / use more concentrated HCl / warm the mixture

▸ *Textbook: Science Grade 10 Part II, Unit 17 Rate of reactions, page 117*

(iv) (a) Write the observations, when wet red and blue litmus papers are dipped in D after collecting CO_2.

Blue litmus turns red; red litmus shows no change.

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 195*

(b) Give the reason for your observations in (a) above.

CO_2 dissolves in water forming carbonic acid (H_2CO_3), so the solution is acidic.

▸ *Textbook: Science Grade 11 Part I, Unit 7 Acids, bases and salts, page 196*

(v) (a) If you use Zn powder instead of $CaCO_3$ pieces in this experiment, what gas will evolve?

Hydrogen (H_2)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 103*

(b) Write **two** differences in physical properties between CO_2 gas and the gas mentioned in (a) above.

CO_2 is denser than air, H_2 is less dense than air; CO_2 is fairly soluble in water, H_2 is almost insoluble.

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 107*

(vi) 15 ml of 0.1 mol dm^{-3} HCl solution is used in this experiment. Calculate the number of moles of HCl used in this experiment. (H = 1, Cl = 35.5)

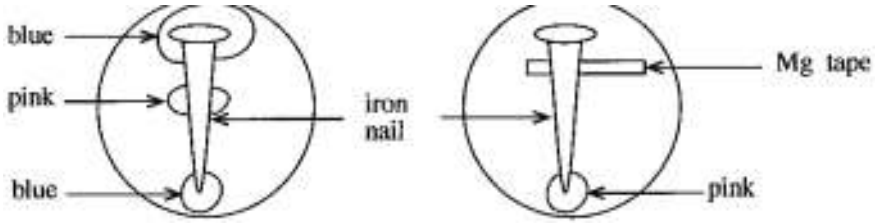
volume = 15 ml = 0.015 dm^3

moles = 0.1 mol dm^{-3} × 0.015 dm^3 = 0.0015 mol (1.5×10^{-3} mol)

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

Question 8 — Chemistry: corrosion and limestone

(A) An experimental set-up used to find the effect of magnesium metal on corrosion of iron is given by the following figures A and B. The agar medium used in this experiment contains small amounts of sodium chloride, potassium ferricyanide and phenolphthalein. The colour patches obtained in agar medium in the petri dishes after few hours are indicated in the figures.



(i) (a) Write respectively, the ions that are responsible for blue and pink colour formation in the above experiment.

Blue — Fe^{2+} ions (with potassium ferricyanide); pink — OH^- ions (with phenolphthalein)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(b) What is the indicator used in this experiment?

Phenolphthalein

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(c) What is the substance used to induce the corrosion of iron?

Sodium chloride (an electrolyte)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(ii) Iron nail in which Petri dish is subjected to corrosion?

A

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(iii) (a) According to the observations above, what is the place of Mg in the activity series in relation to iron?

Magnesium is above iron (more reactive than iron) in the activity series.

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(b) How does Mg function in this experiment?

Mg acts as a sacrificial anode: it is oxidised (corroded) instead of iron, so the iron nail is protected (cathodic protection).

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 108*

(B) Consider the following flow chart regarding a Lime stone based process.

Lime stone —(Heating)→ Quick lime —A→ Slaked lime —B→ Bleaching powder

(i) Name A and B.

A — adding water (slaking); B — passing chlorine gas

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 98*

(ii) Write the chemical name of quick lime.

Calcium oxide

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 93*

(iii) Write **two** uses of bleaching powder.

Any two: bleaching cloth / paper pulp; disinfecting drinking water; killing germs (disinfecting toilets, swimming pools)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 98*

(iv) (a) Write the balanced chemical equation for the reaction that takes place in the production of quick lime from lime stone.

$CaCO_3 \rightarrow CaO + CO_2$

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(b) Find the mass of quick lime that could be produced using 2 kg of pure lime stone. (Ca = 40, O = 16, C = 12)

Molar mass $CaCO_3$ = 100 g mol^{-1}; 2000 g ÷ 100 g mol^{-1} = 20 mol $CaCO_3$

20 mol $CaCO_3$ gives 20 mol CaO; mass = 20 mol × 56 g mol^{-1} = 1120 g (1.12 kg)

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

(c) Explain with **two** facts, how environmental pollution takes place in the process of quick lime production.

Any two: CO_2 released (from limestone and burnt fuel) adds to global warming; burning firewood / fuel produces smoke and leads to deforestation; dust from quarrying and kilns pollutes the air; quarrying damages the land

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 111*

Question 9 — Physics: weight, upthrust and the pulley

A rough diagram relevant to an instance where water is pulled from a well using a rope is given here. (Take g = 10 m s^{-2} for the calculations.)

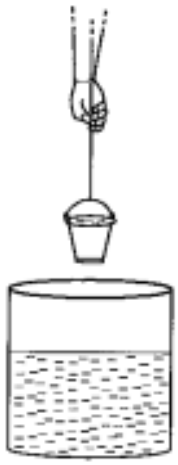


figure (1)

(i) If the mass of the bucket completely filled with water is 5 kg, find its weight.

W = mg = 5 kg × 10 m s^{-2} = 50 N

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 84*

(ii) What is the weight that is felt by the hand when the bucket is lifted in the instance (i) above?

50 N

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 130*

(iii) (a) Does the weight felt by the hand when the water bucket is fully immersed in water equal to the weight that you stated in (ii) above?

No — it is less (the bucket feels lighter).

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(b) What is the reason for your answer in (a) above?

Water exerts an upthrust on the immersed bucket, so the apparent weight = weight – upthrust.

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 76*

(c) With a diagram, show the forces acting on the bucket, when it is completely immersed in water.

Diagram of the bucket with three arrows: weight W acting vertically downwards; tension T in the rope acting upwards; upthrust U acting upwards (T + U = W)

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 82*

(iv) The height to the water level of the well from the ground level is 8 m. A simple machine named as A is used as in the figure (2) to avoid the difficulty of pulling the bucket as in figure (1) above.

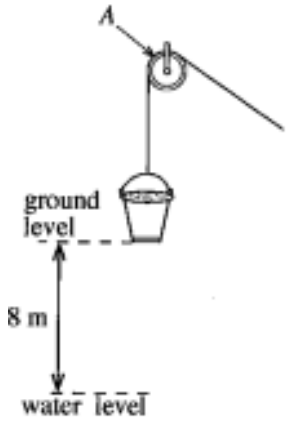


figure (2)

(a) What is the simple machine A?

A single fixed pulley

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 65*

(b) Write an expression for the mechanical advantage of the simple machine used here?

Mechanical advantage = load ÷ effort

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(c) When the bucket is completely filled with water, the mechanical advantage of pulling the bucket at the instance given in figure is 0.9. Calculate the effort that must be applied here.

effort = load ÷ MA = 50 N ÷ 0.9

= 55.6 N

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 72*

(d) A heavier effort than load must be applied when pulling the bucket. What is the reason for that?

Extra effort is needed to overcome friction in the pulley (and to lift the rope).

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 201*

(e) What is the velocity ratio of this simple machine?

Velocity ratio = 1

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 44*

(f) What is the efficiency of the simple machine.

efficiency = (MA ÷ VR) × 100% = (0.9 ÷ 1) × 100%

= 90%

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 65*

(g) If the height from water level of the well to A is 10 m, find the potential energy of the bucket at the level of A. (Take the potential energy as zero at the ground level.)

height of A above ground level = 10 m – 8 m = 2 m

PE = mgh = 5 kg × 10 m s^{-2} × 2 m = 100 J

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

Question 10 — Physics: sound and pressure

(A) Some instruments which are practised by a music group are given below.

Drum, Violin, Flute, Harmonium

(i) Of the above instruments, name respectively, an instrument with vibrating air columns and an instrument with vibrating membranes.

Vibrating air column: flute; vibrating membrane: drum

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 100*

(ii) Write **two** actions that can be followed to get a sharp sound when practising the violin.

Any two: increase the tension of the string (tighten it); shorten the vibrating length (press the string with a finger); use a thinner string

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 99*

(iii) If the same note is played by the violin and the flute, the two instruments can be identified separately. What is the characteristic of sound that causes for this?

Quality (timbre) of sound

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 94*

(B) It is required to place 1 000 kg of nuclear waste at the bottom of the sea.

(i) It is needed to select a suitable location to place the above waste at the bottom of the sea.

(a) What is the special instrument which uses sound waves, needed to find that place?

SONAR (echo sounder)

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 96*

(b) What is the principle used in that instrument?

Reflection of sound (echo)

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 98*

(c) Sound waves of frequency 29 200 Hz are emitted by the instrument mentioned in (a) above. What is the special name given to those sound waves?

Ultrasonic waves (ultrasound) — frequency above 20 000 Hz

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 95*

(d) The sound wave emitted by the instrument mentioned in (a) above has taken a time of 20 seconds to return and record after striking the bottom of the sea. If the speed of sound in water is 1 460 m s^{-1}, find the distance (h) to the place where waste is deposited in the bottom of the sea from the surface of the sea.

distance travelled = 1460 m s^{-1} × 20 s = 29 200 m (to the bottom and back)

h = 29 200 m ÷ 2 = 14 600 m

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(e) Find the wave length of the sound wave mentioned above.

$\lambda = v \div f$ = 1460 m s^{-1} ÷ 29 200 Hz = 0.05 m

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 92*

(ii) (a) If the density of sea water is d, write an equation for the pressure exerted by water at the place where the nuclear waste is placed, in terms of h, d and g (g is the acceleration due to gravity).

P = hdg

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 68*

(b) Considering the value of h in part (d) in (i) above, find the pressure exerted by sea water on the place where the nuclear waste is placed. The density of sea water is 1100 kg m^{-3}. (Take g = 10 m s^{-2})

P = hdg = 14 600 m × 1100 kg m^{-3} × 10 m s^{-2}

= 1.606 × 10^8 Pa (N m^{-2})

▸ *Textbook: Science Grade 10 Part II, Unit 15 Hydrostatic pressure and its applications, page 68*

Paper II • 2016

PREPARED ANSWERS (TEXTBOOK-BASED)

Part B • essay questions • answer three • 20 marks each

Answers prepared from the textbooks — no official marking scheme available.

Question 5 — Digestion and sex determination

(A) Average masses of macronutrients present in a biscuit of a particular brand are given in the following table.

Macronutrient	Mass
Proteins	0.81 g
Carbohydrates	5.67 g
Fat	1.55 g

(i) What are the elements present in proteins?

Carbon, hydrogen, oxygen and nitrogen (sulphur may also be present)

▸ *Textbook: Science Grade 10 Part I, Unit 1 Chemical basis of life, page 7*

(ii) (a) When a person consumes a biscuit of the above brand, in which part of the digestive system does its digestion start?

Mouth (buccal cavity)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 145*

(b) Name the enzyme that is added to food in the part stated in (a) above, and state the nutrient on which that enzyme acts.

Salivary amylase – acts on starch (converting it to maltose)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 145*

(c) State the **two** substances that are mainly added to this food in the stomach.

Hydrochloric acid and pepsin (in gastric juice)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 146*

(d) In which part of the digestive system is the digestion of this food completed?

Small intestine (ileum)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(e) State the end products of this digestive process.

Amino acids, monosaccharides (glucose), fatty acids and glycerol

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 147*

(f) Write one adaptation of the human digestive system for efficient absorption of end products of digestive process.

Villi and microvilli greatly increase the surface area / the small intestine is long / walls of villi are only one cell thick / villi have a rich network of blood capillaries and a lacteal (any one)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 148*

(B) Reproduction is the process of production of a new generation from one generation.

(i) State respectively, the names given to male and female gametes that contribute to human reproductive process.

Male gamete – sperm (spermatozoon); female gamete – ovum (egg)

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(ii) In a human somatic cell, how many pairs of sex chromosomes are present?

One pair (XX in females, XY in males)

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 182*

(iii) Considering the sex chromosomes, show, using a diagram, how sex is determined in humans.

Parents: mother XX × father XY

Gametes: eggs – X only; sperms – X or Y

Offspring: X (egg) + X (sperm) → XX (female); X (egg) + Y (sperm) → XY (male) — ratio 1 : 1

The sex of the child is decided by the type of sperm that fertilizes the ovum

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 184*

(iv) (a) What is the sex-linked disorder that occurs only in males?

Haemophilia (colour blindness is also accepted) — appear mostly in males

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 185*

(b) What is the genetic reason for this disorder?

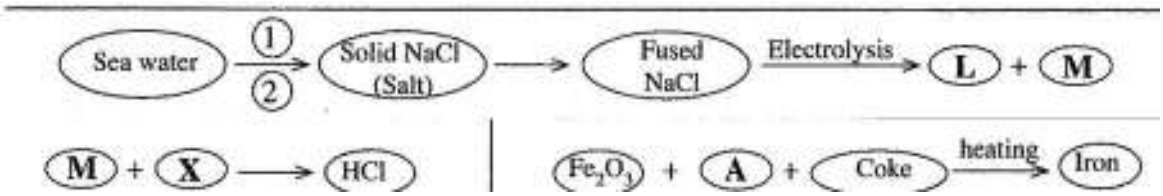
The recessive allele causing it is carried on the X chromosome; a male has only one X chromosome and the Y chromosome carries no matching allele, so a single recessive allele shows its effect

▸ *Textbook: Science Grade 10 Part II, Unit 20 Inheritance, page 184*

(Total marks 20)

Question 6 — Industrial production processes

Consider the following industrial production processes.



(i) Name **A**, **L**, **M** and **X** respectively.

A – limestone ($CaCO_3$); L – sodium (Na); M – chlorine (Cl_2); X – hydrogen (H_2)

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(ii) Write a physical property of **X**.

Colourless and odourless / least dense (lightest) gas / almost insoluble in water (any one)

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 103*

(iii) Write down the **two** separating techniques ① and ② relevant to production of salt from sea water.

① – evaporation of water using solar heat; ② – crystallization

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 64*

(iv) About 40% $CaCl_2$ is added to NaCl when obtaining fused NaCl from solid NaCl. What is the reason for that?

To lower the melting point of NaCl (from about 801 °C to about 600 °C), saving energy

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 13*

(v) What is the strategy used in the cell to prevent the reaction between L and M produced by the electrolysis process?

A steel (iron) gauze separates the anode from the cathode, so the sodium and chlorine produced do not come into contact

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 97*

(vi) (a) Is the chemical reaction occur in A in the process of iron extraction, exothermic or endothermic?

Endothermic (decomposition of limestone: $CaCO_3 \rightarrow CaO + CO_2$)

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 208*

(b) Draw the energy level diagram for this reaction and state reactants and products.

Energy level diagram: reactant $CaCO_3$ at the lower energy level; products $CaO + CO_2$ at a higher energy level; arrow pointing upward from reactant to products showing that heat is absorbed (ΔH positive)

▸ *Textbook: Science Grade 11 Part I, Unit 8 Heat changes associated with chemical reactions, page 203*

(vii) (a) Write the balanced chemical equation relevant to the production of iron from Fe_2O_3.

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 93*

(b) In this process 1680 kg of pure molten iron was obtained from a 2520 kg of mixture of Fe_2O_3 with impurities. (In this case, assume that all Fe_2O_3 reacted completely.)

I. Find the number of moles of molten iron obtained and calculate the mass of Fe_2O_3 reacted. (Fe = 56, O = 16)

Moles of Fe = 1 680 000 g ÷ 56 g mol^{-1} = 30 000 mol

From the equation, Fe_2O_3 : Fe = 1 : 2, so moles of Fe_2O_3 = 30 000 ÷ 2 = 15 000 mol
Molar mass of Fe_2O_3 = 2 × 56 + 3 × 16 = 160 g mol^{-1}
Mass of Fe_2O_3 = 15 000 × 160 = 2 400 000 g = 2400 kg

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 43*

II. What is the mass of impurities presented in the mixture?

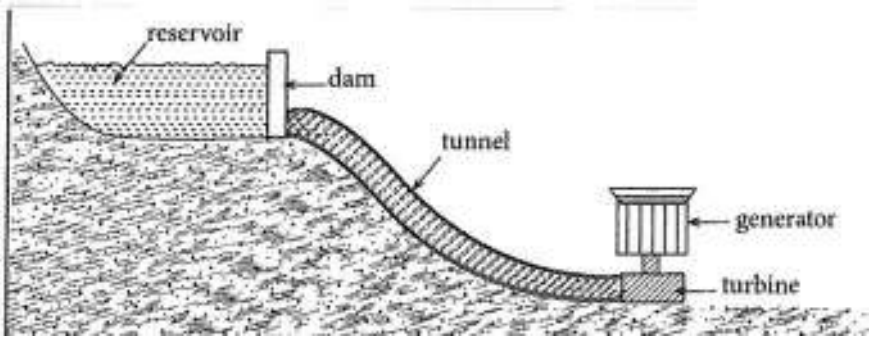
2520 kg − 2400 kg = 120 kg

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 93*

(Total marks 20)

Question 7 — Generation and use of electricity

(A) Consider the following figure pertaining to a hydro-power plant. As shown in the figure, the water is brought from a place in the reservoir to the power plant located below the reservoir through a tunnel. Electric power is generated by rotating a turbine with that water.

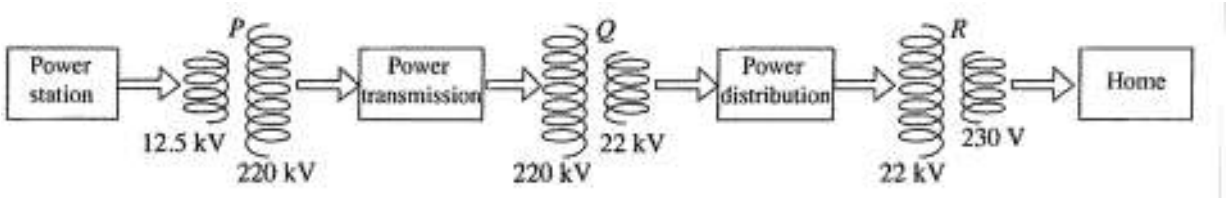


(i) According to the above information, write down the energy transformation that takes place in generating hydroelectric power.

Gravitational potential energy (of water) → kinetic energy → kinetic (rotational) energy of the turbine → electrical energy

▸ *Textbook: Science Grade 10 Part II, Unit 18 Work, energy and power, page 134*

(ii) The following diagram shows the way in which the alternating current electricity is generated in the power station and supplied to homes after transmission. (P, Q and R are transformers.)



(a) What is the type of transformer shown as P?

Step-up transformer

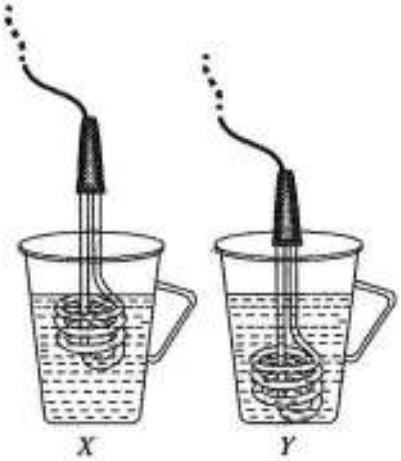
▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 145*

(b) If the number of turns in the primary coil of R is 8 800, find the number of turns in its secondary coil.

$N_s/N_p = V_s/V_p$
N_s = 8800 × 230 V ÷ 22 000 V = 92 turns

▸ *Textbook: Science Grade 11 Part II, Unit 13 Electromagnetism and electromagnetic induction, page 145*

(B) Two similar arrangements, X and Y which have been used in a house to heat water using the voltage of 230 V are given below. However in Y, the immersion coil is immersed to a greater depth.



(i) When the immersion heaters are connected to the voltage supply, in which arrangement is the water heated upto the required temperature in a lesser time?

Y

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 24*

(ii) Briefly explain, the reason why the water in one vessel is heated quicker than the other.

In Y the coil is near the bottom; water heated by the coil becomes less dense and rises, setting up convection currents that circulate and heat all the water. In X the hot water stays at the top and the water below the coil is heated only slowly

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 24*

(iii) 1.5 kg of water in 27 °C is put into the vessel in the arrangement which heats up water in a quicker time and the immersion heater is connected to the voltage supply.

(a) If the water was heated upto 97 °C, find the amount of heat absorbed by water. (Take the specific heat capacity of water as 4 200 J kg^{-1} K^{-1})

$Q = mc\theta$

$Q = 1.5\ kg \times 4200\ J\ kg^{-1}\ K^{-1} \times (97 - 27)\ K = 441\ 000\ J$

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 12*

(b) The power of the heater is 1 kW. If the time taken to heat the water upto 97 °C was 8 minutes, calculate the energy consumed by the immersion heater during that time.

$E = Pt = 1000\ W \times (8 \times 60)\ s = 480\ 000\ J$

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 24*

(c) In that house, water is heated 4 times per day as above. Find the number of units of electricity they have consumed in a month of 30 days.

Energy per heating = 1 kW × 8/60 h = 0.133 kWh

Energy per month = 1 kW × 8/60 h × 4 × 30 = 16 kWh = 16 units

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 47*

(C) There is a greater attention at present to generate electricity using solar cells.

(i) What is the basic electronic component which is used to construct a solar cell?

A p-n junction (diode) made of a semiconductor such as silicon

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

(ii) What will happen when the sun light is incident on that component?

Light energy is absorbed at the p-n junction and a potential difference is produced across it, so a current flows in an external circuit (light energy → electrical energy)

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

(iii) What type of an arrangement is known as a solar panel?

A large number of solar cells connected together in series and in parallel

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

(iv) Write down an advantage of using solar cells to generate electricity.

Renewable energy source / causes no air pollution or greenhouse gases / low running cost / can be used in remote areas (any one)

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

(Total marks 20)

Question 8 — Hormones; forces and motion

(A) Some main endocrine glands in the human body are given below.

Pituitary, Thyroid, Pancreas, Adrenal glands, Gonads

(i) Which of the above glands is located below the hypothalamus?

Pituitary gland

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(ii) Write down, in correct sequence, the glands that secrete calcitonin and oestrogen and state the main function of each hormone in correct sequence.

Calcitonin – thyroid gland – lowers the calcium level in blood (deposits calcium in bones)

Oestrogen – gonads (ovaries) – development of female secondary sexual characteristics / regulation of the menstrual cycle

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(iii) (a) What is the gland that secretes the hormone which converts glucose to glycogen?

Pancreas (islets of Langerhans) – insulin

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(b) In which organ of body, glycogen is mainly stored?

Liver (also in skeletal muscles)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(c) What is the disease condition that occurs due to non-secretion of the hormone stated in (a) above?

Diabetes mellitus

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 180*

(iv) Write **two** features of the hormones secreted by the glands stated above.

Secreted directly into the blood / act on specific target organs / needed only in very small amounts / act as chemical messengers / their effects are slower but longer-lasting than nerve impulses (any two)

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 179*

(B) Following diagrams show some play items in a children park.

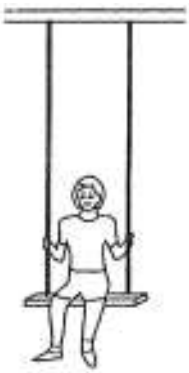


Figure (1) a

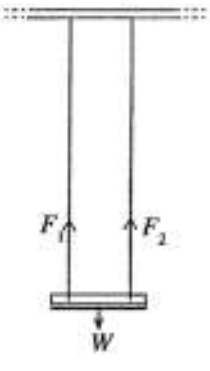


Figure (1) b

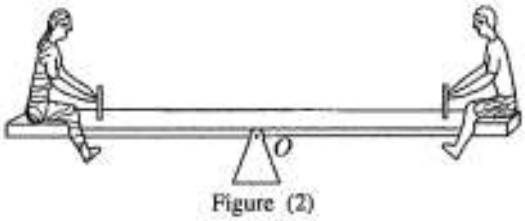


Figure (2)



Figure (3)

(i) As shown in the figure (1) a, a child is sitting in equilibrium and stationary in a swing. Figure (1) b shows the corresponding force diagram for this situation. Write a relationship among F_1, F_2 and W. Here, F_1 and F_2 are the forces exerted by ropes, and W is the weight of the child and the seat.

$F_1 + F_2 = W$

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 207*

(ii) In figure (2), the mass of each child who is sitting on the two sides of the see-saw is 25 kg.

(a) What can be said about the resultant of the system of forces acting on the see-saw?

The see-saw is in equilibrium, so the resultant force is zero and the resultant moment about O is zero

▸ *Textbook: Science Grade 10 Part I, Unit 9 Resultant force, page 167*

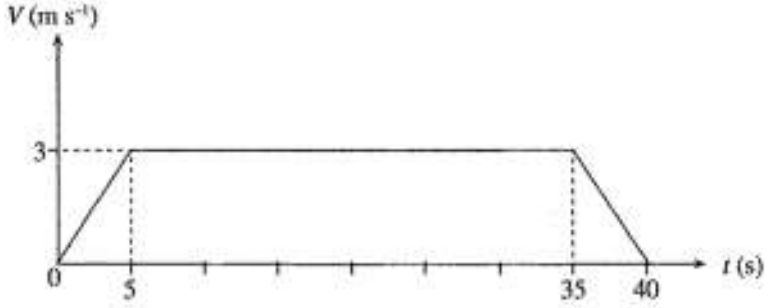
(b) The distance from the rotating point O to the place where each child is sitting is 1.5 m. Find the moment of the couple of forces acting there.

Weight of each child = 25 kg × 10 N kg^{-1} = 250 N

Moment of each weight about O = 250 N × 1.5 m = 375 N m (clockwise and anticlockwise moments are equal and opposite, so the net moment is zero)

▸ *Textbook: Science Grade 10 Part I, Unit 12 Equilibrium of forces, page 207*

(iii) Figure (3) shows a play train in the park that moves in a straight line path. The velocity-time (V – t) graph for its motion from the starting point to the ending point is given below.



(a) Briefly explain the nature of the motion of the play-train.

0 – 5 s: uniform acceleration from rest (0.6 m s^{-2})

5 – 35 s: uniform velocity of 3 m s^{-1}

35 – 40 s: uniform retardation until it comes to rest

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(b) The total mass of the train with the children is 1500 kg. Find the momentum of the train in the time duration from 5 seconds to 35 seconds.

Momentum = mv = 1500 kg × 3 m s^{-1} = 4500 kg m s^{-1}

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 35*

(c) If the length of the play-train is 18 m, calculate the length of the railway.

Distance travelled = area under the graph = (½ × 5 × 3) + (30 × 3) + (½ × 5 × 3) = 7.5 + 90 + 7.5 = 105 m

Length of the railway = 105 m + 18 m (length of the train) = 123 m

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(Total marks 20)

Question 9 — Periodic table and optical instruments

(A) **A**, **E**, **G**, **J**, **L**, **M**, **Q** and **R** are 8 consecutive elements in the periodic table. The atomic number of all these elements are less than 20. **E** naturally occurs in allotropic forms and one of the forms conducts electricity. (Here, the given symbols are **not** the standard symbols of the elements.)

(i) What is the element **E**?

Carbon (graphite conducts electricity) — so A = B, E = C, G = N, J = O, L = F, M = Ne, Q = Na, R = Mg

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(ii) Of the above elements,

(a) which element occurs as a noble gas at room temperature?

M (neon)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(b) which element has the highest electro negativity?

L (fluorine)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(c) which element is at the top most level of the activity series?

Q (sodium)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 82*

(iii) Draw the Lewis dot diagram of a molecule formed by the element **G** with Hydrogen.

NH_3: the N atom is joined to three H atoms, each by one shared pair of electrons, and has one lone pair of electrons

▸ *Textbook: Science Grade 10 Part I, Unit 10 Chemical bonds, page 179*

(iv) Of the above elements, which element is most suitable to produce a sample of H_2 gas in the laboratory?

R (magnesium) – reacted with dilute hydrochloric acid

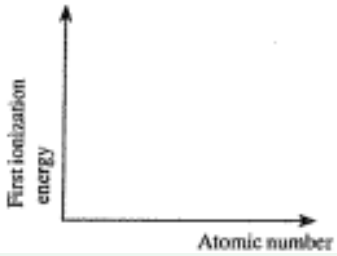
▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 103*

(v) Write the balanced chemical equation for the reaction of **R** with steam.

$Mg + H_2O(g) \rightarrow MgO + H_2$

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(vi) Copy the diagram given below into your answer script and draw a sketch of the variation of first ionization energy of the above elements. (It is **not** necessary to show the atomic number and the values of ionization energy. It is sufficient to mention only the elements.)



Sketch: rises from A (B) to E (C) to G (N); small dip at J (O); rises through L (F) to a peak at M (Ne); falls sharply to Q (Na) (lowest point); rises again at R (Mg)

▸ *Textbook: Science Grade 10 Part I, Unit 3 Structure of matter, page 63*

(B) In the following occasions ①, ②, ③ and ④, optical items/instruments were used.

① – A dentist examining teeth in a mouth of a patient

② – A surgeon observing the internal organs in the body of a patient

③ – A student observing cells in a blood sample in the laboratory

④ – A cricket lover watching a cricket match from a far end of a pavilion

(i) (a) In which occasion a concave mirror was used?

Occasion ① – the dentist

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 111*

(b) Represent with a ray diagram, the way in which an image is formed in such a situation (Here, take the object as an upright arrow OA, with O at its foot and A at its head).

Object OA placed between the principal focus F and the pole P of the concave mirror

A ray from A parallel to the principal axis reflects through F; a ray from A directed through the centre of curvature C (or towards P) reflects back along a known path

The reflected rays diverge; extended behind the mirror (dotted lines) they meet to give a virtual, upright and magnified image

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 114*

(ii) (a) What was the occasion where an instrument with optical fibres was used?

Occasion ② – the surgeon (endoscope)

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 124*

(b) What is the name used for the phenomenon that the light rays undergo when light passes through an optical fibre?

Total internal reflection

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 124*

(c) State the conditions that should be fulfilled to occur the phenomenon that is mentioned in (b) above.

Light must travel from an optically denser medium to a less dense medium, and the angle of incidence must be greater than the critical angle

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 141*

(d) Another instrument where the phenomenon mentioned in (b) above occurs, was also used in another occasion given above. Mention that occasion and write down the name of the instrument that was being used in that occasion.

Occasion ④ – the cricket lover – prismatic binoculars

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 126*

(Total marks 20)

Paper II • 2015 (old syllabus)

OFFICIAL ANSWERS: EVALUATION REPORT

Part B • essay questions • answer three • 20 marks each

Biology

Question 5 — Underground stems and human reproduction

(A) Figures (1) and (2) given below show the underground stems of Ginger and Potato respectively.



(i) State the types of underground stems to which ginger and potato belong respectively.

[Facility: 25 % of candidates answered correctly]

Rhizome (01), Stem tubers **01**

Two answers should be given according to the order. If only rhizome is given as the answer give 01 mark, no marks when the answers are interchanged **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(ii) Write down a common feature that helps to identify these stems as underground stems.

[Facility: 3 % of candidates answered correctly]

Presence of axial buds / presence of scale leaves **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(iii) By which method of reproduction do these underground stems produce new plants?

[Facility: 38 % of candidates answered correctly]

(Natural) Vegetative propagation / Asexual reproduction **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(iv) What is the importance of storage of food in these underground stems?

[Facility: 17 % of candidates answered correctly]

Under ground stem survive to grow new plant if the areal part is destroyed under the unfavourable conditions / Perennation / supply nutrition for the new plant to grow. **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 29*

(B) Generating a new organism is an important phenomenon common to the entire living world. Producing organisms that are more suited to the environment, helps to maintain the continuity of life.

(i) Name respectively the male and female gametes which contribute to the process of human reproduction.

[Facility: 42 % of candidates answered correctly]

Sperm (01), Ova (01) (Correct order is essential) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(ii) (a) What is the type of cell division that occurs in the formation of gametes which helps to transmit parental characteristics to a child?

[Facility: 29 % of candidates answered correctly]

Meiosis **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(b) State one advantage of that type of cell division.

[Facility: 12 % of candidates answered correctly]

Produce offspring with more suitable characteristics for successful survival in the environment. / To obtain haploid chromosomes for gametes / To the maintenance of the constant number of Chromosomes of a Species / Help in evoluation by creating genetic variations / Producing organisms with new variations (by producing new characteristics)

(Two marks for any one of the above) **02**

▸ *Textbook: Science Grade 10 Part I, Unit 6 Plant and animal cells, page 120*

(iii) During the period of pregnancy blood tests are carried out in maternal clinics and the blood group of the mother is identified.

(a) In an emergency, blood of which groups can be transfused to a mother with blood group B?

[Facility: 41 % of candidates answered correctly]

B (group) (01) O (group) (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(b) In addition to the blood groups, what is the other factor that has to be considered essentially in blood transfusion to prevent blood clotting?

[Facility: 26 % of candidates answered correctly]

Rh factor / Rhesus factor **01**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 27*

(iv) (a) State the function of progesterone hormone soon after the fertilization.

[Facility: 21 % of candidates answered correctly]

Ovulation of any more ova is prevented / temporary suspended of menstrual cycle. / Growth of the uterine wall / increases the thickness

(Give marks if an answer is given as preventing further production of ova.) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 54*

(b) State the function of oxytosin hormone after a child birth.

[Facility: 14 % of candidates answered correctly]

Stimulate the secretion of breast milk / Controlling the reflex actions to secrete breast milk (by mammary glands) **02**

Total marks 20

▸ *Textbook: Science Grade 10 Part II, Unit 14 Continuity of life (reproduction), page 57*

Question 6 — Vertebrates and the human brain

(A) Birds and mammals successfully live in terrestrial, aquatic and aerial environments.

(i) Write **two** features that are common to mammals and birds.

[Facility: 53 % of candidates answered correctly]

Warm blooded animals / Homeothermic; Presence of four chambered heart; Respiration through lungs; Having a vertebral column

(Give two marks for any two of above) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(ii) What is the special shape of the body that the birds have for flying?

[Facility: 59 % of candidates answered correctly]

Streamlined body shape **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(iii) To which organs have the fore limbs of birds modified for flying?

[Facility: 65 % of candidates answered correctly]

Wings **01**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 22*

(iv) Birds and mammals are two groups of vertebrates.

(a) Name the other **three** groups that belong to vertebrates except these two groups.

[Facility: 77 % of candidates answered correctly]

Pisces / Fish, Amphibia (Amphibians), Reptillia (Reptiles) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 19*

(b) According to the evolutionary evidences, state the group of vertebrates that first came onto the land.

[Facility: 39 % of candidates answered correctly]

Amphibians **02**

▸ *Textbook: Science Grade 10 Part II, Unit 13 The world of life (classification and nomenclature), page 21*

(B) Cerebrum, cerebellum, medulla oblongata, thalamus and hypothalamus can be identified as the major parts of the human brain.

(i) From the parts given above, write down the **two** parts that are found at the hind part of the human brain.

[Facility: 61 % of candidates answered correctly]

Cerebellum (01), Medulla oblongata (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 175*

(ii) State separately, which part from the four parts given above, performs the following actions.

(a) controlling the memory
(b) controlling of the heart beat
(c) controlling of respiration
(d) coordination of muscle movements
(e) regulation of body temperature
(f) identifying sensation such as vision and hearing

[Facility: (a) 76 %, (b) 54 %, (c) 52 %, (d) 43 %, (e) 51 %, (f) 40 % of candidates answered correctly]

(a) Cerebellum (b) Medulla oblongata (c) Medulla oblongata (d) Cerebellum (e) Hypothalamus (f) Cerebrum **06**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 175*

(iii) Reflex actions are made by the organs brain and the spinal cord.

(a) By which organ, is the reflex actions need instant responses made?

[Facility: 74 % of candidates answered correctly]

Spinal cord / Brain **01**

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 174*

(b) State by which organ the following reflex actions are made.

I. The adjustment of the pupil of the eye as a result of the eye receiving strong and weak light

II. Taking away of the hand when it comes into contact with something hot

[Facility: (I) 47 %, (II) 50 % of candidates answered correctly]

(I) Brain (01) (II) Spinal cord (01) **02**

Total marks 20

▸ *Textbook: Science Grade 11 Part I, Unit 6 Biological processes in the human body, page 174*

Chemistry

Question 7 — Rates of reactions and fire

Consider the following chemical reactions.

- Rusting of iron
- Ripening of fruits
- Reaction of Mg with diluted HCl acid
- Toddy turning into vinegar
- Petrol catching fire

(i) From the above reactions,

(a) write down a reaction that occurs slowly.

[Facility: 95 % of candidates answered correctly]

Rusting of iron / Ripening of fruit / Toddy turning into vinegar (Two marks for any one of above) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 100*

(b) write down a reaction that occurs fast.

[Facility: 95 % of candidates answered correctly]

Reaction of Mg with diluted HCl acid / Petrol catching fire (Two marks for any one of above) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 91*

(ii) (a) Among all the reactions given above, which reaction requires the involvement of micro-organisms?

[Facility: 85 % of candidates answered correctly]

Toddy turning into vinegar **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 90*

(b) Write the chemical equation for the reaction you mentioned in (a) above.

[Facility: 11 % of candidates answered correctly]

$C_2H_5OH(aq) + O_2(g) \rightarrow$ (acetobacter) $\rightarrow CH_3COOH(aq) + H_2O(l)$

or $CH_3CH_2OH(aq) + O_2(g) \rightarrow$ (acetobacter) $\rightarrow CH_3COOH(aq) + H_2O(l)$

(Give marks even though the physical states are not mentioned) (No marks for word equation) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 91*

(iii) Petrol catching fire is a combustion reaction.

(a) Write down the factors which are required to create a fire.

[Facility: 42 % of candidates answered correctly]

Presence of a combustible substance (01); Heating the combustible substance to it's ignition point (01); Supply of supporter of combustion / Oxygen (gas) / $O_2(g)$ (01) **03**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 105*

(b) Name a fire extinguisher which is most suitable to extinguish a petrol fire.

[Facility: 33 % of candidates answered correctly]

Foam fire extinguisher **01**

▸ *Textbook: Science Grade 11 Part II, Unit 14 Hydrocarbons and their derivatives, page 166*

(c) When using the fire extinguisher you mentioned in (b) above, for what reason is the fire extinguished?

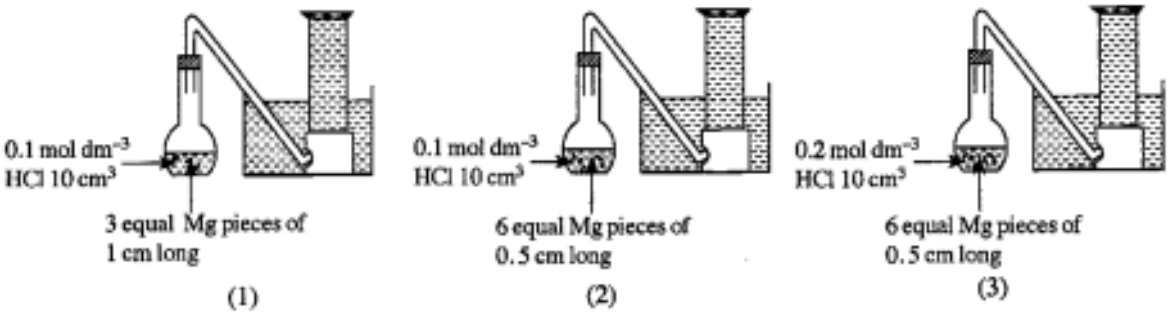
[Facility: 13 % of candidates answered correctly]

Foam spread on oil and preventing contact with supporter of combustion / Oxygen with oil / combustible substance **01**

As the evolved CO_2 is not a supporter of combustion (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 105*

(iv) The experimental setup relevant to an experiment for the determination of the factors affecting the rate of a reaction, using Mg and diluted HCl as reactants are given below as (1), (2) and (3). The initial states of the experiment are shown here.



Gases evolved from the reaction during a constant time interval are collected as shown in the setup.

(a) Out of the given three setup, in which setup does the reaction occur at the highest rate?

[Facility: 64 % of candidates answered correctly]

3 **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 31*

(b) What factor that affects the rate of a reaction is tested in each of the following pairs of experimental setup?

I. by setup (1) and (2)

[Facility: 21 % of candidates answered correctly]

Physical nature of reactants / surface area of reactants **01**

▸ *Textbook: Science Grade 10 Part II, Unit 17 Rate of reactions, page 117*

II. by setup (2) and (3)

[Facility: 32 % of candidates answered correctly]

Concentration (of reactants) **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 92*

(c) If 2.4 g of Mg is used in the above experiments, calculate the mole amount of Mg used (Mg = 24).

[Facility: 31 % of candidates answered correctly]

2.4 (g) / 24 (g mol^{-1}) **01**

= 0.1 mol / 0.1 (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 43*

(d) If you don't have any facilities to collect the gas that evolves during this experiment, how would you identify the reaction which occurs at the highest rate?

[Facility: 17 % of candidates answered correctly]

Counting the number of gas bubbles evolve in a constant time period. / Comparing masses of remaining Mg in a constant time period. / Comparing the time taken to disappear Mg strips. / Identifying the setup which evolves gas bubbles at a higher rate.

(Give two marks for any of the above) **02**

Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 12 Electrochemistry, page 92*

Question 8 — Solutions, solubility and building materials

(A) (i) A solution of 100 g is prepared by dissolving, a mass of 30 g of solid $MgCl_2$ in pure water at 25 °C.

(a) State the reason for selecting water to prepare the $MgCl_2$ solution.

[Facility: 13 % of candidates answered correctly]

$MgCl_2$ is an ionic compound / $MgCl_2$ is a polar solute (01); Water is a polar solvent **01**

or As polar compounds dissolve is polar solvents, $MgCl_2$ dissolves in water (02) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 38*

(b) Calculate the composition of the $MgCl_2$ solution prepared above, as a percentage by mass (w/w).

[Facility: 41 % of candidates answered correctly]

30 (g) / 100 (g) × 100 **01**

= 30 % (w/w) (01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 45*

(ii) (a) A small amount of $MgCl_2$ was deposited at the bottom of the beaker, when another 30 g of $MgCl_2$ was added to the $MgCl_2$ solution prepared in (i) above, stirred well and kept for a short time. What is the special name used to introduce this type of solutions?

[Facility: 29 % of candidates answered correctly]

Saturated solution **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

(b) The beaker with the solution in (a) above was heated up to a temperature of about 60 °C. State an important observation that could be made here.

[Facility: 28 % of candidates answered correctly]

Deposited $MgCl_2$ at the bottom of the beaker dissolves gradually / Disappearance of $MgCl_2$ / Decreases the amount of $MgCl_2$ deposited at the bottom **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 35*

(c) Explain the reason relevant to the observation stated in (b) above.

[Facility: 22 % of candidates answered correctly]

When the temperature increases, the solubility / rate of reaction of $MgCl_2$ increases. **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 51*

(iii) A student has taken 100 g of water at 20 °C into a beaker. Then this beaker containing water was heated up to a temperature of about 80 °C. He observed the evolution of gas bubbles in this situation. Explain the reason relevant to the observation made by the student.

[Facility: 14 % of candidates answered correctly]

Since the solubility of dissolved gases in water decreases when the temperature increases. (When temperature increases the dissolved gasses in water evolved as gas bubbles) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 39*

(B) Some steps followed during the construction of a particular house are given below.

- Preparing a concrete mixture
- Placing the concrete mixture on a steel skeleton above the walls
- Applying mortar on the walls
- Colour washing (painting) of the walls

(i) (a) What is the alloy used in the construction of the above house?

[Facility: 48 % of candidates answered correctly]

Steel **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 64*

(b) State the major component in the alloy.

[Facility: 33 % of candidates answered correctly]

Iron / Fe **01**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 34*

(ii) In which step has a mixture consisting calcium oxide been used?

[Facility: 67 % of candidates answered correctly]

The step of applying motor on the walls / 3rd step **01**

▸ *Textbook: Science Grade 10 Part II, Unit 16 Changes in matter, page 89*

(iii) As soon as the concrete mixture was prepared, it should have been placed on the steel skeleton. What is the reason for this?

[Facility: 45 % of candidates answered correctly]

As the concrete mixture / cement mixture solidified immediately. **02**

▸ *Textbook: Science Grade 11 Part I, Unit 3 Mixtures, page 33*

(iv) Name a heavy metal ion that could be released to the environment when certain kinds of paints are used.

[Facility: 16 % of candidates answered correctly]

Pb^{2+} / Pb ions / Lead ions (give marks when the answer is given as Pb, Lead) / Cd^{2+} / Cadmium ions (give marks for Cd or cadmium) **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 183*

(v) Natural resources are used for the construction of houses and buildings. State **two** environmental damages that would occur when getting these resources from the environment.

[Facility: 60 % of candidates answered correctly]

Destruction of forests (for timber) / Damage to the bio-diversity / Disorder of the natural cycles / Destruction of coral beds / Land slide / Soil erosion / Sea erosion / Spread infectious diseases caused by mosquitoes

(Two marks for any two of above or any acceptable answers) **02**

Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 185*

Physics

Question 9 — X-rays, sound, motion and electrical safety

Chamod who was frightened when a sudden fire broke out in the house due to an electrical leakage fell-down and hurt his head badly while trying to run away. Chamod was first admitted to a base hospital where he had to undergo various tests including an X-ray test. Considering the seriousness of the injury, the doctors decided that he has to undergo an emergency surgery and transferred him by an

ambulance to the general hospital.

(i) Due to which property of X-rays, are X-rays used in the medical field?

[Facility: 16 % of candidates answered correctly]

Can detect only bones / coloured tissues (02) or As these rays contain great deal of energy / frequency (01) they are able to penetrate through the body (01) **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 83*

(ii) The driver in the ambulance had to take the patient to the general hospital as soon as possible.

(a) When an ambulance is travelling on the road, drivers who are ahead of the ambulance, identify the special sound produced by the ambulance (sound emitted by the siren) and give way for it. From what characteristic of the sound would the other drivers identify it as an ambulance?

[Facility: 20 % of candidates answered correctly]

Quality of sound **01**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(b) The wavelength of the sound produced by the ambulance above is 0.44 m and the speed of the sound in air is 330 m s^{-1}, calculate the frequency of the sound emitted by the ambulance.

[Facility: 37 % of candidates answered correctly]

$v = f\lambda$ or $f = 330\ m\ s^{-1} / 0.44\ m$ **01**

f = 750 Hz / 750 Hertz / 750 number of cycles per second / 750 s^{-1} (Correct answer with unit - 01) **02**

▸ *Textbook: Science Grade 11 Part I, Unit 4 Waves and their applications, page 91*

(c) The English word AMBULANCE is written in front of the ambulance as shown below for other drivers ahead to identify it as an ambulance. Explain how other drivers easily identify this word.

ƎNAJUBMA

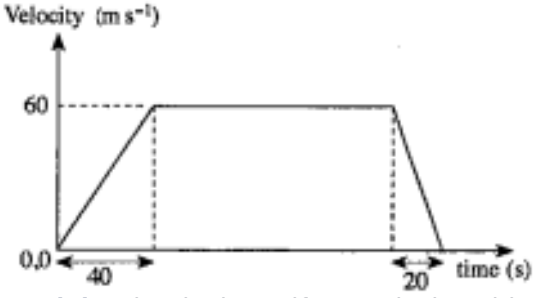
[Facility: 34 % of candidates answered correctly]

As the image formed by side mirrors / mirrors (01) of the vehicle is laterally inverted (01) the word can be read easily. **02**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 108*

(iii) The velocity-time graph relevant to the motion of the above ambulance from the base hospital to the general hospital is given below.

Answer the questions given below using the velocity-time graph or by any other method. (For your calculations, assume that the ambulance has moved in a straight line.)



(a) What is the uniform velocity with which the ambulance has travelled?

[Facility: 65 % of candidates answered correctly]

60 (m s^{-1}) **01**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(b) If the displacement of the ambulance with uniform velocity is 15 km (15 000 m), find the time that it travelled with uniform velocity.

[Facility: 35 % of candidates answered correctly]

Displacement = Area of the rectangle or 15 000 (m) = 60 (m s^{-1}) × t or t = 15 000 (m) / 60 (m s^{-1}) **01**

t = 250 (s) or = 4.17 min or 0.069 hours **01**

or, when using equations: $s = ut + \frac{1}{2}at^2$; t = s/u; t = 15 000 (m) / 60 (m s^{-1}) (01); t = 250 (s) or = 4.17 min or 0.069 hours **01**

When the time is given in minutes or hours, give the final mark only for the answer with units. **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 42*

(c) Find the distance between the two hospitals.

[Facility: 21 % of candidates answered correctly]

Distance between two hospitals = Area of the trapezium = ½ (250 + 310) × 60 or = (½ × 40 × 60) + (60 × 250) + (½ × 20 × 60)

or, when it is found using the equation $s = ut + \frac{1}{2}at^2$: Total distance = {½ × (60 − 0)/40 × 40^2} + (60 × 250) + {½ × (60 − 0)/20 × 20^2} **01**

= 16 800 (m) / 16.8 km **01**

Give 01 mark for the correct substitution in part (c) even though the answer in (iii)(b) is incorrect **02**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(d) The surgery had to be started within 30 minutes, from the instant the patient has been transferred from the base hospital. If the doctors in the general hospital were ready and other necessities were fulfilled for the surgery, were the doctors able to start the surgery in time? Explain your answer.

[Facility: 30 % of candidates answered correctly]

Yes / able **01**

Time taken by the ambulance to travel between the two hospitals = 310 seconds = 310 (s) / 60 (s) = 5.16 min **01**

Therefore the doctors were able to start the surgery as the patient could have been taken to the hospital before 30 minutes (01) **03**

▸ *Textbook: Science Grade 10 Part I, Unit 2 Motion in a straight line, page 46*

(iv) (a) What is the component used in household circuits to prevent electrical shock due to an electrical leakage?

[Facility: 47 % of candidates answered correctly]

Trip switch / miniature circuit breaker / MCB **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 41*

(b) What is the function of the component you have mentioned in (a) above?

[Facility: 18 % of candidates answered correctly]

The household circuit opens automatically / disconnects as the leakage current earthing / As soon as the leakage current from a part of the household circuit is earthing, this switch automatically opens and disconnects the power supply. **01**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 45*

(v) State **three** facts that can be included in an article that you are planning to write to the school science magazine on the topic "The safety precautions that can be taken to prevent accidents by electricity at home."

[Facility: 42 % of candidates answered correctly]

Use fuse wires of appropriate ampere value not exceeding the maximum current in the circuit. / Do not connect number of electrical appliances consuming high amounts of electricity to the same plug base using multiplug. / Use the earth connection when connecting apparatus with metal cover to the supply. / Test once in few time, whether the trip switch is working by pressing the test button. / In an emergency electric fire, use main switch to disconnect the power supply. / When using electric appliances with metal covering like electric iron it is safer to stand on a rubber carpet or wear rubber slippers. / For necessary maintenance, get the service of a trained electrician. / Replace new components instead of damaged plugs / plug bases / holders / When the electric appliances are not used, remove the plug from the plug base.

(Give 03 marks for any acceptable scientific reasons as above) **03**

Total marks 20

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 46*

Question 10 — Heat from the Sun and solar cells

The Sun emits light and heat in all directions.

(i) (a) By which method of heat transfer, does the heat from Sun reach the Earth?

[Facility: 62 % of candidates answered correctly]

Radiation **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(b) How does the method you have mentioned in (a) above differ from the other heat transferring methods?

[Facility: 42 % of candidates answered correctly]

Medium is not essential for the heat transfer from radiation / The other heat transmissions occur through material media but in this method heat transmission can occur through vacuum. **01**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(ii) On a hot sunny day, Sujith came home after school by walking on a tarred road.

(a) When Sujith was walking along the road he saw there appeared to be a pool of water at the far end of the road. Explain briefly the phenomenon seen by him.

[Facility: 11 % of candidates answered correctly]

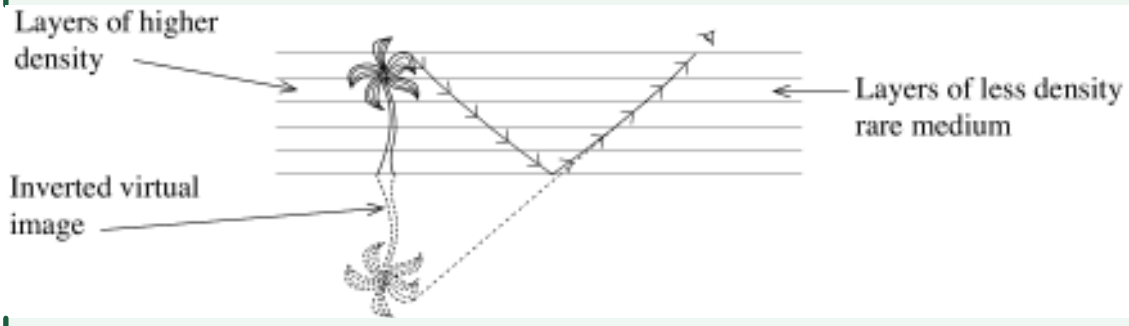
Became a rarer medium / decreases the density of air layer near the hot road because of heating. **01**

Density of higher layers of air comparatively increases / became a denser medium. **01**

When a ray of light refracts from up to down, at the layer closer to tarred road, the incident angle will be greater than the critical angle. **01**

As it takes place, and total internal reflection occurs, the mirage forms. **01**

or, using a diagram:



Represent the rays in correct way (01); Represent the difference of densities of air layers (01); Total internal reflection occurs (01) when the incident angle is greater than the critical angle **01**

(A similar figure without the rays continuing upward after the reflection is also given marks.) **04**

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 125*

(b) The roof of Sujith's house is sheltered with 40 asbestos sheets of 30 kg each. Due to the sun shine the temperature of the sheets increased from 35 °C to 40 °C. (Specific heat capacity of asbestos is 1 050 J kg^{-1} K^{-1})

I. Calculate the solar heat absorbed by one asbestos sheet.

[Facility: 47 % of candidates answered correctly]

Amount of heat absorbed by a sheet = mcθ or = 30 × 1050 × 5 **01**

= 157 500 (J) / 157.5 kJ (01) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 12*

II. Calculate the total amount of solar heat absorbed by all the sheets.

[Facility: 44 % of candidates answered correctly]

Total amount of heat absorbed by 40 sheets = 157 500 × 40 **01**

= 6 300 000 (J) = 6.3 × 10^6 (J) or = 6300 kJ = 6.3 × 10^3 (kJ) **01**

Give one mark for correct substitution if the answer is wrong in (I) above. **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 12*

(c) Sujith has activated a 0.1 kW electric fan for ½ an hour since the house was warm. Calculate the electrical energy consumed by the electric fan.

[Facility: 30 % of candidates answered correctly]

Energy = 0.1 (kW) × ½ (h) **01**

= 0.05 kWh / 0.05 kilo watt - hours **01**

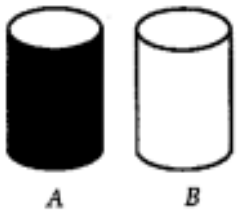
or Power = Energy / Time; 0.1 × 1000 (W) = Energy / (30 × 60 (s)) or Energy = 0.1 × 1000 × 30 × 60 **01**

Energy = 180 000 J / 18 × 10^4 J / 1.8 × 10^5 J / 180 kJ **01**

Give the final mark for the correct answer with the unit. **02**

▸ *Textbook: Science Grade 11 Part II, Unit 10 Power and energy of electric appliances, page 34*

(d) There were equal volumes of water in two equal cylindrical metal tanks A and B kept outside the house under the sun. The outer surface of tank A was painted with black paint and the outer surface of tank B was shiny.



I. Out of the two tanks, if Sujith wanted to have a bath with lesser warm water, which tank should he select?

[Facility: 64 % of candidates answered correctly]

tank B / tank with shiny surface **01**

▸ *Textbook: Science Grade 11 Part II, Unit 15 Biosphere, page 204*

II. Explain briefly the reason for the water in the two tanks to have different temperatures.

[Facility: 27 % of candidates answered correctly]

Black surfaces absorb thermal radiation with a higher rate than the shiny surfaces **02**

or the rate of absorption of thermal radiation by the black surfaces is higher than the shiny surfaces **02**

or The rate of absorption of thermal radiation by the black surfaces is high (01); The rate of absorption of thermal radiation by shiny surfaces is less **01**

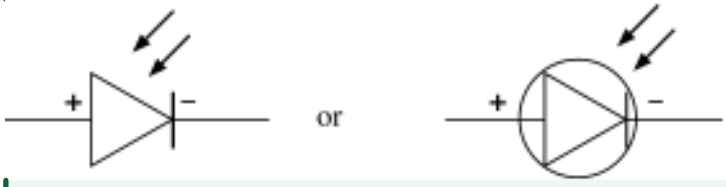
or The shiny surfaces reflect more thermal radiation rather than black surfaces (02) **02**

▸ *Textbook: Science Grade 11 Part II, Unit 9 Heat, page 26*

(iii) Solar cells are used to generate electricity from the energy of sunlight. Solar cells are photodiodes constructed in a special way.

(a) Draw the symbol of a photodiode and mark its positive (+) terminal and negative (−) terminal.

[Facility: 41 % of candidates answered correctly]



for symbol (01); naming terminals (01) **02**

▸ *Textbook: Science Grade 10 Part II, Unit 19 Current electricity, page 144*

(b) Name a compound that is used to increase the light sensitive property of a photodiode.

[Facility: 10 % of candidates answered correctly]

Cadmium sulphide / Cadmium selenide / CdS / CdSe **01**

▸ *Textbook: Science Grade 11 Part II, Unit 11 Electronics, page 65*

(c) What is the optical component in a photodiode used to focus light onto the p-n junction?

[Facility: 26 % of candidates answered correctly]

Convex lens / Converging lens **01**

Total marks 20

▸ *Textbook: Science Grade 11 Part I, Unit 5 Geometrical optics, page 127*

5

Definitions

Key terms for all 35 textbook units

- Grade 10: units 1-20
- Grade 11: units 1-15
- Learn the exact wording - marks are given for key words
- Unit codes match the analysis in Section 1

Grade 10

10.1 Chemical basis of life	Biology
Biomolecules	Organic compounds that build living matter: carbohydrates, proteins, lipids and nucleic acids. All contain C, H and O.
Carbohydrate	Compound of C, H and O with H and O in a 2:1 ratio; general formula Cx(H2O)y. Main source of energy.
Monosaccharide	Simplest sugar; the monomer of carbohydrates (glucose, fructose, galactose).
Disaccharide	Two monosaccharides joined by condensation: sucrose, maltose, lactose.
Polysaccharide	Polymer of many glucose units: starch (plant store), glycogen (animal store), cellulose (cell wall).
Protein	Polymer of amino acids; contains C, H, O, N (often S). Used for growth, repair, enzymes and hormones.
Amino acid	Monomer of proteins; about 20 kinds occur in living things.
Enzyme	A protein that acts as a biological catalyst, speeding up biochemical reactions without being used up.
Lipid	Fats and oils formed from fatty acids and glycerol; give about twice the energy of carbohydrates per gram.
Nucleic acid	Polymer of nucleotides (DNA, RNA) containing C, H, O, N and P; stores and expresses genetic information.
Nucleotide	Monomer of nucleic acids: a pentose sugar, a nitrogenous base and a phosphate group.
Vitamin	Organic substance needed in tiny amounts for normal body function; lack causes deficiency disease.
Mineral (nutrient)	Inorganic element needed by the body, e.g. Ca, Fe, I, Na, K, P.

10.2 Motion in a straight line	Physics
Distance	Total length of path travelled; a scalar (m).
Displacement	Straight-line distance from start to finish in a stated direction; a vector (m).
Speed	Distance travelled per unit time (m s^{-1}); scalar.
Velocity	Displacement per unit time, i.e. rate of change of displacement (m s^{-1}); vector.
Uniform velocity	Equal displacements in equal time intervals in the same direction.
Acceleration	Rate of change of velocity (m s^{-2}); vector.
Retardation (deceleration)	Rate of decrease of velocity.
Gravitational acceleration (g)	Acceleration of a freely falling body; about 10 m s^{-2} near the Earth's surface.
Scalar quantity	Has magnitude only (mass, time, distance, speed, work, energy, pressure).
Vector quantity	Has magnitude and direction (displacement, velocity, acceleration, force, weight, momentum).

10.3 Structure of matter	Chemistry
Atom	Smallest particle of an element that takes part in a chemical reaction.
Atomic number (Z)	Number of protons in the nucleus of an atom.
Mass number (A)	Number of protons + neutrons in the nucleus.
Isotopes	Atoms of the same element with the same atomic number but different mass numbers (different numbers of neutrons), e.g. 1H, 2H, 3H.
Electronic configuration	Arrangement of electrons in energy levels, e.g. Na = 2,8,1.
Group	Vertical column of the periodic table; elements have the same number of valence electrons.
Period	Horizontal row of the periodic table; elements have the same number of occupied energy levels.
First ionisation energy	Energy needed to remove the most loosely held electron from one mole of gaseous atoms.
Electronegativity	Tendency of an atom to attract the shared electron pair of a covalent bond towards itself.
Allotropes	Different structural forms of the same element, e.g. diamond, graphite and fullerene (carbon); rhombic and monoclinic sulphur.
Metalloid	Element with properties of both metals and non-metals, e.g. Si, B, Ge.
Valency	Combining power of an element: number of electrons lost, gained or shared.

10.4 Newton's laws of motion	Physics
Force	A push or pull that changes, or tends to change, the state of rest or uniform motion of a body (newton, N).
Newton's first law	A body stays at rest or moves with uniform velocity unless an unbalanced external force acts on it.
Inertia	The tendency of a body to resist a change in its state of rest or motion; depends on mass.
Newton's second law	The rate of change of momentum is proportional to the unbalanced force and takes place in the direction of the force (F = ma).
Newton's third law	For every action there is an equal and opposite reaction, acting on different bodies.
Momentum	Mass × velocity (kg m s^{-1}); a vector.
Mass	Quantity of matter in a body (kg); constant everywhere.
Weight	Gravitational force on a body (N); W = mg; changes with location.
1 newton	The force that gives a 1 kg mass an acceleration of 1 m s^{-2}.

10.5 Friction	Physics
Friction	Force that opposes relative motion (or attempted motion) between surfaces in contact.
Static friction	Friction acting while a body is at rest under an applied force; increases with the applied force.
Limiting friction	Maximum value of static friction, just before motion starts.
Dynamic (kinetic) friction	Friction acting while the body slides; slightly less than limiting friction.
Normal reaction (R)	Force exerted by a surface perpendicular to it on a body resting on it.

10.6 Plant and animal cells	Biology
Cell	The basic structural and functional unit of life.
Cell theory	All organisms are made of cells; the cell is the basic unit of life; new cells arise from existing cells.
Organelle	A specialised structure inside a cell with a particular function.
Nucleus	Contains chromosomes (DNA); controls cell activities and heredity.
Mitochondrion	Site of aerobic respiration; releases energy (ATP).
Chloroplast	Site of photosynthesis in plant cells; contains chlorophyll.
Ribosome	Site of protein synthesis.
Endoplasmic reticulum	Network of membranes that transports substances (rough ER carries proteins).
Golgi complex	Packages and secretes substances.
Cell wall	Non-living cellulose layer around plant cells; gives shape and support.
Mitosis	Cell division producing two identical daughter cells with the same chromosome number (growth, repair, asexual reproduction).
Meiosis	Cell division producing four cells with half the chromosome number (gamete formation).

10.7 Quantification of elements and compounds	Chemistry
Relative atomic mass (Ar)	Mass of an atom compared with one-twelfth of the mass of a carbon-12 atom.
Relative molecular mass (Mr)	Sum of the relative atomic masses of all atoms in a molecule.
Mole	Amount of substance containing 6.022×10^{23} particles (Avogadro constant).
Avogadro constant (L)	6.022×10^{23} mol^{-1}, the number of particles in one mole.
Molar mass	Mass of one mole of a substance (g mol^{-1}); numerically equal to Ar or Mr.

10.8 Characteristics of organisms	Biology
Cellular organisation	Living things are built of cells, organised into tissues, organs and systems.
Nutrition	Obtaining food: autotrophic (make own food) or heterotrophic (depend on others).
Respiration	Breakdown of food to release energy; aerobic or anaerobic.
Irritability	Ability to sense and respond to stimuli.
Excretion	Removal of metabolic waste products from the body.

10.8 Characteristics of organisms	Biology
Reproduction	Producing new individuals of the same kind.
Growth	Irreversible increase in size and dry mass.

10.9 Resultant force	Physics
Resultant force	A single force that has the same effect as two or more forces acting together.
Collinear forces	Forces acting along the same straight line.
Parallel forces	Forces whose lines of action are parallel.

10.10 Chemical bonds	Chemistry
Ionic bond	Electrostatic attraction between oppositely charged ions formed by transfer of electrons (metal + non-metal).
Covalent bond	Bond formed by sharing a pair of electrons between two atoms (non-metals).
Lone pair	A pair of valence electrons not used in bonding.
Polar covalent bond	Covalent bond in which the shared pair is pulled towards the more electronegative atom (e.g. O-H).
Intermolecular forces	Weak attractions between molecules (e.g. hydrogen bonds between water molecules).
Lewis (dot-cross) structure	Diagram showing bonding pairs and lone pairs of valence electrons.
Octet rule	Atoms tend to gain, lose or share electrons to reach eight electrons in the outer shell.

10.11 Turning effect of a force	Physics
Moment of a force	Turning effect of a force = force × perpendicular distance from the pivot to the line of action (N m).
Couple	Two equal, parallel, opposite forces not acting along the same line, producing rotation only.
Moment of a couple	One force × perpendicular distance between the two forces.
Principle of moments	For a body in equilibrium, sum of clockwise moments = sum of anticlockwise moments about any point.

10.12 Equilibrium of forces	Physics
Equilibrium	State in which the resultant force and resultant moment on a body are both zero.
Centre of gravity	Point through which the whole weight of a body appears to act.

10.13 The world of life (classification and nomenclature)	Biology
Classification	Grouping organisms according to similarities and differences.
Binomial nomenclature	Two-part scientific name: Genus (capital letter) + species (simple letter), underlined separately or in italics, e.g. Mangifera indica.
Domain	Highest category: Bacteria, Archaea and Eukarya.
Kingdom	Major group within Eukarya: Protista, Fungi, Plantae, Animalia.
Prokaryote	Organism with no organised nucleus or membrane-bound organelles (bacteria).
Eukaryote	Organism whose cells have a true nucleus and membrane-bound organelles.
Gymnosperm	Plant with naked seeds (no fruit), e.g. Cycas, Pinus.
Angiosperm	Flowering plant with seeds enclosed in a fruit; monocots and dicots.
Homoeotherm (warm-blooded)	Animal that keeps a constant body temperature: birds and mammals.
Poikilotherm (cold-blooded)	Animal whose body temperature changes with the surroundings: fish, amphibians, reptiles.

10.14 Continuity of life (reproduction)	Biology
Asexual reproduction	Producing offspring from one parent without gametes; offspring identical; fast and numerous.
Sexual reproduction	Fusion of male and female gametes (fertilisation) giving genetic variation.
Vegetative propagation	Asexual reproduction from roots, stems or leaves (natural or artificial).

10.14 Continuity of life (reproduction)	Biology
Pollination	Transfer of pollen from anther to stigma.
Fertilisation	Fusion of a male gamete with a female gamete to form a zygote.
Grafting	Joining a scion onto a stock so that they grow as one plant.
Layering	Rooting a branch while it is still attached to the parent plant.
Menstrual cycle	About 28-day cycle of changes in the ovary and uterus controlled by hormones.
Ovulation	Release of an ovum from a mature Graafian follicle.

10.15 Hydrostatic pressure and its applications	Physics
Pressure	Force acting perpendicularly per unit area (N m^{-2} = pascal, Pa).
Hydrostatic pressure	Pressure exerted by a liquid at rest; depends on depth, density and g.
Pascal's principle	Pressure applied to an enclosed liquid is transmitted equally in all directions.
Upthrust (buoyant force)	Upward force exerted by a fluid on an immersed body.
Archimedes' principle	Upthrust equals the weight of fluid displaced by the immersed body.
Law of flotation	A floating body displaces its own weight of fluid.
Density	Mass per unit volume (kg m^{-3} or g cm^{-3}).
Atmospheric pressure	Pressure exerted by the weight of the air column; about 1×10^5 Pa (76 cm Hg) at sea level.

10.16 Changes in matter	Chemistry
Chemical change	Change that produces new substances; usually not easily reversed (burning, rusting).
Physical change	Change in state or form without forming new substances (melting, evaporation, dissolving).
Combination reaction	Two or more substances combine to form one product.
Decomposition reaction	One substance breaks down into two or more simpler substances.
Single displacement reaction	A more reactive element displaces a less reactive one from its compound.
Double displacement reaction	Ions of two compounds exchange partners, often forming a precipitate.
Activity series	Metals arranged in order of decreasing reactivity: K, Na, Ca, Mg, Al, Zn, Fe, Pb, (H), Cu, Ag, Au.

10.17 Rate of reactions	Chemistry
Rate of reaction	Change in amount (or concentration) of a reactant or product per unit time.
Catalyst	Substance that increases the rate of a reaction and remains chemically unchanged at the end.
Activation energy	Minimum energy colliding particles need in order to react.

10.18 Work, energy and power	Physics
Work	Done when a force moves its point of application in the direction of the force (J).
Energy	Capacity to do work (J).
Kinetic energy	Energy due to motion.
Gravitational potential energy	Energy due to position above a reference level.
Power	Rate of doing work or transferring energy (W = J s^{-1}).
Principle of conservation of energy	Energy cannot be created or destroyed, only changed from one form to another.
Efficiency	Useful energy output / total energy input × 100%.

10.19 Current electricity	Physics
Electric current	Rate of flow of charge (A); in metals a flow of free electrons.
Potential difference	Work done per unit charge in moving charge between two points (V).
Electromotive force (e.m.f.)	Potential difference across a cell when no current is drawn.

10.19 Current electricity	Physics
Resistance	Opposition to current flow (Ω); R = V/I.
Ohm's law	At constant temperature, current through a conductor is directly proportional to the p.d. across it.
Static electricity	Charge at rest produced by friction through transfer of electrons.

10.20 Inheritance	Biology
Gene	Unit of heredity; a part of DNA on a chromosome that controls a characteristic.
Allele	Alternative form of a gene (e.g. T and t).
Dominant allele	Expressed when present in one copy (capital letter).
Recessive allele	Expressed only when two copies are present (homozygous).
Genotype	Genetic make-up of an organism (TT, Tt, tt).
Phenotype	Observable characteristic resulting from the genotype and environment.
Homozygous / heterozygous	Two identical alleles / two different alleles.
Monohybrid cross	Cross involving one pair of contrasting characters.
Mutation	Sudden change in a gene or chromosome.
Genetic engineering	Altering the genetic material of an organism using biotechnology.

Grade 11

11.1 Living tissues	Biology
Tissue	A group of cells with a common origin, structure and function.
Meristematic tissue	Actively dividing plant cells at growing points (apical and lateral meristems).
Parenchyma	Simple permanent tissue of thin-walled, spherical living cells with large vacuoles and intercellular spaces; storage and photosynthesis.
Collenchyma	Living cells with walls thickened at the corners; flexible support in young stems.
Sclerenchyma	Dead cells with thick lignified walls (fibres and sclereids/stone cells); mechanical support.
Xylem	Complex tissue that conducts water and minerals upwards and gives support.
Phloem	Complex tissue (sieve tubes, companion cells) that translocates food.
Epithelial tissue	Covers body surfaces and lines cavities.
Connective tissue	Binds and supports other tissues (bone, cartilage, blood).

11.2 Photosynthesis	Biology
Photosynthesis	Process in which green plants make glucose from carbon dioxide and water using light energy absorbed by chlorophyll, releasing oxygen.
Limiting factor	The factor in shortest supply that limits the rate of photosynthesis.

11.3 Mixtures	Chemistry
Mixture	Two or more substances mixed without chemical combination; can be separated by physical methods.
Homogeneous mixture	Uniform composition throughout; one phase (salt solution, air, alcohol + water).
Heterogeneous mixture	Non-uniform; components can be distinguished (sand + water, flour + water, oil + water).
Solution	Homogeneous mixture of solute and solvent.
Solubility	Maximum mass of solute that dissolves in a given amount of solvent at a given temperature.
Saturated solution	Solution that can dissolve no more solute at that temperature.
Concentration	Amount of solute in a unit volume of solution (mol dm^{-3} or g dm^{-3}).
Mole fraction	Moles of one component / total moles of all components.

11.4 Waves and their applications	Physics
Wave	A disturbance that transfers energy from one place to another without transferring matter.
Transverse wave	Particles vibrate perpendicular to the direction of travel (crests and troughs): water waves, EM waves.

11.4 Waves and their applications	Physics
Longitudinal wave	Particles vibrate parallel to the direction of travel (compressions and rarefactions): sound.
Amplitude	Maximum displacement of a particle from its rest position.
Wavelength	Distance between two consecutive crests (or compressions).
Frequency	Number of waves per second (Hz).
Electromagnetic waves	Transverse waves that need no medium and travel at 3×10^8 m s^{-1} in vacuum.
Ultrasound	Sound with frequency above 20 000 Hz.
Echo	Reflected sound.

11.5 Geometrical optics	Physics
Laws of reflection	Angle of incidence = angle of reflection; incident ray, reflected ray and normal lie in one plane.
Refraction	Change in direction of light as it passes between media because its speed changes.
Refractive index	n = sin i / sin r (light from air into the medium) = real depth / apparent depth.
Critical angle	Angle of incidence in the denser medium for which the angle of refraction is 90 degrees.
Total internal reflection	Complete reflection of light inside a denser medium when the angle of incidence exceeds the critical angle.
Principal focus (F)	Point where rays parallel to the principal axis meet (or appear to diverge from) after reflection/refraction.
Focal length (f)	Distance from the pole/optical centre to the principal focus.

11.6 Biological processes in the human body	Biology
Digestion	Breakdown of large insoluble food molecules into small soluble ones that can be absorbed.
Peristalsis	Waves of muscular contraction that push food along the gut.
Respiration (cellular)	Release of energy from food; aerobic: glucose + O_2 → CO_2 + H_2O + energy.
Anaerobic respiration	Release of less energy without oxygen; in muscle produces lactic acid.
Excretion	Removal of metabolic waste products (urea, CO_2, excess salts and water).
Nephron	Structural and functional unit of the kidney.
Homeostasis	Maintenance of a constant internal environment (temperature, water, glucose).
Hormone	Chemical messenger secreted by an endocrine gland directly into the blood, acting on target organs.
Reflex action	Rapid automatic response to a stimulus through a reflex arc (receptor - sensory neurone - spinal cord - motor neurone - effector).

11.7 Acids, bases and salts	Chemistry
Acid	Substance that releases H^+ ions in aqueous solution.
Base	Substance that neutralises an acid; alkalis release OH^- ions in water.
Strong acid / base	Ionises completely in water (HCl, HNO_3, H_2SO_4; NaOH, KOH).
Weak acid / base	Ionises partially (CH_3COOH, H_2CO_3; NH_4OH).
Salt	Compound formed when the H^+ of an acid is replaced by a metal or ammonium ion.
Neutralisation	Reaction of an acid with a base to form salt and water; exothermic.
pH	Scale (0-14) of acidity: <7 acidic, 7 neutral, >7 basic.
Indicator	Substance that changes colour with pH (litmus, phenolphthalein, methyl orange).

11.8 Heat changes associated with chemical reactions	Chemistry
Exothermic reaction	Releases heat to the surroundings; products have less energy than reactants (combustion, neutralisation, respiration).
Endothermic reaction	Absorbs heat; products have more energy than reactants (decomposition of $CaCO_3$, photosynthesis, dissolving glucose or NH_4Cl).
Heat of reaction	Heat change when the molar quantities in the balanced equation react.

11.9 Heat	Physics
Temperature	Degree of hotness of a body; measured in °C or kelvin (K).
Heat	Energy transferred because of a temperature difference (J).
Specific heat capacity	Heat needed to raise the temperature of 1 kg of a substance by 1 K (J kg^{-1} K^{-1}); water 4200.
Specific latent heat	Heat needed to change the state of 1 kg of a substance at constant temperature.
Thermal expansion	Increase in size of a substance when heated.
Conduction	Heat transfer through a material from particle to particle without the material moving.
Convection	Heat transfer by the movement of a fluid (liquid or gas).
Radiation	Heat transfer by electromagnetic (infra-red) waves; needs no medium.
Charles' law	At constant pressure the volume of a fixed mass of gas is proportional to its absolute temperature.

11.10 Power and energy of electric appliances	Physics
Electric power	Rate of electrical energy consumption: P = VI (W).
Kilowatt-hour (unit)	Energy used by a 1 kW appliance in 1 hour = 3.6×10^6 J.
Fuse	Thin wire that melts when current exceeds a safe value, breaking the circuit.
Earth wire	Connects the metal body of an appliance to earth to prevent electric shock.

11.11 Electronics	Physics
Semiconductor	Material whose conductivity lies between conductors and insulators (pure Si, Ge are intrinsic).
n-type semiconductor	Si/Ge doped with a Group 15 element (P, As) - extra electrons.
p-type semiconductor	Si/Ge doped with a Group 13 element (B, Al, Ga) - holes.
p-n junction diode	Allows current in one direction only (forward bias).
Forward bias	p-side to +, n-side to -; depletion layer narrows and current flows.
Rectification	Converting a.c. into d.c. using diodes (half-wave: one diode; full-wave: bridge of four diodes).
Transistor	Three-terminal device (emitter, base, collector) used as an amplifier and a switch.
LDR	Light dependent resistor: resistance falls as light intensity rises.
LED	Light emitting diode: emits light when forward biased.

11.12 Electrochemistry	Chemistry
Electrochemical (galvanic) cell	Converts chemical energy into electrical energy (e.g. Zn/Cu in dilute H_2SO_4).
Electrolytic cell	Uses electrical energy to drive a chemical reaction (electrolysis).
Anode	Electrode where oxidation (loss of electrons) occurs.
Cathode	Electrode where reduction (gain of electrons) occurs.
Electrolyte	Molten or dissolved ionic compound that conducts electricity.
Corrosion (rusting)	Gradual destruction of a metal by reaction with its environment; iron needs water and oxygen.
Sacrificial (cathodic) protection	Connecting iron to a more reactive metal (Zn, Mg, Al) that corrodes instead.
Electroplating	Coating an object with a thin layer of metal by electrolysis.

11.13 Electromagnetism and electromagnetic induction	Physics
Magnetic field	Region where a magnetic force acts.
Maxwell's corkscrew / right-hand grip rule	Give the direction of the magnetic field around a current-carrying conductor.
Fleming's left-hand rule	Gives the direction of the force on a current-carrying conductor in a magnetic field (motor rule).
Fleming's right-hand rule	Gives the direction of the induced current (dynamo rule).
Electromagnetic induction	Production of an e.m.f. in a conductor when the magnetic flux linked with it changes.
Transformer	Device that changes a.c. voltage using electromagnetic induction (step-up or step-down).

11.14 Hydrocarbons and their derivatives	Chemistry
Hydrocarbon	Compound of carbon and hydrogen only.
Alkane	Saturated hydrocarbon with single C-C bonds (CnH2n+2): methane, ethane, propane, butane.
Alkene	Unsaturated hydrocarbon with a C=C double bond (CnH2n): ethene.
Polymer	Large molecule made by joining many small monomer units.
Addition polymerisation	Monomers with C=C join without losing atoms (ethene → polythene).
Natural rubber	Linear polymer of isoprene (2-methylbuta-1,3-diene, two C=C).
Vulcanisation	Heating rubber with sulphur to form cross-links, making it harder and more elastic.

11.15 Biosphere	Biology
Biosphere	All parts of the Earth where life exists.
Population	All individuals of one species living in an area at a given time.
Community	All populations of different species living together in an area.
Ecosystem	A community interacting with its non-living environment.
Food chain / web	Feeding relationships showing energy transfer between organisms; interlinked chains form a web.
Ecological pyramid	Diagram of numbers, biomass or energy at each trophic level; energy pyramids are always upright.
Carrying capacity	Maximum population size an environment can support sustainably.
Biomagnification	Increase in concentration of persistent toxins at higher trophic levels.
Eutrophication	Excess nutrients (nitrates, phosphates) causing algal blooms and oxygen depletion in water.
BOD	Oxygen needed by micro-organisms to decompose organic matter in water; high BOD = polluted.
Sustainable development	Meeting present needs without compromising the ability of future generations to meet theirs.
Food miles	Distance food travels from producer to consumer; fewer food miles = less fuel and CO_2.
Carbon footprint	Total greenhouse gases emitted by an individual or activity.

6

Equations

Formulae and chemical equations, unit by unit

- Physics formulae with units
- Chemical equations to learn by heart
- Constants and conversions
- Always: formula, substitution, answer with unit

Constants and conversions

Quantity	Value
g (Earth)	10 m s^{-2} (use the value given in the question)
g (Moon)	about g/6
Avogadro constant	6.022×10^{23} mol^{-1}
Speed of light / EM waves in vacuum	3.0×10^{8} m s^{-1}
Speed of sound in air	about 330-340 m s^{-1} (faster in water, about 1460 m s^{-1})
Specific heat capacity of water	4200 J kg^{-1} K^{-1}
Density of water	1000 kg m^{-3} = 1 g cm^{-3}
Atmospheric pressure (sea level)	1×10^{5} Pa = 76 cm Hg
Temperature	T (K) = t (°C) + 273
Electrical energy	1 kWh = 3.6×10^{6} J
Volume	1 dm^3 = 1000 cm^3 = 1 litre; 1 m^3 = 1000 dm^3

Grade 10

10.2 Motion in a straight line	
v = s / t	average velocity = displacement / time
a = (v - u) / t	acceleration from initial velocity u to final velocity v in time t
v = u + at	equation of motion for uniform acceleration
s = area under a velocity-time graph	displacement from a v-t graph
gradient of s-t graph = velocity; gradient of v-t graph = acceleration	reading motion graphs
$v^2 = u^2 + 2as$	used for free fall: $v^2 = 2gh$ when starting from rest

10.3 Structure of matter	
mass number = protons + neutrons	A = Z + N
ion charge = protons - electrons	e.g. Na^+ has 11 p and 10 e^-

10.4 Newton's laws of motion	
F = m a	unbalanced force = mass × acceleration
p = m v	momentum
W = m g	weight; g = 10 m s^{-2} on Earth, about g/6 on the Moon

10.7 Quantification of elements and compounds	
n = m / M	moles = mass (g) / molar mass (g mol^{-1})
N = n x L	number of particles = moles × 6.022×10^{23}
mass of one atom = Ar × (1/12 mass of C-12 atom)	meaning of relative atomic mass
mole ratio from a balanced equation	e.g. $2H_2 + O_2 \rightarrow 2H_2O$: 2 mol H_2 react with 1 mol O_2

10.9 Resultant force	
same direction: $R = F_1 + F_2$	collinear forces in the same direction
opposite directions: $R = F_1 - F_2$ (towards larger force)	collinear forces in opposite directions
$F_1 - F_2 \leq R \leq F_1 + F_2$	range of the resultant of two forces at any angle
perpendicular: $R = \sqrt{F_1^2 + F_2^2}$	two forces at right angles (e.g. 3 N and 4 N give 5 N)

10.11 Turning effect of a force	
$M = F \times d$	moment (N m)
moment of a couple = F x d (d = distance between the forces)	e.g. steering wheel, screwdriver, tap

10.12 Equilibrium of forces	
two forces: $F_1 = F_2$, opposite, same line	equilibrium under two forces
three parallel forces: upward sum = downward sum; moments balance	e.g. a plank on two supports
three non-parallel forces: concurrent; resultant of any two equal and opposite to the third	triangle of forces

10.15 Hydrostatic pressure and its applications	
$P = F / A$	pressure = force / area
$P = h \rho g$	liquid pressure at depth h (ρ = density)
$F_2 / A2 = F_1 / A1$	hydraulic jack / brake (Pascal's principle)
upthrust = weight of liquid displaced = $V \rho g$	Archimedes
apparent weight = real weight - upthrust	body immersed in liquid
density = mass / volume	$\rho = m / V$

10.16 Changes in matter	
$Mg + ZnSO_4 \rightarrow MgSO_4 + Zn$	single displacement
$2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$	laboratory preparation of oxygen (decomposition)
$Zn + 2HCl \rightarrow ZnCl_2 + H_2$	laboratory preparation of hydrogen
$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$	laboratory preparation of carbon dioxide
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	blast furnace reduction of iron ore
$2Na + 2H_2O \rightarrow 2NaOH + H_2$	reactive metal with cold water

10.18 Work, energy and power	
$W = F \times s$	work = force × distance moved in the direction of the force
$Ek = 1/2\ m\ v^2$	kinetic energy
$Ep = m\ g\ h$	gravitational potential energy
$P = W / t$	power
efficiency = (output / input) × 100%	energy efficiency

10.19 Current electricity	
V = I R	Ohm's law
$R = R_1 + R_2 + \ldots$	resistors in series
$1/R = 1/R_1 + 1/R_2 + \ldots$	resistors in parallel
R proportional to l / A	resistance increases with length, decreases with cross-sectional area
cells in series: $E = E_1 + E_2$	aiding connection

10.20 Inheritance	
Tt x Tt → 1 TT : 2 Tt : 1 tt (3 : 1 phenotypes)	monohybrid F_2 ratio
Tt × tt → 1 Tt : 1 tt	test-cross ratio

Grade 11

11.2 Photosynthesis	
$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$	light energy, chlorophyll

11.3 Mixtures	
c = n / V	concentration (mol dm^{-3}) = moles / volume (dm^3)
mass of solute = c x V x M	for preparing standard solutions
x(A) = nA / (nA + nB)	mole fraction
w/w % = (mass solute / mass solution) × 100	mass fraction
w/v = mass solute / volume solution	g dm^{-3}

11.4 Waves and their applications	
v = f x λ	wave equation
T = 1 / f	period
depth = v t / 2	echo sounding (sonar)

11.5 Geometrical optics	
n = sin i / sin r	Snell's law
n = real depth / apparent depth	apparent depth
1/f = 1/u + 1/v (sign convention used in class)	lens / mirror formula (where taught)
magnification m = image height / object height = v / u	magnification

11.6 Biological processes in the human body	
$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy	aerobic respiration

11.7 Acids, bases and salts	
$H^+ + OH^- \rightarrow H_2O$	ionic equation for neutralisation
$HCl + NaOH \rightarrow NaCl + H_2O$	example
acid + metal → salt + H_2; acid + carbonate → salt + H_2O + CO_2	acid reactions

11.8 Heat changes associated with chemical reactions	
Q = m c (change in temperature)	heat change measured in a calorimeter
heat per mole = Q / moles reacted	scaling to one mole

11.9 Heat	
T(K) = t(°C) + 273	temperature conversion; a temperature difference is the same in K and °C
Q = m c (change in θ)	heat to change temperature
Q = m L	heat to change state
heat lost = heat gained	mixtures (no heat loss)

11.10 Power and energy of electric appliances	
$P = V\,I = I^2\,R = V^2 / R$	electric power
E = P t	energy (J or kWh)
units (kWh) = power (kW) x time (h)	electricity bill
efficiency = useful output / input × 100%	appliance efficiency

11.12 Electrochemistry	
$Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$	anode of Zn/Cu cell (oxidation)
$2H^+(aq) + 2e^- \rightarrow H_2(g)$	cathode of simple cell in dilute acid
$Na^+ + e^- \rightarrow Na$	cathode, Downs cell
$2Cl^- \rightarrow Cl_2 + 2e^-$	anode, Downs cell
$Cu^{2+} + 2e^- \rightarrow Cu$	cathode in copper plating/refining

11.13 Electromagnetism and electromagnetic induction	
F = B I L	force on a conductor (increases with B, I and L)
Vp / Vs = Np / Ns	transformer turns ratio
Vp Ip = Vs Is	ideal (100% efficient) transformer

11.14 Hydrocarbons and their derivatives	
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	combustion of methane
$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$	combustion of ethene
n $CH_2{=}CH_2 \rightarrow -(CH_2{-}CH_2)n-$	polymerisation of ethene

7

Short notes

Fast revision for every unit

- The facts examiners test again and again
- Read one unit a day in the final month
- Pair with Section 5 definitions
- Unit codes match Figures 3 and 4

Grade 10

10.1 Chemical basis of life — Biology

- Reducing sugars (glucose, fructose, maltose) give a brick-red precipitate with Benedict's solution on heating; sucrose does not until hydrolysed with acid.
- Starch gives a blue-black colour with iodine; proteins give violet with the Biuret test; lipids leave a translucent spot on paper / stain red with Sudan III.
- Water: the medium for reactions, a solvent and transport medium, and it regulates temperature (high specific heat capacity).
- Key deficiencies: vitamin A - night blindness, Bitot's spots; B12/folate - anaemia; C - scurvy; D - rickets; K - poor clotting; iron - anaemia; iodine - goitre; calcium - weak bones.
- Cellulose (dietary fibre) is not digested by humans but prevents constipation.
- Exam favourite: which elements are common to all biomolecules (C, H, O), and which group has H:O = 2:1 (carbohydrates).

10.2 Motion in a straight line — Physics

- Displacement can be less than or equal to distance, never greater.
- On a displacement-time graph a straight sloping line = uniform velocity; a horizontal line = at rest; a curve flattening = retardation.
- On a velocity-time graph a horizontal line = uniform velocity; a straight sloping line = uniform acceleration; area under the line = displacement.
- A falling body speeds up by about 10 m s^{-1} every second (air resistance ignored).
- Mean velocity = total displacement / total time (not the average of velocities).

10.3 Structure of matter — Chemistry

- Proton +1 (mass 1), neutron 0 (mass 1), electron -1 (mass about 1/1840).
- Across a period: atomic radius decreases; ionisation energy and electronegativity generally increase (small dips at Group 3 and Group 6).
- Down a group: atomic radius increases; ionisation energy decreases; metallic character increases.
- Noble gases (Group 18) have the highest ionisation energies; Group 1 metals the lowest.
- Oxides: metal oxides basic (Na_2O, MgO); Al_2O_3 amphoteric; non-metal oxides acidic (CO_2, SO_2, SiO_2).
- Graphite conducts electricity (free electrons); diamond is the hardest natural substance.
- Writing formulae: balance valencies, e.g. Al (3) and SO_4 (2) gives $Al_2(SO_4)_3$.

10.4 Newton's laws of motion — Physics

- Seat belts and head rests protect passengers because of inertia (first law).
- A rocket, a bouncing ball and a swimmer pushing water back are third-law examples.
- Weight on the Moon = weight on Earth / 6; mass does not change.
- Unit of force in base units: kg m s^{-2}.

10.5 Friction — Physics

- Limiting friction depends on the normal reaction and the nature of the surfaces; it does NOT depend on the area of contact.
- Graph of friction vs applied force: rises linearly (static), peaks at limiting friction, drops slightly and stays constant (dynamic).
- Useful friction: walking, brakes, writing, gripping. Harmful: wear of machine parts, heat, energy loss.
- Reduce friction: lubricants, ball bearings, polishing, streamlining, air cushions (hovercraft), magnetic levitation.
- Wet roads reduce friction, so vehicles skid and need longer stopping distances.

10.6 Plant and animal cells — Biology

- Only plant cells have a cell wall, chloroplasts and a large central vacuole; animal cells may have centrioles.
- With a light microscope only the nucleus, cell wall, cytoplasm and chloroplasts are clearly seen; other organelles need an electron microscope.
- A 'typical cell' is a model drawn to show all organelles together.

- Cellulose cell wall is non-living; plasma membrane is selectively permeable.

10.7 Quantification of elements and compounds — Chemistry

- One mole of any substance contains 6.022×10^{23} particles; 56 g of iron and 44 g of CO_2 are each one mole.
- Count atoms carefully: one mole of CO_2 contains 3 moles of atoms ($3 \times 6.022 \times 10^{23}$).
- Always balance the equation before using mole ratios.
- Percentage by mass of an element = (mass of element in formula / Mr) × 100.

10.8 Characteristics of organisms — Biology

- Levels of organisation: cell → tissue → organ → system → organism (e.g. the heart and liver are organs).
- Seven characteristics of life: movement, respiration, irritability, growth, reproduction, excretion, nutrition (cellular organisation underlies all).
- Respiration (gas exchange) distinguishes a living seed or egg from a non-living specimen of similar appearance.
- Viruses show both living (reproduce in host cells) and non-living (crystallise) features.

10.9 Resultant force — Physics

- The resultant of two forces is greatest when they act in the same direction and least when opposite.
- Parallel forces: resultant = algebraic sum; its line of action is found using moments.
- Inclined forces: use the parallelogram rule (scale drawing).

10.10 Chemical bonds — Chemistry

- Ionic compounds: high melting and boiling points, conduct when molten or dissolved (not as solids), usually soluble in water.
- Covalent (simple molecular) compounds: low melting points, do not conduct; giant covalent (diamond, SiO_2) have very high melting points.
- Bond counts: H_2O 2 single bonds, 2 lone pairs on O; NH_3 3 bonds, 1 lone pair; CH_4 4 bonds; CO_2 two double bonds (4 bonds); N_2 triple bond; O_2 double bond.
- Hydrogen bonding explains water's high boiling point compared with HCl.
- HCl is covalent but ionises completely in water.

10.11 Turning effect of a force — Physics

- Door handles are far from hinges so a small force gives a large moment.
- Spanners with long handles tighten bolts with less force.
- Levers: first order (scissors, see-saw), second order (wheelbarrow, nutcracker), third order (forearm, tongs).

10.12 Equilibrium of forces — Physics

- A hanging body is in equilibrium when the tension equals its weight (no unbalanced force).
- For three forces in equilibrium, the third force equals the resultant of the other two in size but acts in the opposite direction, and all three lines of action meet at one point.
- Centre of gravity of an irregular lamina is found by hanging it from two points and drawing plumb lines.

10.13 The world of life (classification and nomenclature) — Biology

- Taxonomic order: Domain → Kingdom → Phylum → Class → Order → Family → Genus → Species.
- Fungi: eukaryotic, heterotrophic decomposers with chitin in the cell wall. Fungi and Animalia are wholly heterotrophic.
- Plants: non-flowering seedless (mosses, ferns - Nephrolepis, Salvinia), gymnosperms (Cycas, Pinus), angiosperms.
- Monocot: parallel venation, fibrous roots, trimerous flowers, one cotyledon (paddy, coconut, grass, bamboo). Dicot: net venation, tap root, tetra/pentamerous flowers, two cotyledons.
- Invertebrate phyla: Cnidaria (two germ layers, e.g. Hydra), Annelida (segmented, chaetae, e.g. earthworm, leech), Mollusca (muscular foot, e.g. snail), Arthropoda (jointed legs, chitin exoskeleton, e.g. insects, spiders, scorpions), Echinodermata (only marine, e.g. starfish).

- Vertebrate classes: Pisces, Amphibia (toad, salamander), Reptilia (tortoise, cobra, crocodile), Aves (fowl, parrot), Mammalia (bat, whale, human).
- Birds: feathers, wings, hollow bones, air sacs. Mammals: hair, mammary glands, external ears.

10.14 Continuity of life (reproduction) — Biology

- Underground stems: rhizome (ginger, turmeric), corm (colocasia), bulb (onion), stem tuber (potato). Root tubers: sweet potato, manioc.
- Seed dispersal - wind: hairs (milkweed/wara, cotton, imbul) or wings (hora, drumstick, mahogany); water: fibrous/air-filled (coconut, Ceylon almond, lotus, water lily); animals: hooks (love grass, epala) or succulent fruit (mango); explosive: rubber, balsam, ladies' fingers.
- Flower: stamen = anther + filament (androecium); pistil = stigma + style + ovary (gynoecium).
- After fertilisation: ovary → fruit; ovules → seeds; integuments → seed coat; petals and stamens wither.
- Human: sperms produced in the testes; ova in the ovaries; fertilisation in the fallopian tube; implantation in the uterus.
- Testosterone - male secondary sexual characteristics; oestrogen and progesterone - female characteristics and menstrual cycle.
- STDs: gonorrhoea, syphilis (bacterial), HIV/AIDS, herpes (viral) - not inherited.

10.15 Hydrostatic pressure and its applications — Physics

- Liquid pressure does not depend on the shape of the vessel, its volume or the area of the base, only on depth and density.
- Water from a lower tap flows faster because the pressure there is greater.
- A body floats if its density is less than the liquid's; it sinks if maximum upthrust is less than its weight.
- Applications: hydraulic jack and brakes, dams thicker at the bottom, Cartesian diver, submarines, hydrometers, the bisokotuwa of ancient tanks.
- Water barometer column about 10 m; mercury barometer about 76 cm.

10.16 Changes in matter — Chemistry

- K, Na, Ca react with cold water; Mg reacts with hot water/steam; metals below H do not liberate H_2 from dilute acids.
- Extraction: very reactive metals (K, Na, Ca, Mg, Al) by electrolysis; middle metals (Zn, Fe, Pb) by reduction with carbon/CO; least reactive (Au) occur free.
- Blast furnace: limestone removes sandy impurities (SiO_2) as slag; coke supplies heat and CO.
- Gas collection: O_2 and H_2 over water; CO_2 by upward displacement of air (denser) or over water; H_2 by downward displacement of air.
- Tests: O_2 rekindles a glowing splinter; H_2 burns with a 'pop'; CO_2 turns lime water milky.
- Ammonia is very soluble in water; chlorine is used as a disinfectant.

10.17 Rate of reactions — Chemistry

- Factors increasing rate: higher concentration, higher temperature, larger surface area (powder), catalyst, (pressure for gases), light for some reactions.
- Higher temperature increases the kinetic energy of particles, giving more frequent and more energetic collisions.
- Iron wool burns in a flame but an iron nail does not - surface area.
- Examples: V_2O_5 in the contact process (H_2SO_4); Fe in the Haber process (NH_3); Ni in hydrogenation of oils (margarine); MnO_2 in decomposition of H_2O_2.
- Rate can be followed by measuring gas volume or loss of mass with time; the curve is steep at first and levels off as reactants are used up.

10.18 Work, energy and power — Physics

- $1\ J = 1\ N\ m = 1\ kg\ m^2\ s^{-2}$.
- Climbing stairs: power = mgh / t.
- Hydropower: potential energy of stored water → kinetic energy → electrical energy.
- Braking converts kinetic energy into heat and sound.

10.19 Current electricity — Physics

- Resistance depends on length, cross-sectional area, material and temperature - not on V or I.
- Parallel resistors always give less than the smallest single resistor (two equal resistors: R/2).
- Ammeter in series (low resistance); voltmeter in parallel (high resistance).
- Cells with like terminals joined oppose each other (e.m.f.s cancel).
- When rubbed, the object that loses electrons becomes positively charged; protons never move.

10.20 Inheritance — Biology

- Mendel used garden pea (round vs wrinkled seeds, tall vs dwarf).
- Humans: 23 pairs of chromosomes (22 pairs autosomes + 1 pair sex chromosomes). Female XX, male XY; the sperm decides the sex. An ovum carries 22 + X.
- Sex-linked (X-linked recessive): haemophilia, red-green colour blindness - commoner in males; a colour-blind son inherits it from his mother.
- Autosomal gene disorders: thalassaemia, albinism. Thalassaemia carriers are Tt.
- Marriage between blood relatives increases the chance of children being homozygous for harmful recessive alleles.

Grade 11

11.1 Living tissues — Biology

- Plant tissues: meristematic and permanent; permanent = simple (parenchyma, collenchyma, sclerenchyma) and complex (xylem, phloem).
- Animal tissues: epithelial, connective (including blood), muscle, nervous.
- Smooth muscle: spindle-shaped, uninucleate, no striations, involuntary (walls of gut and blood vessels).
- Skeletal muscle: long, multinucleate, striated, voluntary, fatigues.
- Cardiac muscle: branched, uninucleate, striated, intercalated discs, involuntary, never fatigues.
- Blood is a connective tissue: RBCs (oxygen), WBCs (defence; granulocytes - neutrophils, eosinophils, basophils; agranulocytes - lymphocytes, monocytes), platelets (clotting), plasma (transport of nutrients, hormones, CO_2, urea).

11.2 Photosynthesis — Biology

- Factors needed: light, CO_2, water, chlorophyll, suitable temperature. Water cannot be tested in a school laboratory.
- Destarch a plant in the dark for 48 h before testing; test a leaf for starch with iodine after boiling in water and alcohol.
- KOH (or NaOH) absorbs CO_2 - used to show CO_2 is needed.
- Variegated leaves show chlorophyll is needed (only green parts form starch).
- Hydrilla set-up shows oxygen is released; the gas rekindles a glowing splinter. More dissolved CO_2 = more bubbles.
- Glucose is the first product, stored temporarily as starch in chloroplasts and translocated as sucrose in phloem.
- Light energy → chemical energy; photosynthesis is the basis of food chains and keeps O_2/CO_2 balanced.

11.3 Mixtures — Chemistry

- Polar solutes dissolve in polar solvents (salt in water); non-polar in non-polar (grease in kerosene, sulphur in CS_2, iodine in alcohol).
- Solubility of most solids increases with temperature; solubility of gases decreases with temperature and increases with pressure (soda water).
- Separation: filtration, crystallisation, simple distillation (pure water), fractional distillation (crude oil, liquid air), steam distillation (cinnamon and other essential oils), solvent extraction (medicinal extracts), chromatography (dyes), magnetic separation (mineral sands).
- Salt production in salterns: $CaCO_3$ deposits first, then $CaSO_4$, then NaCl (about 10x concentration); $MgCl_2$ and $MgSO_4$ make salt bitter and damp.
- Preparing a standard solution: weigh, dissolve, transfer to a volumetric flask with washings, make up to the mark, shake.

11.4 Waves and their applications — Physics

- EM spectrum (increasing frequency): radio, microwaves, infra-red, visible, ultraviolet, X-rays, gamma rays.
- Frequency does not change when a wave enters a new medium; speed and wavelength do.
- Sound needs a medium; it is fastest in solids, then liquids, slowest in gases; it travels faster in warmer air.
- Characteristics of sound: loudness (amplitude), pitch (frequency), quality/timbre (wave shape).
- Uses: ultrasound scanning of a foetus, sonar, echo location by bats and dolphins; infra-red in TV remotes; X-rays in medicine; microwaves in cooking and communication.
- Audible range: 20 Hz - 20 000 Hz.

11.5 Geometrical optics — Physics

- Plane mirror image: virtual, upright, same size, laterally inverted, as far behind as the object is in front.
- Concave mirror: object beyond C - real, inverted, diminished; at C - real, inverted, same size; between F and P - virtual, upright, magnified (shaving/dentist's mirror).
- Convex mirror: always virtual, upright, diminished; wide field of view (vehicle side mirrors).
- Convex lens: object between F and lens - virtual, upright, magnified (magnifying glass); far object - real, inverted, diminished (camera, burning paper with sunlight).
- Concave lens always forms a virtual, upright, diminished image; corrects short sight.
- TIR uses: optical fibres (endoscope), diamond sparkle, prismatic binoculars and periscopes, mirages. A rainbow is due to dispersion.
- Short sight (myopia) - concave lens; long sight (hypermetropia) - convex lens. A normal eye focuses on the retina.

11.6 Biological processes in the human body — Biology

- Digestion: mouth (salivary amylase: starch → maltose; pH about 7.5); stomach (pepsin + HCl: proteins; pH about 2-3.5); duodenum (pancreatic amylase, trypsin, lipase; bile from the liver emulsifies fat); small intestine completes digestion and absorbs.
- End products: glucose, amino acids, fatty acids + glycerol (into lacteals). Villi increase surface area.
- Breathing in: intercostal muscles and diaphragm contract, diaphragm flattens, thoracic volume increases. Gas exchange at the alveolar wall.
- Respiratory diseases: TB (cough with blood, weight loss), pneumonia, bronchitis, asthma, laryngitis, silicosis/asbestosis (occupational).
- Double circulation: blood passes the heart twice per circuit. Left ventricle has the thickest wall. Arteries carry blood away from the heart (pulmonary artery carries deoxygenated blood).
- Urine formation: ultrafiltration, selective reabsorption, secretion. Urea is made in the liver, excreted by kidneys. Glucose and amino acids are fully reabsorbed.
- Brain: cerebrum (thinking, senses), cerebellum (balance, coordination), medulla oblongata (heart rate, breathing, vomiting).
- Hormones: insulin (lowers glucose) and glucagon (raises it) - pancreas; thyroxine (needs iodine) and calcitonin - thyroid; adrenaline - emergencies; pituitary is the master gland below the hypothalamus.

11.7 Acids, bases and salts — Chemistry

- Litmus: acid turns blue litmus red; base turns red litmus blue. Phenolphthalein: colourless in acid, pink in base. Methyl orange: red in acid, yellow in base.
- Increasing pH at equal concentration: $HCl < CH_3COOH < NH_4OH < NaOH$.
- Ant stings (formic acid) are relieved by a weak base (lime water, baking soda); acetic/formic acid coagulates rubber latex.
- Antacids ($Mg(OH)_2$) neutralise excess stomach acid; limestone neutralises acidic waste water and acidic soils.

11.8 Heat changes associated with chemical reactions — Chemistry

- Energy-level diagram: exothermic - products below reactants (arrow down); endothermic - products above reactants.
- Assumptions in calorimetry: solution has the density and specific heat capacity of water; no heat is lost to the surroundings.
- Use an insulated (polystyrene) cup with a lid to reduce heat loss.

11.9 Heat — Physics

- Temperature stays constant while a substance melts or boils (latent heat).
- Water's high specific heat capacity makes it a good coolant in engines.
- Bimetallic strip bends with the more-expanding metal on the outside when heated (thermostats).
- Heated liquid in a flask: level first falls (glass expands) then rises (liquid expands more).
- Sea breeze by day (land heats faster); land breeze at night. Heat from the Sun reaches Earth by radiation.
- Evaporation happens at any temperature, only at the surface, and causes cooling; boiling occurs at a fixed temperature throughout the liquid.

11.10 Power and energy of electric appliances — Physics

- Three-pin plugs (live, neutral, earth) for appliances with metal bodies: irons, kettles, heaters, microwave ovens.
- Switches and fuses are placed on the live wire.
- LED and CFL lamps use far less power than filament lamps for the same brightness (energy conservation).
- An immersion heater placed low in the water heats faster because of convection.
- Energy management: switch off unused lamps, use efficient appliances, use solar power.

11.11 Electronics — Physics

- A capacitor smooths rectified d.c.
- npn transistor: n-type emitter and collector, p-type base.
- Transistors amplify and switch; they do not rectify.
- A solar cell is a p-n junction that converts light energy to electrical energy.
- IC pins are numbered anticlockwise from the notch when viewed from above.

11.12 Electrochemistry — Chemistry

- In a galvanic cell the more reactive metal is the anode; electrons flow from anode to cathode through the external wire (conventional current the opposite way).
- In electrolysis, the anode is connected to the + terminal and the cathode to the - terminal.
- Downs cell: fused NaCl with $CaCl_2$ to lower the melting point; a steel gauze separates Na and Cl_2.
- Electroplating: object = cathode; plating metal = anode; electrolyte = a salt of the plating metal; dilute solution and small d.c. current.
- Corrosion test (agar with NaCl, ferricyanide, phenolphthalein): blue = Fe^{2+} (iron corroding), pink = OH^- (cathode area).
- Galvanising = zinc coating (protects even when scratched); tin plating protects only while unbroken (speeds rust when scratched).

11.13 Electromagnetism and electromagnetic induction — Physics

- Motor effect devices: d.c. motor, loudspeaker, moving-coil meters, electric bell (electromagnet).
- Induction devices: dynamo/generator, moving-coil microphone, transformer, induction in a coil when a magnet moves in or out.
- No relative motion between magnet and coil = no induced current.
- Transmission: generator voltage stepped up (e.g. 220 kV) to reduce energy loss, then stepped down for homes (230 V).
- The secondary of a step-down transformer uses thicker wire because it carries a larger current.

11.14 Hydrocarbons and their derivatives — Chemistry

- Derivatives of ethene: chloroethene (vinyl chloride) → PVC; tetrafluoroethene → Teflon.
- LP gas = propane + butane; biogas = mainly methane.
- Fractional distillation of crude oil: gases at the top (lowest boiling points), bitumen at the bottom.
- Synthetic polymers: combustible, resistant to acids, electrical insulators, NOT biodegradable.
- Natural polymers: rubber, cellulose, starch, proteins.

11.15 Biosphere — Biology

- Energy is lost at each trophic level, so shorter food chains are more efficient.
- Nitrogen cycle: N-fixing bacteria (root nodules) → nitrates; decomposition; denitrification (waterlogged soils). Floods reduce soil nitrogen by denitrification, leaching and wash-off.
- Pollutants: greenhouse gases (CO_2, CH_4, N_2O, CFC) - global warming, sea-level rise; CFC - ozone depletion (ozone absorbs UV); SO_2 and NOx - acid rain; nitrates/phosphates - eutrophication; NO_2 - photochemical smog; heavy metals (Hg, Cd, Pb, As) - biomagnification, kidney disease.
- Mercury is released from broken fluorescent/CFL lamps; batteries release heavy metals.
- Primary pollutants (SO_2, CO, NO_2, NH_3) are released directly; secondary pollutants (SO_3, H_2SO_4, HNO_3, O_3) form from them.
- 4R waste management (textbook): Reduce, Reuse, Recycle, Replace (e.g. organic fertiliser instead of chemical; biogas from animal waste is recycling).
- Non-communicable diseases (diabetes, heart disease, cancer, CKD) are linked to lifestyle; genetic diseases (haemophilia) cannot be prevented by lifestyle change.
- Conventions: Ramsar (wetlands), Montreal (ozone), CITES (trade in endangered species), Kyoto/Paris (climate).
- Traditional tank structures: bisokotuwa (sluice valve pit), ralapanawa (wave breaker protecting the bund).
- Natural disasters with little human influence: tsunami, earthquakes. Human-influenced: landslides, floods, smog, invasive species.

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