

**Paper 2: Theory
Marking Scheme****Sample Paper****1 hour****Mark Scheme Criteria**

Examiners must apply positive marking only. Do not deduct any marks for incorrect responses. Provide marks in line with this scheme only.

Response(s) must be in line with prescribed marking indicators shown below. Variation is permissible only with prior acknowledgment from Chief Examiner.

Text shown below, in the majority of instances, is a text perfect response. Learners do not have to provide a text perfect response in order to qualify for a mark; their response must be in line with the text shown within the response, but the wording can vary.

For single mark questions, learner response must meet the stated characteristics as indicated in this mark scheme. Where more than one option is shown, learners can deviate from the prescribed responses, as long as they meet the general theme of the response.

For multiple mark questions, learner responses must meet the stated characteristics as indicated in this mark scheme. However, where the examiner feels a learner has demonstrated more than a basic response, and which meets the minimum stated characteristics, additional marks may be awarded. Where this occurs, the examiner must flag this response for enhanced moderation by the Chief Examiner.

Whilst indicative responses are shown below, and particularly for multiple mark responses, where 2 or more marks are permissible (as shown for each question), where learner responses do not align with the suggested response, examiners can use best judgement. Where this occurs, the examiner must flag this response for enhanced moderation by the Chief Examiner

Biology Section Mark Scheme (40 Marks)

Question 1: Plant Biology (10 marks)

(a) Diagram of a leaf cell

i) Label the vacuole and chloroplast on the diagram. (2 marks)

- 1 mark for correctly labeling the vacuole.
- 1 mark for correctly labeling the chloroplast.

ii) State the main function of the chloroplast. (1 mark)

- 1 mark: Chloroplasts are responsible for photosynthesis, converting light energy into chemical energy (glucose).

iii) Explain how the structure of the cell wall supports its function. (2 marks)

- 1 mark: The cell wall is made of cellulose, which provides mechanical strength.
- 1 mark: It maintains the shape of the cell and prevents it from bursting under osmotic pressure.

(b) Water absorption in plants

i) Describe how osmosis enables water absorption in root hair cells. (3 marks)

- 1 mark: Water moves from a region of higher water potential in the soil to lower water potential inside the root hair cell.
- 1 mark: Movement occurs across a partially permeable membrane.
- 1 mark: This process does not require energy (passive transport).

ii) Suggest two adaptations of root hair cells for efficient absorption. (2 marks)

- 1 mark for each correct adaptation:
 - Large surface area for greater absorption.
 - Thin cell wall to facilitate faster water and mineral ion entry.
 - Presence of many mitochondria for active transport of minerals.

Question 2: Enzymes (8 marks)

(a) Biological catalysts

i) Define the term catalyst. (1 mark)

- 1 mark: A catalyst is a substance that increases the rate of a chemical reaction without being consumed in the process.

ii) Explain how temperature affects enzyme activity. (3 marks)

- 1 mark: Enzyme activity increases with temperature up to the optimum due to more kinetic energy and collisions.
- 1 mark: Beyond the optimum temperature, enzymes denature due to the breaking of bonds in the active site.
- 1 mark: Denaturation reduces enzyme activity as the substrate can no longer bind effectively.

(b) Digestion and enzymes

i) Name the enzyme that breaks down starch. (1 mark)

- 1 mark: Amylase.

ii) State the products of starch digestion. (1 mark)

- 1 mark: Glucose or maltose.

iii) Explain the role of bile in fat digestion. (2 marks)

- 1 mark: Bile emulsifies fats into smaller droplets, increasing the surface area for enzyme action.
- 1 mark: Neutralizes stomach acid to create an alkaline environment for lipase activity.

Question 3: Circulatory System (8 marks)

(a) Blood vessels

i) Compare the structure of arteries and veins. (4 marks)

- 1 mark: Arteries have thicker walls to withstand high pressure; veins have thinner walls.
- 1 mark: Arteries have a smaller lumen; veins have a larger lumen.
- 1 mark: Veins have valves to prevent backflow; arteries do not.
- 1 mark: Arteries carry blood away from the heart; veins carry blood towards the heart.

ii) Explain the function of capillaries in tissue exchange. (2 marks)

- 1 mark: Capillaries have thin walls (one-cell thick) for efficient diffusion of gases and nutrients.
- 1 mark: They allow oxygen and nutrients to pass into tissues and waste products to diffuse out.

(b) White blood cells

i) Name one type of white blood cell and describe its function. (2 marks)

- 1 mark: Phagocyte or lymphocyte.
 - 1 mark: Phagocytes engulf and digest pathogens; lymphocytes produce antibodies to neutralize pathogens.
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Question 4: Genetics (6 marks)

(a) Genetic variation

i) Explain how sexual reproduction leads to genetic variation. (3 marks)

- 1 mark: Involves the fusion of gametes (sperm and egg) during fertilization.
- 1 mark: Offspring inherit a combination of alleles from both parents.
- 1 mark: Crossing over and independent assortment during meiosis increase variation.

(b) Biodiversity

i) Define biodiversity. (1 mark)

- 1 mark: The variety of different species, genetic diversity, and ecosystems in a given area.

ii) Suggest two ways in which deforestation reduces biodiversity. (2 marks)

- 1 mark: Destruction of habitats leading to loss of species.
 - 1 mark: Disruption of food chains and ecosystems.
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Question 5: Respiratory System (8 marks)

(a) Gas exchange

i) Name the two gases exchanged in the alveoli. (1 mark)

- 1 mark: Oxygen and carbon dioxide.

ii) Explain how the structure of alveoli makes them efficient for gas exchange. (3 marks)

- 1 mark: Large surface area increases the rate of diffusion.
- 1 mark: Thin walls (one-cell thick) shorten the diffusion distance.
- 1 mark: Rich blood supply maintains a steep concentration gradient.

(b) Smoking and its effects

i) State one harmful chemical in cigarette smoke and its effect on the lungs. (2 marks)

- 1 mark: Tar damages alveoli, reducing lung capacity.
 - 1 mark: Carbon monoxide reduces oxygen transport by binding to hemoglobin.
- ii) Suggest two ways in which smoking increases the risk of cardiovascular disease. (2 marks)
- 1 mark: Increases blood pressure by narrowing arteries.
 - 1 mark: Leads to the formation of blood clots, causing heart attacks or strokes.

Chemistry Section Mark Scheme (40 Marks)

Question 5: Atomic Structure (8 marks)

(a)

i) State the name of this atom. (1 mark)

- 1 mark: Correct identification of the atom based on its electronic structure (e.g., carbon, oxygen).

ii) Draw the electronic configuration of an oxygen atom. (2 marks)

- 1 mark: Correct placement of 2 electrons in the first shell.
- 1 mark: Correct placement of 6 electrons in the second shell.

(b)

i) Define an ionic bond. (2 marks)

- 1 mark: An ionic bond is the electrostatic attraction between oppositely charged ions.
- 1 mark: Formed through the transfer of electrons from one atom to another.

ii) Explain why ionic compounds conduct electricity when molten but not when solid. (3 marks)

- 1 mark: In solid form, ions are fixed in a lattice and cannot move.
- 1 mark: When molten, ions are free to move.
- 1 mark: Movement of ions allows electric current to flow.

Question 6: Chemical Reactions (7 marks)

(a)

i) Write the balanced chemical equation for the reaction between hydrochloric acid and sodium hydroxide. (2 marks)

- 1 mark: Correct reactants ($\text{HCl} + \text{NaOH}$).
- 1 mark: Correct products ($\text{NaCl} + \text{H}_2\text{O}$).

ii) State one common use of this neutralization reaction. (1 mark)

- 1 mark: For treating indigestion (e.g., antacids) or in agriculture to neutralize acidic soils.

(b)

i) Write a balanced chemical equation for the reaction between calcium carbonate and hydrochloric acid. (2 marks)

- 1 mark: Correct reactants ($\text{CaCO}_3 + \text{HCl}$).
- 1 mark: Correct products ($\text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$).

ii) Suggest a test to confirm the presence of carbon dioxide gas. (2 marks)

- 1 mark: Pass the gas through limewater.
 - 1 mark: Limewater turns milky/cloudy in the presence of carbon dioxide.
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Question 7: Experimental Chemistry (7 marks)

(a)

i) Define the term catalyst. (1 mark)

- 1 mark: A catalyst is a substance that increases the rate of a reaction without being consumed.

ii) Explain how increasing temperature affects the rate of reaction. (3 marks)

- 1 mark: Particles gain more kinetic energy at higher temperatures.
- 1 mark: Increased frequency of collisions between reactant particles.
- 1 mark: More collisions have sufficient energy to overcome the activation energy.

(b)

i) Describe how you would obtain pure salt from a mixture of salt and sand. (3 marks)

- 1 mark: Add water to dissolve the salt.

- 1 mark: Filter the mixture to separate the sand.
 - 1 mark: Evaporate the water to obtain pure salt crystals.
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Question 8: Forms of Carbon (7 marks)

(a)

i) Name two allotropes of carbon. (2 marks)

- 1 mark each: Diamond, graphite, graphene, or fullerene.

ii) Explain why diamond is a hard substance. (2 marks)

- 1 mark: Diamond has a giant covalent structure.
- 1 mark: Each carbon atom forms strong covalent bonds with four other carbon atoms.

(b)

i) State one harmful effect of carbon dioxide on the environment. (1 mark)

- 1 mark: Contributes to global warming or causes ocean acidification.

ii) Suggest two ways to reduce the impact of burning fossil fuels. (2 marks)

- 1 mark each:
 - Use renewable energy sources (e.g., wind, solar).
 - Increase energy efficiency or use carbon capture and storage technologies.
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Question 9: Metal Chemistry (11 marks)

(a)

i) State two physical properties of metals. (2 marks)

- 1 mark each: Good conductors of heat and electricity, malleable, ductile, or high melting point.

ii) Explain why metals are malleable. (2 marks)

- 1 mark: Metal atoms are arranged in layers.
- 1 mark: Layers can slide over each other without breaking metallic bonds.

(b)

i) Name one transition metal and a typical use for it. (2 marks)

- 1 mark for a transition metal (e.g., iron, copper, or gold).

- 1 mark for a use (e.g., iron in construction, copper in electrical wiring).

(c)

i) Define electrolysis. (2 marks)

- 1 mark: Electrolysis is the process of breaking down a compound using electricity.
- 1 mark: Requires an electrolyte to conduct the electric current.

ii) Identify the product formed at the cathode and the anode during the electrolysis of molten lead(II) bromide. (2 marks)

- 1 mark: Lead (metal) at the cathode.
- 1 mark: Bromine (gas) at the anode.

(d) Suggest one reason why electrolysis is an expensive method of metal extraction. (1 mark)

- 1 mark: High energy consumption for maintaining molten conditions or generating electricity.

Physics Section Mark Scheme (40 Marks)

Question 10: Motion and Kinematics (7 marks)

(a)

i) Define velocity. (1 mark)

- 1 mark: Velocity is the rate of change of displacement in a specific direction.

ii) Describe the motion of the car during the first four seconds. (2 marks)

- 1 mark: The car is accelerating uniformly.
- 1 mark: The graph shows a straight line indicating constant acceleration.

iii) Determine which part of the journey has the greatest acceleration. Show your working and give a reason for your choice. (2 marks)

- 1 mark: Correct calculation of acceleration from the steepest slope of the graph (e.g., $a = \frac{\Delta v}{\Delta t}$ or $a = \Delta v / \Delta t$).
- 1 mark: Identifies the steepest slope as the section with the greatest acceleration.

(b)

i) Calculate the work done when a cyclist applies a force of 50 N to move 5 m forward. (2 marks)

- 1 mark: Uses the formula $W = F \times d$ or $W = Fd$.

- 1 mark: Correct substitution and result ($W=50 \times 5=250$ J $W = 50 \times 5 = 250$ \, $JW=50 \times 5=250$ J).

Question 11: Refraction and Waves (7 marks)

(a)

i) Complete the ray diagram to show the path of light as it enters and leaves the block. (2 marks)

- 1 mark: Correct refraction towards the normal when entering the glass.
- 1 mark: Correct refraction away from the normal when leaving the glass.

ii) Define refraction. (1 mark)

- 1 mark: Refraction is the bending of light as it passes from one medium to another due to a change in speed.

(b)

i) State one example of each type of wave. (2 marks)

- 1 mark each:
 - Transverse wave: Light or water wave.
 - Longitudinal wave: Sound wave or compression wave in a spring.

ii) Describe the difference between transverse and longitudinal waves. (2 marks)

- 1 mark: In transverse waves, particles move perpendicular to the wave direction.
- 1 mark: In longitudinal waves, particles move parallel to the wave direction.

Question 12: Moments and Circuits (7 marks)

(a)

i) State the formula for calculating the moment of a force. (1 mark)

- 1 mark: Moment = Force \times Perpendicular distance from pivot.

ii) A seesaw is in equilibrium with a 30 N force on one side, 2 m from the pivot. Calculate the force on the other side if it is 1.5 m from the pivot. (2 marks)

- 1 mark: Uses the principle of moments ($F_1 \times d_1 = F_2 \times d_2$ $F_1 \times d_1 = F_2 \times d_2$ $F_1 \times d_1 = F_2 \times d_2$).
- 1 mark: Correct substitution and result ($30 \times 2 = F \times 1.5 \rightarrow F = 40$ N $30 \times 2 = F \times 1.5$ $\rightarrow F = 40$ N).

(b)

i) Name two safety devices used in household circuits. (2 marks)

- 1 mark each: Fuse, circuit breaker, or residual current device (RCD).

ii) Explain the function of each device. (2 marks)

- 1 mark each:
 - Fuse: Protects the circuit by melting when current exceeds a safe limit.
 - Circuit breaker: Automatically switches off the circuit when current is too high.
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Question 13: Energy (6 marks)

(a)

i) State one advantage and one disadvantage of using solar energy. (2 marks)

- 1 mark: Advantage: Renewable, no greenhouse gas emissions, or low operating costs.
- 1 mark: Disadvantage: High initial cost, depends on sunlight, or less efficient in cloudy areas.

(b)

i) Calculate the energy consumed by a 100 W bulb used for 2 hours in kilowatt-hours. (2 marks)

- 1 mark: Correct formula $E = P \times t$
- 1 mark: Correct substitution and result ($E = 0.1 \text{ kW} \times 2 \text{ h} = 0.2 \text{ kWh}$)

ii) If electricity costs \$0.15 per kilowatt-hour, calculate the cost of using the bulb. (2 marks)

- 1 mark: Correct formula ($\text{Cost} = \text{Energy} \times \text{Cost per kWh}$)
 - 1 mark: Correct substitution and result ($0.2 \times 0.15 = \$0.03 \text{ USD}$)
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Question 14: Nuclear Physics (13 marks)

(a)

i) Label the nucleus and one electron on the diagram. (2 marks)

- 1 mark for the nucleus.
- 1 mark for one electron correctly labeled in its shell.

ii) Define the term isotope. (2 marks)

- 1 mark: Isotopes are atoms of the same element with the same number of protons.

- 1 mark: They have different numbers of neutrons.

iii) Describe one medical or industrial use of radioactive isotopes. (2 marks)

- 1 mark: Medical use: E.g., cancer treatment (radiotherapy) or tracers for imaging.
- 1 mark: Industrial use: E.g., checking welds in pipes or measuring material thickness.

(b)

i) Name the three types of radiation emitted during nuclear decay. (3 marks)

- 1 mark each: Alpha, beta, and gamma radiation.

ii) Compare the penetrating powers of alpha, beta, and gamma radiation. (3 marks)

- 1 mark each:
 - Alpha: Weakly penetrating, stopped by paper or skin.
 - Beta: Moderately penetrating, stopped by a few mm of aluminum.
 - Gamma: Highly penetrating, stopped by thick lead or concrete.

iii) Suggest one way to protect workers handling radioactive materials. (1 mark)

- 1 mark: Use shielding (e.g., lead apron), work at a distance, or limit exposure time.