

General Instructions:

1. This question paper consists of 39 questions in 3 sections.
 2. Section A is Biology, Section B is Chemistry, Section C is Physics.
 3. All questions are compulsory. However, an internal choice is provided in some questions. Attempt only one option where a choice is given.
 4. Marks are indicated against each question.
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SECTION A - BIOLOGY (30 Marks)

1. Which of the following correctly describes the role of villi in the small intestine? [1]
 - A. They secrete digestive enzymes only.
 - B. They increase the surface area for absorption of digested food.
 - C. They store undigested food temporarily.
 - D. They produce bile for fat digestion.
2. During intense physical activity, when oxygen supply to muscle cells is insufficient, glucose is broken down anaerobically to produce: [1]
 - A. Carbon dioxide and water
 - B. Ethanol and carbon dioxide
 - C. Lactic acid
 - D. Pyruvic acid and oxygen
3. Which part of the human brain is responsible for thinking, memory, and voluntary actions? [1]
 - A. Cerebrum
 - B. Cerebellum
 - C. Medulla
 - D. Spinal cord
4. Adrenaline, secreted during stressful situations, primarily prepares the body for: [1]
 - A. Digestion of food
 - B. Fight or flight response by increasing heartbeat and blood supply to muscles
 - C. Long-term growth and development
 - D. Regulation of blood sugar levels
5. In a cross between a pure-breeding tall pea plant (TT) and a pure-breeding short pea plant (tt), all F1 offspring were tall. When these F1 plants were self-pollinated, the F2 generation showed tall and short plants in a ratio of approximately: [1]
 - A. 1:1
 - B. 3:1
 - C. 1:3
 - D. 9:1
6. Which of the following statements correctly describe the effects of ozone layer depletion? (i) It allows more harmful UV radiation to reach earth's surface. (ii) It increases the risk of skin cancer and eye damage. (iii) It is beneficial as it increases vitamin D production without any harm. (iv) It is linked to the release of chlorofluorocarbons. [1]
 - A. (i), (ii) and (iv)
 - B. (i) and (iii)
 - C. (ii) and (iii)
 - D. (iii) and (iv) only

7. Which practice would most effectively help reduce the accumulation of non-biodegradable waste in the environment? [1]

- A. Increasing the use of single-use plastic bags
- B. Segregating waste and promoting recycling of materials like plastic and glass
- C. Burning all waste in open areas
- D. Dumping waste directly into water bodies

The following two questions consist of an Assertion (A) and a Reason (R). Choose the correct option: (A) Both A and R are true, and R is the correct explanation of A. (B) Both A and R are true, but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.

8. Assertion (A): Two pea plants, both showing the tall phenotype, may have different genotypes. Reason (R): A dominant trait can be expressed in both homozygous and heterozygous conditions. [1]

9. Assertion (A): The number of organisms generally decreases at each successive trophic level in a food chain. Reason (R): Only about 10 percent of energy is transferred from one trophic level to the next, with the rest lost mainly as heat. [1]

10. Explain why the excretory system in plants is fundamentally different from that in animals, giving one example of how plants get rid of waste products. [2]

11. Attempt either option A or B. [2]

A.. What is a reflex action? Explain with the help of one example how a reflex arc allows a very quick response compared to actions controlled directly by the brain.

OR

B.. Explain the role of the hormone auxin in the bending of a plant shoot towards light (phototropism).

12. A grassland ecosystem contains grass, grasshoppers, mice, snakes, hawks and decomposer fungi. Construct one food chain with at least three trophic levels using organisms from this list. [2]

13. With the help of a labelled diagram, describe the structure of a nephron and briefly explain its role in the formation of urine. [3]

14. Pea plants with round, yellow seeds (heterozygous for both traits, RrYy) were self-pollinated. [3]

(i). Using a suitable method, show the possible combinations of gametes formed by the RrYy parent.

(ii). If 320 seeds were obtained from this cross, in what ratio would you expect the four phenotypes (round yellow, round green, wrinkled yellow, wrinkled green) to appear, and how many seeds of each type would you expect approximately?

15. Vikram had a meal consisting of chapati, a bowl of dal, and a glass of buttermilk. Attempt either subpart A or B. [4]

A.. Which component of this meal is rich in proteins? Explain, step by step, how protein digestion begins in the stomach, naming the enzyme and condition required.

OR

B.. (i) Which component of the meal is richest in starch? (ii) Name the enzyme present in saliva responsible for the initial breakdown of starch, and the products formed. (iii) In which organ is the digestion of proteins, fats and carbohydrates completed, and what happens to the undigested food afterwards?

16. Attempt either option A or B. [5]

A.. A horticulturist wants to multiply a rare variety of chrysanthemum flower quickly while preserving its exact characteristics. (i) Would grafting/cutting (vegetative propagation) or growing from seeds be more suitable? Justify your choice. (ii) Why do vegetatively propagated plants usually lack the variation seen in sexually reproduced plants? (iii) Explain briefly why variation is essential for a species to survive changing environmental conditions.

OR

B.. A scientist studied seed production in two sets of cucumber plants: Set A grown in a poly-house with bees introduced for pollination, Set B grown in a separate poly-house sealed off from insects. (i) Which set would you expect to produce more seeds and fruits? Explain your reasoning. (ii) Describe three changes that occur in a flower's structure once fertilisation has taken place.

SECTION B - CHEMISTRY (25 Marks)

17. In the reaction $2\text{Na}(s) + \text{Cl}_2(g) \rightarrow 2\text{NaCl}(s)$, which statement is correct? [1]

- A. Sodium is reduced and chlorine is oxidised.

- B. Sodium is oxidised and chlorine is reduced.
- C. Neither sodium nor chlorine changes oxidation state.
- D. Both sodium and chlorine are oxidised.

18. Consider these statements: (I) Calcium oxide reacts with dilute HCl but not with NaOH. (II) Aluminium oxide reacts with both dilute HCl and NaOH. (III) Carbon dioxide reacts with NaOH but not with dilute HCl. (IV) Sulphur dioxide reacts with both dilute HCl and NaOH. Which statements are correct? [1]

- A. I, II and III
- B. II and IV
- C. I and IV
- D. III and IV only

19. A zinc strip is dipped in aqueous copper sulphate, and a copper strip in aqueous zinc sulphate, in two separate test tubes. What would be observed? [1]

- A. Zinc displaces copper from copper sulphate; no reaction occurs with copper strip in zinc sulphate.
- B. Copper displaces zinc from zinc sulphate; no reaction occurs in the other test tube.
- C. Both reactions take place, forming zinc and copper metal respectively.
- D. No reaction occurs in either test tube.

20. Phenolphthalein indicator is added separately to dilute hydrochloric acid and to aqueous sodium hydroxide. What would be observed? [1]

- A. Colourless in both solutions
- B. Pink in acid, colourless in base
- C. Colourless in acid, pink in base
- D. Pink in both solutions

21. Which of the following, when dissolved in equal volumes of water, would give a solution with a pH closest to 7? [1]

- A. Hydrochloric acid
- B. Sodium hydroxide
- C. Sodium chloride
- D. Acetic acid

22. Dilute hydrochloric acid is added to solid calcium carbonate. The gas evolved: [1]

- A. Is oxygen and relights a glowing splinter
- B. Is carbon dioxide and turns lime water milky
- C. Is hydrogen and burns with a pop sound
- D. Is chlorine and bleaches litmus paper

23. Aqueous solutions of sodium sulphate and barium chloride are mixed. The observation is: [1]

- A. No reaction occurs
- B. A white precipitate of barium sulphate is formed
- C. A yellow precipitate forms
- D. The solution turns blue

The following question consists of an Assertion (A) and a Reason (R). Choose the correct option as described above.

24. Assertion (A): Ethanoic acid is a weaker acid compared to hydrochloric acid of the same concentration. Reason (R): Ethanoic acid is a carboxylic acid and does not ionise completely in water, unlike hydrochloric acid. [1]

25. A copper rod and an iron rod of the same dimensions are each coated with wax at one end, with a pin stuck to the wax, and heated from the other end simultaneously. Which rod would show the pin falling off first? Justify your answer based on thermal conductivity. [2]

26. Attempt either option A or B. [3]

A.. An element 'A' has a high melting point, is a good conductor of electricity, and reacts with dilute hydrochloric acid to liberate hydrogen gas. (i) Is 'A' likely to be a metal or non-metal? Justify. (ii) Write a general word equation for the reaction of a metal with a dilute acid.

OR

B. Iron articles develop a flaky reddish-brown coating when left exposed to moist air for a long time. (i) Name this phenomenon and the chemical compound responsible. (ii) Suggest two methods commonly used to prevent this from happening. (iii) Why is this process considered economically significant?

27. During an electrolysis experiment on acidified water, Tanya observed that one electrode collected gas at twice the rate of the other. [3]

(i). Name the gas collected at the electrode with the larger volume, and identify whether this electrode is the anode or cathode.

(ii). Why does pure distilled water not conduct electricity well enough for this experiment without an additive?

(iii). Write the balanced chemical equation for the decomposition of water during electrolysis.

28. Farhan took 4 mL of dilute sodium hydroxide solution and added two drops of phenolphthalein, turning it pink. He added dilute hydrochloric acid drop by drop until the pink colour disappeared, using 48 drops. He repeated with different volumes: Volume of NaOH (mL): 4, 6, 8 → Drops of HCl required: 48, 72, 96. [4]

A. Name the type of reaction occurring in this experiment.

B. Based on the pattern, how many drops of HCl would be required for 10 mL of the same NaOH solution?

C. Write the balanced chemical equation for this reaction, and name the salt formed.

29. Attempt either option A or B. [5]

A. A hydrocarbon C_xH_y undergoes complete combustion as: $C_xH_y + 2O_2 \rightarrow CO_2 + 2H_2O$ (with $x=1$). (a) Determine y . (b) Give the IUPAC name of this hydrocarbon and state whether saturated or unsaturated. (c) Write its structural formula. (d) Can this hydrocarbon undergo an addition reaction with hydrogen? Explain why or why not. (e) Name one everyday use of this hydrocarbon.

OR

B. Two elements, M (atomic number 19) and N (atomic number 17), combine to form a compound. (a) What type of bond will form between M and N? (b) Write the chemical formula of the compound formed. (c) Will this compound conduct electricity in the solid state? What about in molten or dissolved state? Explain. (d) State whether the compound will have a high or low melting point, with reason. (e) If N combines with hydrogen instead, what type of bond forms, and is the resulting compound's aqueous solution acidic, basic or neutral?

SECTION C - PHYSICS (25 Marks)

30. Which of the following statements correctly describes the nature of the image formed by a plane mirror? [1]

- A. Real, inverted and magnified
- B. Virtual, erect and of the same size as the object
- C. Real, erect and diminished
- D. Virtual, inverted and magnified

31. Which of the following correctly explains why we can see the sun for a short while even before actual sunrise? [1]

- A. Atmospheric refraction bends light from the sun, making it visible before it actually rises above the horizon.
- B. The sun physically moves faster than expected in the morning.
- C. Scattering of light causes this effect, unrelated to refraction.
- D. This is purely an optical illusion caused by the human eye.

The following question consists of an Assertion (A) and a Reason (R). Choose the correct option as described earlier.

32. Assertion (A): A concave mirror is preferred over a convex mirror for use as a shaving mirror. Reason (R): A concave mirror produces an enlarged, virtual and erect image when the object (face) is placed close to it, within its focal length. [1]

33. A concave mirror forms a real image of an object, four times the size of the object, on a screen placed 40 cm from the mirror. [2]

(i). What is the image distance from the mirror (with appropriate sign)?

(ii). Using the magnification relation, calculate the object distance from the mirror.

34. Attempt either option A or B. [2]

A. Three resistors of 5Ω , 10Ω and 15Ω are connected in series to a 60 V battery. Calculate (i) the total resistance and (ii) the current in the circuit.

OR

B.. Two resistors of 10Ω each are connected in parallel, and this combination is connected in series with a 3Ω resistor across a 16 V battery. Calculate the current through the 3Ω resistor.

35. A student's eye can focus on objects placed far away but experiences blurred vision for objects closer than 50 cm. [3]

(i). Name the defect of vision.

(ii). State the type of lens required for correction.

(iii). Mention one lifestyle or age-related factor that can cause this defect.

36. A wire has a length of 2 m, a cross-sectional area of 1 mm^2 , and a resistance of 4Ω . [3]

(i). Calculate the resistivity of the material of the wire.

(ii). A second wire of the same material has half the length and the same cross-sectional area as the first. Calculate its resistance.

37. State two properties of the magnetic field lines produced inside a current-carrying solenoid. Explain, giving a reason, how the strength of the magnetic field inside the solenoid changes if the number of turns of the coil is increased while keeping the current constant. [3]

38. A simple compound microscope uses a convex lens of focal length 5 cm to view a small object placed close to the lens. [4]

A.. Should the object be placed within the focal length or beyond it for a magnified virtual image to be seen, as in a simple microscope?

B.. What type of image (real/virtual, magnified/diminished) is formed in this case?

Attempt either subpart C or D.

C.. If the object is placed 4 cm from the lens, calculate the position of the image formed using the lens formula.

OR

D.. A magnifying lens forms a virtual image at a distance of 20 cm from the lens when the object is placed 4 cm from the lens. Calculate the focal length of the lens.

39. Attempt either option A or B. [5]

A.. In a circuit, two resistors of 40Ω and 10Ω are connected in parallel, and this combination is connected in series with a 6Ω resistor. This series combination is connected to a battery, and the power dissipated in the 6Ω resistor is found to be 24 W. Calculate: (i) the current flowing through the circuit (ii) the voltage across the parallel combination (iii) the total voltage of the battery.

OR

B.. Three heating elements, each rated 400 W, 200 V, and having equal constant resistance, are connected as follows: elements A and B are connected in series, and this series combination is connected in parallel with element C. The circuit is connected to a 200 V supply. (i) Calculate the resistance of one heating element. (ii) Calculate the current through element C when the circuit is switched on. (iii) Calculate the total power consumed by the circuit.

General Instructions: The value points below are suggested guidelines only. Award marks for any scientifically correct alternative method or expression.

SECTION A - BIOLOGY (30 Marks)

1. B [1]
2. C [1]
3. A [1]
4. B [1]
5. B [1]
6. A [1]
7. B [1]
8. A (Both A and R are true, and R is the correct explanation of A) [1]
9. A (Both A and R are true, and R is the correct explanation of A) [1]
10. Plants excrete waste differently from animals because most of their waste (like oxygen or CO₂) is gaseous and diffuses out through stomata, while excess water is removed through transpiration, and some other wastes are stored in vacuoles or shed along with leaves, bark or fruit, rather than needing a dedicated excretory organ system. [2]
11. A. A reflex action is a rapid, automatic and involuntary response to a stimulus, such as withdrawing a hand suddenly upon touching something hot. This is faster than a brain-controlled action because the signal travels through a short reflex arc via the spinal cord, without waiting for the brain to process and consciously decide on a response. OR B. Auxin, a plant hormone, accumulates more on the shaded side of a shoot; this causes cells on the shaded side to elongate faster than those on the illuminated side, causing the shoot to bend towards the light source (phototropism). [2]
12. Sample food chain: Grass → Grasshopper → Mice → Hawk (any valid three-or-more level chain using the given organisms with correct trophic order is acceptable). [2]
13. Diagram should show the nephron with Bowman's capsule, glomerulus, and a long tubule (proximal convoluted tubule, loop of Henle, distal convoluted tubule) leading to the collecting duct. The nephron filters blood at the glomerulus, and useful substances are reabsorbed along the tubule while waste and excess water are retained to form urine. [3]
14. (i) An RrYy plant produces four types of gametes: RY, Ry, rY, ry, each in equal proportion. (ii) Expected ratio in F₂: 9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green. Out of 320 seeds: approximately 180 round yellow, 60 round green, 60 wrinkled yellow, 20 wrinkled green. [3]
15. A. Dal (lentils) is rich in protein. In the stomach, the enzyme pepsin acts on proteins in the presence of hydrochloric acid (acidic condition), breaking proteins into smaller peptides. OR B. (i) Chapati (wheat) is richest in starch. (ii) Salivary amylase breaks down starch into maltose. (iii) Digestion is completed in the small intestine, where digested nutrients are absorbed through the villi into the bloodstream, and undigested material passes into the large intestine. [4]
16. A. (i) Vegetative propagation (grafting/cutting) is more suitable, since it produces genetically identical plants quickly, preserving the exact characteristics of the parent chrysanthemum. (ii) Vegetative propagation does not involve fusion of gametes, so there is no genetic recombination, resulting in offspring identical to the parent. (iii) Variation helps ensure that at least some individuals in a population can survive and adapt if environmental conditions change, supporting the species' long-term survival. OR B. (i) Set A (with bees) would produce more seeds and fruits, since pollination by bees is necessary for fertilisation to occur, which is absent in the insect-free Set B. (ii) After fertilisation, the ovary develops into a fruit, ovules develop into seeds, and the petals and other floral parts typically wither and fall off. [5]

SECTION B - CHEMISTRY (25 Marks)

17. B [1]
18. A [1]

19. A [1]

20. C [1]

21. C [1]

22. B [1]

23. B [1]

24. A (Both A and R are true, and R correctly explains A, since ethanoic acid is a weak acid due to its incomplete ionisation, unlike the strong acid HCl) [1]

25. The pin would fall off first in the copper rod, since copper has a higher thermal conductivity than iron, allowing heat to travel faster along its length to melt the wax. [2]

26. A. (i) 'A' is likely a metal, since it has a high melting point, conducts electricity well, and reacts with dilute acid to release hydrogen, all typical metallic properties. (ii) Metal + Dilute acid → Salt + Hydrogen gas (general word equation). OR B. (i) This is called rusting; the compound formed is hydrated iron(III) oxide. (ii) Prevention methods: painting/coating with oil or grease, and galvanising (coating with zinc). (iii) Rusting causes significant economic loss as it damages iron structures, vehicles, bridges and machinery, requiring costly repairs or replacement. [3]

27. (i) The gas at the electrode with the larger volume is hydrogen, collected at the cathode. (ii) Pure distilled water has very few free ions, making it a poor conductor; hence electrolysis proceeds very slowly or not at all without an added electrolyte. (iii) $2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{H}_2(\text{g}) + \text{O}_2(\text{g})$ (electrolysis of water, balanced equation). [3]

28. A. This is a neutralisation reaction. B. Based on the pattern (12 drops of HCl per mL of NaOH), 10 mL of NaOH would require approximately 120 drops of HCl. C. $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$; the salt formed is sodium chloride. [4]

29. A. (a) $y=4$ (the hydrocarbon is CH_4). (b) IUPAC name: methane; it is a saturated hydrocarbon (alkane). (c) Structural formula: a central carbon atom bonded to four hydrogen atoms (CH_4). (d) No, methane cannot undergo an addition reaction with hydrogen, since it is already fully saturated with no double or triple bonds available for addition. (e) Methane is commonly used as a fuel (e.g. in CNG, biogas, or LPG mixtures). OR B. (a) M (potassium, group 1) and N (chlorine, group 17) form an ionic bond. (b) Chemical formula: KCl. (c) KCl does not conduct electricity in the solid state, since ions are fixed in a rigid lattice; it does conduct in molten or dissolved state, since ions become free to move and carry charge. (d) KCl has a high melting point due to strong electrostatic forces between oppositely charged ions in the crystal lattice. (e) Chlorine (N) with hydrogen forms HCl through a covalent (polar covalent) bond; its aqueous solution is acidic. [5]

SECTION C - PHYSICS (25 Marks)

30. B [1]

31. A [1]

32. A (Both A and R are true, and R correctly explains A, since a concave mirror produces a magnified, virtual, erect image for an object placed within its focal length, making it suitable for shaving) [1]

33. (i) Image distance $v = -40$ cm (real image, in front of a concave mirror as per sign convention). (ii) Using $m = -v/u$ with $|m| = 4$ (real, inverted image): $-4 = -(-40)/u$, so $u = -10$ cm; the object is placed 10 cm from the mirror. [2]

34. A. (i) Total resistance = $5+10+15 = 30 \Omega$. (ii) Current = $V/R = 60/30 = 2$ A. OR B. Parallel combination of two 10Ω resistors = 5Ω ; total resistance with series 3Ω resistor = 8Ω ; current = $16/8 = 2$ A. [2]

35. (i) Hypermetropia (long-sightedness/far-sightedness). (ii) A convex (converging) lens is required for correction. (iii) Possible cause: ageing/weakening of ciliary muscles, or a shortened eyeball. [3]

36. (i) Resistivity $\rho = RA/L = (4 \times 1 \times 10^{-6})/2 = 2 \times 10^{-6} \Omega \cdot \text{m}$. (ii) When length is halved (area unchanged), new resistance = original/2 = 2Ω . [3]

37. Properties: (a) Inside a solenoid, magnetic field lines are parallel to the axis and nearly uniform, resembling the field of a bar magnet. (b) Field lines emerge from one end (acting as north pole) and enter the other end (acting as south pole). Increasing the number of turns (with current constant) increases the magnetic field strength inside the solenoid, since each additional turn contributes its own magnetic field, and these add up constructively inside the coil. [3]

38. A. The object should be placed within the focal length of the convex lens for a magnified virtual image, as in a simple microscope. B. A virtual, erect and magnified image is formed. C. Using $1/v = 1/f + 1/u$ with $f=5$, $u=-4$: $1/v = 1/5 - 1/4 = -1/20$, so $v = -20$ cm (virtual image). OR D. Using $1/f = 1/v - 1/u$ with $v=-20$, $u=-4$: $1/f = -1/20 + 1/4 = 4/20 = 1/5$, so $f = 5$ cm. [4]

39. A. Parallel combination of 40Ω and $10\Omega = 8\Omega$. Using $P=I^2R$ for the 6Ω resistor: $24=I^2 \times 6$, so $I=2$ A. (i) Current = 2 A. (ii) Voltage across parallel combination = $I \times 8 = 16$ V. (iii) Total battery voltage = $16 + (I \times 6) = 16+12 = 28$ V. OR B. (i) Resistance of one element = $V^2/P = 200^2/400 = 100 \Omega$. (ii) Current through C (across 200V directly) = $200/100 =$

2 A. (iii) Total power = power of C (400 W at rated voltage) + power of A&B in series ($V^2/R_{\text{series}} = 200^2/200 = 200$ W) = 600 W. [5]