Science (086)

CBSE Class 10 Board Examination 2027 – Practice Paper No. 1

Model Answer Paper

Time: 3 hours **Max. Marks: 80**

Model answers show one correct method; any other correct method gets full marks.

SECTION A – BIOLOGY (Q.1 to Q.7) Multiple choice questions. Select the correct option. (1 mark each) **[7]**

1 Which one of the following events does **NOT** take place during photosynthesis?

(A) Absorption of light energy by chlorophyll

(B) Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen

(C) Reduction of carbon dioxide to carbohydrates

(D) Breakdown of glucose into pyruvate in the cytoplasm

Answer (1 mark)
(D) Breakdown of glucose into pyruvate in the cytoplasm.
This is the first step of respiration (it occurs in all cells), not of photosynthesis. Events (A), (B) and (C) are the three events of photosynthesis.

2 During a 400 m race on sports day, Aditya felt painful cramps in his leg muscles. These cramps are caused by the build-up of:

(A) ethanol and carbon dioxide

(B) carbon dioxide and water

(C) lactic acid

(D) glucose

Answer (1 mark)
(C) lactic acid.
During sudden heavy activity, oxygen falls short in muscle cells, so pyruvate is converted into lactic acid. Its build-up causes cramps.

3 During a long dry spell in Marathwada, the leaves of a bajra crop were seen wilting. Which plant hormone inhibits growth and has wilting of leaves among its effects?

(A) Auxin

(B) Gibberellin

(C) Cytokinin

(D) Abscisic acid

Answer (1 mark)
(D) Abscisic acid – it is a growth-inhibiting hormone; its effects include wilting of leaves. Auxin, gibberellins and cytokinins promote growth.

4 After fertilisation in a flower of a brinjal plant, the ovules and the ovary respectively develop into:

(A) fruit and seed

(B) seed and fruit

(C) embryo and seed coat

(D) pollen tube and seed

Answer (1 mark)
(B) seed and fruit.
The ovule develops a tough coat and becomes the seed; the ovary grows rapidly and ripens to form the fruit.

5 A couple in Latur has two daughters. Some relatives blame the mother for not having a son. Which statement correctly explains how the sex of a human child is decided?

(A) The mother's egg decides it, because an egg may carry either an X or a Y chromosome.

(B) It depends on whether the sperm that fertilises the egg carries an X or a Y chromosome.

(C) It depends on the temperature at which the fertilised egg develops.

(D) A daughter inherits both her X chromosomes from her mother.

Answer (1 mark)
(B). All eggs carry an X chromosome. A sperm carries either X or Y; an X-sperm gives a girl (XX) and a Y-sperm gives a boy (XY). So the sex of the child is decided by the father's sperm – the mother cannot be blamed. (C) is true for some reptiles, not for humans; in (D) one X comes from the father.

6 Which one of the following statements about ozone is correct?

(A) Ozone in the higher levels of the atmosphere is formed when UV radiation splits O_2 molecules into free oxygen atoms, which then combine with O_2.

(B) A molecule of ozone is made up of two atoms of oxygen.

(C) The ozone layer is being depleted mainly by carbon dioxide released from vehicles.

(D) Ozone at ground level is harmless and useful to living organisms.

Answer (1 mark)
(A). $O_2 + UV \rightarrow O + O$; $O + O_2 \rightarrow O_3$. Ozone has three oxygen atoms, its depletion is linked mainly to CFCs, and at ground level ozone is a deadly poison.

7 Which one of the following methods of contraception also helps to protect against sexually transmitted diseases such as HIV-AIDS?

(A) Copper-T

(B) Oral pills

(C) Condom

(D) Vasectomy

Answer (1 mark)
(C) Condom – a mechanical barrier that prevents the sperm from meeting the egg and also prevents the transfer of infection between partners. Copper-T, oral pills and vasectomy do not prevent the transmission of infections.

Q.8 – Q.9 Assertion–Reason. Each question has two statements – Assertion (A) and Reason (R). Select the appropriate option (A), (B), (C) or (D) given below the question. (1 mark each) **[2]**

8 **Assertion (A):** In human beings, the right side of the heart receives oxygenated blood from the lungs.
Reason (R): In mammals, blood passes through the heart twice during each cycle of circulation.

(A) Both A and R are true, and R is the correct explanation of A.

(B) Both A and R are true, and R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false but R is true.

Answer (1 mark)
(D) A is false but R is true.
Oxygenated blood from the lungs enters the **left** atrium; the right side of the heart receives deoxygenated blood from the body. R is true – this is double circulation.

9 **Assertion (A):** In an ecosystem, the flow of energy is unidirectional.
Reason (R): The energy captured by green plants passes on to herbivores and then to carnivores, but it never passes back from a higher trophic level to a lower one or to the solar input.

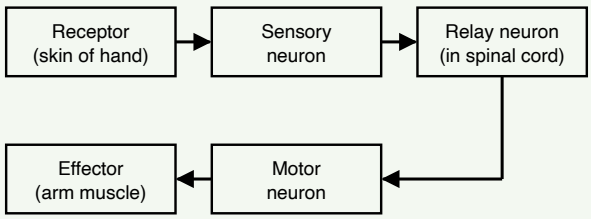
(A) Both A and R are true, and R is the correct explanation of A.
(B) Both A and R are true, and R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Answer (1 mark)
(A) Both A and R are true, and R is the correct explanation of A.
The energy captured by the autotrophs does not revert back to the solar input, and the energy which passes to the herbivores does not come back to the autotrophs; it only moves forward from one trophic level to the next. That is why the flow of energy is said to be unidirectional.

Q.10 – Q.12 Answer the following questions. (2 marks each) **[6]**

10 While making chapatis, Sana's hand touched a hot tawa and she pulled it away at once, even before she felt the pain.
(a) What is such a quick response called? Trace the path followed by the message from her skin to the muscles of her arm.
(b) Why is it useful that this response is controlled by the spinal cord and not by the thinking part of the brain?

Answer (2 marks)
(a) It is a **reflex action**.
Path (reflex arc): receptors in the skin of the hand detect heat → sensory neuron carries the impulse to the spinal cord → relay neuron in the spinal cord → motor neuron → effector (muscles of the arm), which contract and pull the hand away.
(b) Thinking takes time. The reflex arc in the spinal cord connects the input nerve directly to the output nerve, so the response is very quick and the hand is withdrawn before it gets badly burnt. The information also goes on to the brain, so she feels the pain a moment later.



Marking: (a) Naming reflex action – ½ mark; correct path receptor → sensory neuron → spinal cord (relay neuron) → motor neuron → effector – ½ mark · (b) Quick response without involving the thinking process, preventing injury – 1 mark

Examiner tip: Write the path in the correct order with arrows; many students skip the relay neuron or call the arm muscle a 'receptor'.

11 **Attempt either option A or B.**

A. On a hot, dry afternoon a student observed under the microscope that most of the stomatal pores in a leaf peel of a plant were closed.

(a) Which cells control the opening and closing of a stomatal pore? How do they do it?

(b) How does closing the pores at such a time help the plant?

OR

B. A slice of bread left in a warm, moist kitchen for a few days was covered with a white, cottony growth with tiny black dots.

(a) Name the organism and the method by which it reproduces. What are the tiny black dots?

(b) Why did a dry slice of bread kept in the same kitchen not show this growth?

Answer (2 marks)

A. (a) The **guard cells**. When water flows into the guard cells they swell, causing the stomatal pore to open; when the guard cells shrink (lose water), the pore closes.

(b) Large amounts of water are lost through the stomata. Closing them on a hot, dry afternoon reduces the loss of water (transpiration), so the plant does not lose too much water and wilt, even though less carbon dioxide can enter for photosynthesis while the pores are closed.

OR

B. (a) **Rhizopus** (bread mould), which reproduces by **spore formation**. The tiny black dots are **sporangia**, which contain spores that can develop into new Rhizopus individuals.

(b) The spores are covered by thick walls that protect them; they begin to grow only when they come into contact with a moist surface. The dry slice did not provide the moisture they need to grow.

Marking: A: (a) guard cells – ½ mark; swell when water enters → pore opens, shrink → pore closes – ½ mark; (b) reduces loss of water through stomata – 1 mark · OR B: (a) Rhizopus with spore formation – ½ mark; black dots are sporangia containing spores – ½ mark; (b) spores (protected by thick walls) grow only on a moist surface – 1 mark

Examiner tip: Name the cells/structures exactly (guard cells, sporangia) – a general answer such as 'the leaf closes the pores' gets no credit.

12 A farmer in Satara crossed pure-breeding pea plants having round seeds with pure-breeding pea plants having wrinkled seeds. All the F_1 plants produced round seeds. When the F_1 plants were self-pollinated, 1200 seeds were obtained in the F_2 generation.

(a) Which trait is dominant? Give a reason.

(b) Using suitable symbols, show the $F_1 \times F_1$ cross and find how many of the F_2 seeds are expected to be wrinkled.

Answer (2 marks)

(a) **Round** seed shape is dominant – the F_1 plants carry both factors (Rr) but only the round trait is expressed; the wrinkled trait is recessive.

(b) Let R = round, r = wrinkled. F_1: Rr × Rr

Gametes: R, r × R, r

F_2: RR, Rr, Rr, rr → 3 round : 1 wrinkled

Wrinkled seeds = ¼ × 1200 = **300**

Marking: (a) Round with reason – 1 mark · (b) Cross showing RR, Rr, rr in 3 : 1 ratio – ½ mark; 300 wrinkled seeds – ½ mark

Examiner tip: Show gametes and the F_2 combinations; just writing '300' without the cross loses ½ mark.

Q.13 – Q.14 Answer the following questions. (3 marks each) **[6]**

13 A mango sapling about 2 m tall is growing in a large pot on a terrace in Nashik. It is watered every evening, and it makes food in its leaves.

(a) Name the tissues that transport (i) water and minerals and (ii) food in the plant.

(b) Water rises up the stem much faster on a sunny afternoon than at night. Explain why.

(c) Suppose a complete ring of bark, including the phloem, is removed from the stem near its base, leaving the xylem intact. Which transport will be affected – of water to the leaves or of food to the roots? Give a reason.

Answer (3 marks)

(a) (i) Xylem (ii) Phloem

(b) During the day the stomata are open and water evaporates from the cells of the leaves (transpiration). This loss of water creates a suction which pulls water up from the xylem cells of the roots through the xylem of the stem; this transpiration pull is the major driving force during the day. At night the stomata are closed and there is little transpiration, so water moves up mainly by root pressure, which is a much weaker effect.

(c) The transport of food to the roots will be affected. Food made in the leaves is carried downward (translocation) through the phloem, which has been removed in the ring, so food cannot reach the roots (in time the roots will starve). Water and minerals continue to rise because the xylem is intact.

Marking: (a) Xylem and phloem – ½ + ½ mark · (b) Day: open stomata, transpiration creates suction (transpiration pull) – ½ mark; night: little transpiration, only root pressure – ½ mark · (c) Food transport to roots stopped (phloem removed); water transport continues through intact xylem – 1 mark

Examiner tip: In (c) link each transport to its tissue: food – phloem (removed), water – xylem (intact). Naming only the effect without the reason gets ½ mark.

14 The residents of a housing society in Pune collected the following waste in one week: vegetable peels, plastic milk pouches, dry leaves, glass bottles, old newspapers and aluminium foil.

(a) Classify these wastes into biodegradable and non-biodegradable.

(b) Why should the plastic milk pouches never be put into the compost pit along with the vegetable peels?

(c) The society wants to make manure for its garden on its own premises. Which of the above wastes can be used, and why?

Answer (3 marks)

(a) Biodegradable: vegetable peels, dry leaves, old newspapers.
Non-biodegradable: plastic milk pouches, glass bottles, aluminium foil.

(b) Plastic is non-biodegradable – it is not broken down by decomposers (bacteria, fungi). It would stay in the compost and soil for a long time, spoil the manure and harm the soil and the organisms living in it.

(c) Vegetable peels, dry leaves and old newspapers – these are biodegradable; decomposers such as bacteria and fungi break them down into simple substances that enrich the soil (manure).

Marking: (a) Correct classification – 1 mark (½ for each group) · (b) Not broken down by decomposers – ½ mark; persists and harms soil/compost – ½ mark · (c) Correct wastes with reason (broken down by decomposers) – 1 mark

Examiner tip: Paper is biodegradable; aluminium foil and glass are not. Name 'decomposers (bacteria, fungi)' in (c).

Q.15 Case-based question. (4 marks) **[4]**

15 Fourteen-year-old Pooja lives in a hilly village where most of the food is grown locally. She noticed a swelling in her neck. The doctor at the primary health centre said it was goitre and advised the family to use iodised salt. Pooja's grandfather visits the same doctor because he has a high level of sugar in his blood; he has been asked to control his diet and take medicines regularly.

(A) Which hormone is not being made in sufficient amount in Pooja's body? Why is iodine needed for it? (1)

(B) Name the hormone whose deficiency causes the grandfather's condition, and the gland that secretes it. (1)

Attempt either sub-part C or D.

(C) Explain how the timing and amount of the hormone named in (B) released into the blood are regulated. (2)

OR

(D) One morning a stray dog suddenly chased Pooja on her way to school and her heart began to beat very fast. Name the hormone and the gland responsible, and describe two changes this hormone brings about to prepare her body to deal with the situation. (2)

Answer (4 marks)

(A) Thyroxin (made by the thyroid gland). Iodine is essential for the thyroid gland to make thyroxin, which regulates carbohydrate, protein and fat metabolism in the body. Deficiency of iodine leads to goitre.

(B) Insulin, secreted by the pancreas. (Its deficiency causes diabetes.)

(C) By a feedback mechanism: when the sugar level in blood rises, it is detected by the cells of the pancreas, which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.

OR

(D) Adrenaline, secreted by the adrenal glands directly into the blood. Changes (any two): the heart beats faster, so more oxygen is supplied to the muscles; blood to the digestive system and skin is reduced because the muscles around small arteries in these organs contract, diverting blood to the skeletal muscles; the breathing rate increases because of contractions of the diaphragm and rib muscles.

Marking: (A) Thyroxin – ½ mark; role of iodine – ½ mark · (B) Insulin – ½ mark; pancreas – ½ mark · (C) Rise in blood sugar detected by pancreas → more insulin – 1 mark; fall in sugar → less insulin (feedback) – 1 mark · OR (D) Adrenaline and adrenal gland – 1 mark (½ + ½); two changes – ½ + ½ mark

Examiner tip: In (C) use the term 'feedback mechanism' and describe both the rise and the fall of blood sugar.

Q.16 Long answer question. (5 marks) **[5]**

16 **Attempt either option A or B.**

A. With reference to reproduction in human beings:

I. Name the part of the female reproductive system where (a) fertilisation of the egg takes place and (b) the fertilised egg (zygote) gets implanted. (1)

II. The embryo growing inside the mother's body cannot take in food or oxygen on its own, and the blood of the mother does not flow into the embryo. Name the special tissue through which the embryo obtains glucose and oxygen, and describe how its structure helps in the exchange of materials between the mother and the embryo. (2)

III. About how long does the development of the child inside the mother's body take, and how is the child born at the end of this period? (1)

IV. Why are the testes located outside the abdominal cavity, in the scrotum? (1)

OR

B. With reference to nutrition in human beings:

I. Name the three substances secreted by the gastric glands in the wall of the stomach. (1)

II. The enzyme pepsin can act only in an acidic medium. Which substance secreted in the stomach provides this medium, and why is the inner lining of the stomach normally not harmed by it? (1)

III. Name the enzymes present in pancreatic juice that digest (a) proteins and (b) fats. (1)

IV. In a certain disease, the finger-like projections on the inner lining of the small intestine become damaged and flattened. The patient becomes weak even though he eats enough food. Name these projections and explain why the patient becomes weak. (2)

Answer (5 marks)

A. I. (a) Oviduct (fallopian tube) (b) Lining of the uterus

II. The **placenta** – a disc-shaped special tissue embedded in the uterine wall. It contains villi on the embryo's side; on the mother's side it has blood spaces which surround the villi. This provides a large surface area for glucose and oxygen to pass from the mother's blood to the embryo. The waste substances produced by the developing embryo are removed by transfer into the mother's blood through the placenta.

III. The development of the child inside the mother's body takes approximately nine months. The child is born as a result of rhythmic contractions of the muscles in the uterus.

IV. The formation of sperms takes place in the testes, and sperm formation requires a lower temperature than the normal body temperature. The scrotum, outside the abdominal cavity, keeps the testes at this lower temperature.

OR

B. I. Hydrochloric acid, the protein-digesting enzyme pepsin, and mucus.

II. **Hydrochloric acid** creates the acidic medium which facilitates the action of pepsin. The inner lining is protected because **mucus** covers it and protects it from the action of the acid under normal conditions.

III. (a) Trypsin – digests proteins (b) Lipase – breaks down emulsified fats

IV. These are **villi**. Normally they greatly increase the surface area for absorption of digested food, and they are richly supplied with blood vessels which take the absorbed food to each and every cell of the body. When the villi are flattened, the surface area for absorption falls sharply, so much of the digested food is not absorbed into the blood; the cells do not get enough food and the patient becomes weak.

Marking: A: I (a) and (b) – ½ + ½ mark; II placenta named – ½ mark, villi on embryo's side with surrounding maternal blood spaces giving large surface area – 1 mark, glucose/oxygen in and wastes out – ½ mark; III about nine months – ½ mark, rhythmic contractions of uterus muscles – ½ mark; IV sperm formation needs lower than body temperature – 1 mark · OR B: I three substances – 1 mark (any two – ½); II hydrochloric acid – ½ mark, mucus protects the lining – ½ mark; III trypsin, lipase – ½ + ½ mark; IV villi named – ½ mark, villi normally give a large surface area with rich blood supply – ½ mark, flattened villi → less absorption of digested food → cells get too little food – 1 mark

Examiner tip: In A-II, mention both directions of exchange through the placenta (nutrients and oxygen in, wastes out); in B-IV link the flattened villi to reduced absorption – just naming villi earns only ½ mark.

SECTION B – CHEMISTRY (Q.17 to Q.23) Multiple choice questions. Select the correct option. (1 mark each) **[7]**

17 A few drops of silver nitrate solution were added to a sample of salty well water from a coastal village. A white, insoluble substance formed at once:

$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

This reaction is an example of:

(A) a combination reaction

(B) a decomposition reaction

(C) a displacement reaction

(D) a double displacement (precipitation) reaction

Answer (1 mark)

(D) a double displacement (precipitation) reaction – the ions are exchanged between the two reactants and an insoluble precipitate (AgCl) is formed.

18 The pH values of four solutions are given below.

Solution	pH
Lemon juice	2.2
Pure water	7.0
Baking soda solution	8.3
Sodium hydroxide solution	13.5

Which one of the following statements is correct?

(A) Baking soda solution turns blue litmus red.

(B) Lemon juice has the highest concentration of hydrogen ions.

(C) Sodium hydroxide solution has the highest concentration of hydrogen ions.

(D) Pure water turns red litmus blue.

Answer (1 mark)

(B). The lower the pH, the higher the concentration of H^+ ions; lemon juice has the lowest pH (2.2). Baking soda solution is basic (turns red litmus blue), NaOH has the lowest H^+ concentration and pure water is neutral.

19 A student set up four test tubes as follows:

(i) magnesium ribbon in copper sulphate solution

(ii) iron nail in zinc sulphate solution

(iii) zinc granules in copper sulphate solution

(iv) lead strip in iron(II) sulphate solution

In which test tubes will a displacement reaction take place?

(A) (i) and (iii)

(B) (ii) and (iv)

(C) (i), (ii) and (iii)

(D) (iii) only

Answer (1 mark)
(A) (i) and (iii). A more reactive metal displaces a less reactive metal from its salt solution. Reactivity order: Mg > Zn > Fe > Pb > Cu. Magnesium and zinc both displace copper; iron cannot displace zinc and lead cannot displace iron.

20 The correct IUPAC name of the compound $CH_3–CH_2–CH_2–CHO$ is:

(A) Butanal
(B) Butanone
(C) Butanol
(D) Butanoic acid

Answer (1 mark)
(A) Butanal – four carbon atoms (butane) with an aldehyde group (–CHO at the end of the chain), so the suffix '-al' is used.

21 A baker in Kolhapur adds a white powder, made by mixing a mild edible acid such as tartaric acid with compound X, to cake batter. On heating, gas Y is released, which makes the cake soft and spongy. X and Y are:

(A) sodium carbonate and hydrogen
(B) sodium hydrogencarbonate and hydrogen
(C) calcium sulphate hemihydrate and carbon dioxide
(D) sodium hydrogencarbonate and carbon dioxide

Answer (1 mark)
(D). The powder is baking powder (baking soda, $NaHCO_3$, + tartaric acid). On heating or mixing with water, carbon dioxide is produced, which makes the cake rise and become soft and spongy.

22 Consider the reaction: $H_2S + Cl_2 \rightarrow 2HCl + S$
Which one of the following statements is correct?

(A) H_2S is oxidised and Cl_2 is reduced.
(B) H_2S is reduced and Cl_2 is oxidised.
(C) Both H_2S and Cl_2 are oxidised.
(D) It is not a redox reaction, because no oxygen is involved.

Answer (1 mark)
(A). H_2S loses hydrogen, so it is oxidised; Cl_2 gains hydrogen, so it is reduced. (Oxidation = gain of oxygen or loss of hydrogen.)

23 A compound X has a high melting point, is soluble in water but insoluble in kerosene, and conducts electricity in the molten state but not in the solid state. X is most likely to be:

(A) carbon tetrachloride
(B) glucose
(C) magnesium chloride
(D) ethanol

Answer (1 mark)
(C) magnesium chloride – an ionic compound: high melting point, soluble in water, insoluble in kerosene, conducts in molten state (ions free to move) but not as a solid. The other three are covalent compounds.

Q.24 Assertion–Reason. Each question has two statements – Assertion (A) and Reason (R). Select the appropriate option (A), (B), (C) or (D) given below the question. (1 mark) **[1]**

24 **Assertion (A):** Pure ethanoic acid is often called glacial acetic acid.
Reason (R): A 5–8% solution of ethanoic acid in water is called vinegar.

(A) Both A and R are true, and R is the correct explanation of A.
(B) Both A and R are true, and R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Answer (1 mark)
(B) Both A and R are true, but R is not the correct explanation of A.
Pure ethanoic acid is called glacial acetic acid because its melting point is 290 K, so it often freezes during winters in cold climates. Vinegar being a dilute solution does not explain this name.

Q.25 Answer the following question. (2 marks) **[2]**

25 Reena added dilute nitric acid to zinc granules, expecting to collect hydrogen gas as she had done with dilute hydrochloric acid. No hydrogen gas was collected.
(a) Explain why hydrogen gas is not evolved when a metal reacts with nitric acid.
(b) Name two metals that do give hydrogen gas with very dilute nitric acid.

Answer (2 marks)
(a) Nitric acid (HNO_3) is a strong oxidising agent. It oxidises the hydrogen produced to water and itself gets reduced to oxides of nitrogen (such as N_2O, NO, NO_2).
(b) Magnesium (Mg) and manganese (Mn) react with very dilute HNO_3 to evolve hydrogen gas.
Marking: (a) HNO_3 is a strong oxidising agent – ½ mark; oxidises H_2 to water, itself reduced to nitrogen oxides – ½ mark · (b) Magnesium and manganese – ½ + ½ mark
Examiner tip: Write 'strong oxidising agent' – just saying 'nitric acid is a strong acid' gets no credit.

Q.26 – Q.27 Answer the following questions. (3 marks each) **[6]**

26 **Attempt either option A or B.**
A. An organic compound P (molecular formula $C_2H_4O_2$) is used as a preservative in pickles.
(i) Name P and write its functional group.
(ii) What will you observe when P is added to sodium hydrogencarbonate? Write the balanced chemical equation and state how you will test the gas evolved.
(iii) What happens when P reacts with sodium hydroxide solution? Write the equation, name the salt formed and the type of reaction.
OR
B. An open-chain hydrocarbon Y has the molecular formula C_3H_6.
(i) Is Y a saturated or an unsaturated hydrocarbon? Draw its structural formula and give its IUPAC name.
(ii) Y and propane (C_3H_8) are burnt separately in air. One of them burns with a clean blue flame and the other with a yellow, sooty flame. Which one gives the sooty flame? Write the balanced chemical equation for the complete combustion of propane.
(iii) Propane reacts with chlorine in the presence of sunlight. Name the type of reaction and write the equation for the formation of one product.

Answer (3 marks)
A. (i) P is ethanoic acid (acetic acid), CH_3COOH. Functional group: carboxylic acid, –COOH.
(ii) Brisk effervescence is seen as a colourless gas is evolved.

$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$

Test: pass the gas through lime water – it turns milky, showing CO_2.

(iii) Ethanoic acid reacts with sodium hydroxide to form salt and water:

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

The salt is sodium ethanoate (sodium acetate); it is a neutralisation reaction.

OR

B. (i) Unsaturated – it has a carbon–carbon double bond. Structural formula: $H_2C{=}CH{-}CH_3$ (each carbon having four bonds). IUPAC name: **propene**.

(ii) Y (propene, an unsaturated hydrocarbon) burns with a yellow, sooty flame; saturated propane gives a clean blue flame.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ + heat and light

(iii) Substitution reaction:

$C_3H_8 + Cl_2 \rightarrow C_3H_7Cl + HCl$ (in the presence of sunlight)

Marking: A: (i) name and –COOH – ½ + ½ mark; (ii) observation/equation – ½ mark, lime-water test – ½ mark; (iii) equation – ½ mark; sodium ethanoate and neutralisation – ½ mark · OR B: (i) unsaturated with structure and name propene – ½ + ½ mark; (ii) Y (propene) gives sooty flame – ½ mark, balanced combustion equation – ½ mark; (iii) substitution with equation – ½ + ½ mark

Examiner tip: Balanced equations need correct formulae of all products; in A(ii) do not forget water as a product.

27 Give reasons for the following:

(a) Riya's dentist advises her to brush her teeth after eating chocolates and sweets.

(b) When Riya's younger brother was stung by a red ant, their mother applied a paste of baking soda on the spot.

(c) After a heavy, spicy meal, Riya's grandmother complained of pain and a burning feeling in her stomach. The doctor advised her to take milk of magnesia and not a fizzy lemon drink.

Answer (3 marks)

(a) Bacteria present in the mouth produce acids by degrading sugar and food particles remaining in the mouth after eating. Tooth decay starts when the pH of the mouth falls below 5.5, as tooth enamel (calcium phosphate) gets corroded. Toothpastes, which are generally basic, neutralise the excess acid and prevent tooth decay.

(b) The ant sting injects methanoic acid, which causes pain and irritation. Baking soda (sodium hydrogencarbonate) is a mild base; it neutralises the acid and gives relief.

(c) During indigestion the stomach produces too much hydrochloric acid, which causes pain and irritation. Milk of magnesia (magnesium hydroxide) is a mild base – an antacid – which neutralises the excess acid and gives relief. A lemon drink is acidic (citric acid), so it would add to the acid instead of neutralising it.

Marking: (a) Acid from bacteria, pH below 5.5, basic toothpaste neutralises – 1 mark · (b) Methanoic acid neutralised by mild base – 1 mark · (c) Excess HCl during indigestion; milk of magnesia is a mild base (antacid) that neutralises it – ½ mark; lemon drink is acidic – ½ mark

Examiner tip: Each reason must name the chemical idea – pH 5.5, neutralisation, mild base/antacid – not just the everyday advice.

Q.28 Case-based question. (4 marks) **[4]**

28 Rajasthan has large deposits of zinc blende (ZnS), an ore of zinc. The flow chart shows the main steps used to obtain pure zinc from it.

(A) Name the process used in Step 2 and write the balanced chemical equation for it. (1)

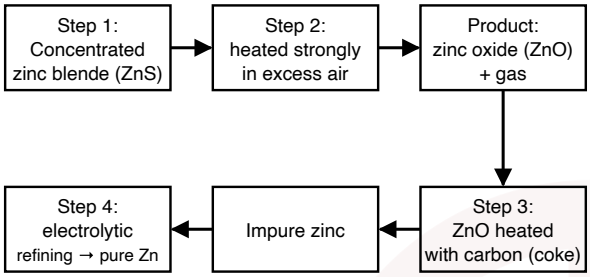
(B) Write the chemical equation for Step 3 and identify the reducing agent. (1)

Attempt either sub-part C or D.

(C) Another mine supplies an ore that contains zinc carbonate ($ZnCO_3$). How must Step 2 be changed for this ore? Name the new process, write its equation and state how the supply of air differs from that in Step 2. (2)

OR

(D) Aluminium oxide cannot be reduced to aluminium by heating it with carbon as in Step 3. Explain why, and name the method used to obtain such metals. Write the reaction taking place at the cathode when sodium is obtained from molten sodium chloride by this method. (2)



Answer (4 marks)

(A) Roasting.

$2ZnS(s) + 3O_2(g) \rightarrow 2ZnO(s) + 2SO_2(g)$ (on strong heating)

(B) $ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$

Carbon (coke) is the reducing agent (zinc oxide is reduced to zinc).

(C) The carbonate ore is changed to oxide by **calcination**:

$ZnCO_3(s) \rightarrow ZnO(s) + CO_2(g)$ (on strong heating)

In calcination the ore is heated strongly in limited air, whereas in roasting (Step 2) it is heated strongly in the presence of excess air.

OR

(D) Metals high in the reactivity series such as sodium, magnesium, calcium and aluminium have more affinity for oxygen than carbon, so carbon cannot reduce their oxides. They are obtained by electrolytic reduction (electrolysis of their molten compounds).

At cathode: $Na^+ + e^- \rightarrow Na$

Marking: (A) Roasting – ½ mark; balanced equation – ½ mark · (B) Equation – ½ mark; carbon as reducing agent – ½ mark · (C) Calcination – ½ mark; equation – ½ mark; limited air vs excess air – 1 mark · OR (D) Greater affinity for oxygen than carbon – ½ mark; electrolytic reduction – ½ mark; cathode reaction – 1 mark

Examiner tip: Roasting = sulphide ore + excess air; calcination = carbonate ore + limited air. Students often swap them.

Q.29 Long answer question. (5 marks) **[5]**

29 **Attempt either option A or B.**

A.

I. Balance the following skeletal equations and state the type of each reaction: (3)

(i) $Mg + AgNO_3 \rightarrow Mg(NO_3)_2 + Ag$

(ii) $Fe_2O_3 + CO \rightarrow Fe + CO_2$ (also name the substance oxidised and the substance reduced)

(iii) $AlCl_3 + NaOH \rightarrow Al(OH)_3 + NaCl$ (a white precipitate forms)

II. (a) When dilute hydrochloric acid is added to sodium hydroxide solution in a test tube, the test tube becomes warm. Name the type of reaction and state whether it is exothermic or endothermic. (1)

(b) Classify as exothermic or endothermic: (i) burning of LPG in a kitchen stove; (ii) decomposition of calcium carbonate into quicklime in a lime kiln. (1)

OR

B.

I. Sculptors in Pen (Raigad district) make Ganesh idols from a white powder Y which, on mixing with water, sets into a hard solid mass. Y is obtained by heating gypsum at 373 K.

(a) Name Y and write its chemical formula. (1)

(b) Write the chemical equation for the preparation of Y from gypsum. (1)

(c) When the sculptors mix Y with water and pour it into a mould, it sets into a hard idol within a short time. Name the substance formed and write the chemical equation for this change. (1)

II. (a) What is meant by water of crystallisation? Write the chemical formula of washing soda to show it. (1)

(b) Give one use of washing soda other than as a cleaning agent. (1)

Answer (5 marks)

A. I. (i) $Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag$ – displacement reaction (magnesium, being more reactive, displaces silver).

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ – redox (oxidation–reduction) reaction. CO is oxidised (gains oxygen) to CO_2; Fe_2O_3 is reduced (loses oxygen) to Fe.

(iii) $AlCl_3 + 3NaOH \rightarrow Al(OH)_3 + 3NaCl$ – double displacement (precipitation) reaction; the ions are exchanged and a white precipitate of aluminium hydroxide is formed.

II. (a) Neutralisation reaction (acid + base → salt + water: $HCl + NaOH \rightarrow NaCl + H_2O$), which is a double displacement reaction. Heat is given out, so it is exothermic.

(b) (i) Burning of LPG – exothermic (heat and light are given out). (ii) Decomposition of calcium carbonate – endothermic (heat must be supplied).

OR

B. I. (a) Y is Plaster of Paris, calcium sulphate hemihydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$.

(b) $CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O$ (heated at 373 K)

(c) Gypsum (a hard solid mass) is formed again:

$CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4 \cdot 2H_2O$

II. (a) Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. Washing soda: $Na_2CO_3 \cdot 10H_2O$ (10 molecules of water of crystallisation).

(b) (any one) Used in the glass, soap and paper industries; in the manufacture of sodium compounds such as borax; for removing permanent hardness of water.

Marking: A: I each equation balanced – ½ mark and type correct – ½ mark (3 × 1); (ii) oxidised/reduced included in its type mark; II (a) neutralisation – ½ mark, exothermic – ½ mark; (b) exothermic, endothermic – ½ + ½ mark · OR B: I (a) name and formula – ½ + ½ mark; (b) equation – 1 mark; (c) gypsum named – ½ mark, equation – ½ mark; II (a) definition with formula – ½ + ½ mark; (b) one use – 1 mark

Examiner tip: Count atoms on both sides after balancing. In B, write the half molecule of water as ½H_2O – a very common slip is writing 2H_2O for Plaster of Paris.

SECTION C – PHYSICS (Q.30 to Q.31) Multiple choice questions. Select the correct option. (1 mark each) **[2]**

30 A large mirror is fixed at a sharp bend on a ghat road so that drivers can see vehicles coming from the other side. The mirror is convex. The image formed by it is always:

(A) real, inverted and diminished
(B) virtual, erect and diminished
(C) virtual, erect and enlarged
(D) real, erect and of the same size

Answer (1 mark)
(B) virtual, erect and diminished. A convex mirror always gives such an image, and it gives a much wider field of view – useful at blind turns.

31 Two wires P and Q are made of the same copper. Wire Q is twice as long as wire P and has twice the diameter of P. The ratio of the resistance of Q to that of P is:

(A) 1 : 2
(B) 2 : 1
(C) 1 : 4
(D) 4 : 1

Answer (1 mark)
(A) 1 : 2. $R = \rho l/A$ and $A \propto d^2$. For Q, length is doubled (×2) and area becomes 4 times (÷4), so $R_Q/R_P = 2/4 = 1/2$.

Q.32 Assertion–Reason. Each question has two statements – Assertion (A) and Reason (R). Select the appropriate option (A), (B), (C) or (D) given below the question. (1 mark) **[1]**

32 **Assertion (A):** The sky appears blue on a clear day.
Reason (R): Blue light has a longer wavelength than red light, so it is scattered more by the particles in the atmosphere.

(A) Both A and R are true, and R is the correct explanation of A.
(B) Both A and R are true, and R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.

Answer (1 mark)
(C) A is true but R is false.
The sky appears blue because the fine particles in air scatter blue light (shorter wavelength) much more strongly than red light. Blue light has a **shorter** wavelength than red, so R is false.

Q.33 – Q.34 Answer the following questions. (2 marks each) **[4]**

33 A candle flame is placed 30 cm in front of a thin lens. A sharp image of the flame is obtained on a screen placed 60 cm behind the lens.
(a) Is the lens converging or diverging? Give a reason.
(b) Find the focal length and the power of the lens.

Answer (2 marks)
(a) **Converging (convex) lens**. The image is obtained on a screen, so it is real; a diverging (concave) lens always forms a virtual image of a real object.
(b) Using the New Cartesian sign convention: u = –30 cm, v = +60 cm

Lens formula: $1/v - 1/u = 1/f$

$1/f = 1/60 - 1/(-30) = 1/60 + 2/60 = 3/60 = 1/20$

f = **+20 cm** = +0.20 m

P = 1/f (in metres) = 1/0.20 = **+5 D**

Marking: (a) Converging lens with reason (real image on screen) – ½ mark · (b) Correct formula and signs – ½ mark; f = +20 cm – ½ mark; P = +5 D – ½ mark

Examiner tip: Use the lens formula 1/v – 1/u = 1/f (not the mirror formula) and convert f to metres before finding power.

34 **Attempt either option A or B.**

A. I. Why is the wire of an electric fuse made of a material of low melting point, and how is the fuse connected with the device it protects?

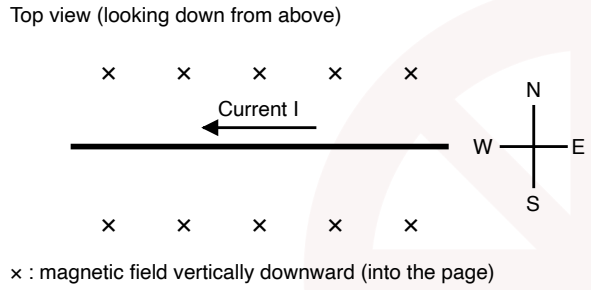
II. The heating element of an electric geyser produces 1.32×10^6 J of heat in 10 minutes when a current of 10 A flows through it. Calculate the resistance of the element.

OR

B. A straight horizontal wire carries a current from east to west in a magnetic field that is directed vertically downward, as shown in the figure (top view).

I. State Fleming's left-hand rule.

II. Using the rule, find the direction of the force acting on the wire.



Answer (2 marks)

A. I. When an unduly high current flows, the fuse wire heats up (Joule heating) and melts quickly because of its low melting point, breaking the circuit and protecting the device. The fuse is connected in series with the device.

II. $H = I^2Rt$, so $R = H/(I^2t)$, with t = 10 × 60 = 600 s

$R = (1.32 \times 10^6)/((10)^2 \times 600) = (1.32 \times 10^6)/(6 \times 10^4)$ = **22 Ω**

OR

B. I. Stretch the thumb, forefinger and middle finger of the left hand so that they are mutually perpendicular. If the forefinger (first finger) points in the direction of the magnetic field and the middle (second) finger in the direction of current, then the thumb points in the direction of motion or the force acting on the conductor.

II. Forefinger vertically downward (field), middle finger towards west (current) → thumb points towards the **south**. The force on the wire is towards the south.

Marking: A: I melts on high current, connected in series – ½ + ½ mark; II R = $H/(I^2t)$ with substitution – ½ mark, R = 22 Ω – ½ mark · OR B: I statement – 1 mark; II south – 1 mark

Examiner tip: Convert minutes to seconds (t = 600 s). In B, the field into the page in the top view is 'vertically downward'.

Q.35 – Q.37 Answer the following questions. (3 marks each) **[9]**

35 A jeweller uses a concave mirror of focal length 4 cm to inspect the fine engraving on a ring placed 3 cm in front of the mirror.

(a) Find the position of the image.

(b) Find the magnification and state the nature of the image.

(c) Why is a concave mirror, and not a convex mirror, suitable for this purpose?

Answer (3 marks)

Using the New Cartesian sign convention: f = –4 cm, u = –3 cm

(a) Mirror formula: 1/v + 1/u = 1/f

1/v = 1/f – 1/u = –1/4 + 1/3 = (–3 + 4)/12 = 1/12

v = **+12 cm**, i.e. the image is formed 12 cm behind the mirror.

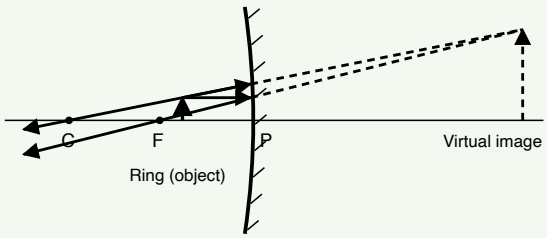
(b) m = –v/u = –(12)/(–3) = **+4**

The image is virtual, erect and magnified (4 times the size of the engraving).

(c) When the object is placed between the pole and the focus of a concave mirror, it gives an enlarged, erect image, so the jeweller sees a large, upright image of the engraving. A convex mirror always forms a diminished image.

(Ray diagram for reference – not required in the answer.)

Concave mirror, object between P and F (not to scale)



Marking: (a) Correct formula and signs – ½ mark; v = +12 cm (behind mirror) – ½ mark · (b) m = +4 – ½ mark; virtual, erect, magnified – ½ mark · (c) Concave mirror gives enlarged erect image when object is within F; convex gives diminished image – 1 mark

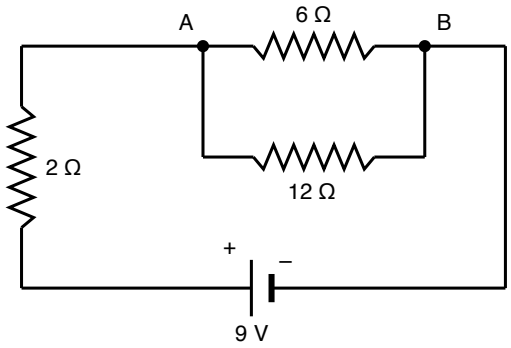
Examiner tip: Put u and f as negative for a concave mirror. A positive v means the image is behind the mirror (virtual).

36 In the circuit shown, a 9 V battery is connected to a 2 Ω resistor in series with a parallel combination of 6 Ω and 12 Ω resistors. Neglect the resistance of the battery and the connecting wires.

(a) Find the equivalent resistance of the circuit.

(b) Find the current drawn from the battery and the potential difference across the 2 Ω resistor.

(c) Find the current through the 6 Ω and the 12 Ω resistors.



Answer (3 marks)

(a) Parallel part: $1/R_p = 1/6 + 1/12 = (2 + 1)/12 = 3/12 \rightarrow R_p = 4\ \Omega$

Equivalent resistance $R = 2 + 4 =$ **6 Ω**

(b) $I = V/R = 9/6 =$ **1.5 A**

Potential difference across 2 Ω: $V_1 = IR = 1.5 \times 2 =$ **3 V**

(c) Potential difference across the parallel part (between A and B) = 9 – 3 = 6 V (also = 1.5 × 4 = 6 V)

Current through 6 Ω = 6/6 = **1 A**; current through 12 Ω = 6/12 = **0.5 A**

(Check: 1 + 0.5 = 1.5 A, the total current.)

Marking: (a) $R_p = 4\ \Omega$ – ½ mark; R = 6 Ω – ½ mark · (b) I = 1.5 A – ½ mark; 3 V – ½ mark · (c) 1 A and 0.5 A – ½ + ½ mark

Examiner tip: Find the p.d. across the parallel part first; the same p.d. acts across each branch, not the same current.

37 Mr. Kulkarni plugs a 2200 W induction cooktop and an 880 W microwave oven, through a multi-plug adaptor, into a single kitchen socket that is on the 5 A circuit of his house. The supply voltage is 220 V.

(a) What is the maximum power that can be drawn safely from this 5 A circuit? Find the total current when both appliances work together, and state what will happen to the fuse of this circuit.

(b) Houses commonly have circuits of 5 A and 15 A current rating. Which of the two appliances can be used safely on the 5 A circuit, and which one must be connected to the 15 A circuit? Support your answer with a calculation.

(c) Name the wire, and the colour of its insulation, that must be connected to the metal body of the cooktop for the user's safety.

Answer (3 marks)

(a) Maximum safe power $P = VI = 220 \times 5 =$ **1100 W**

Total power of both appliances = 2200 W + 880 W = 3080 W; $I = P/V = 3080/220 =$ **14 A**

This is much more than 5 A (overloading). The fuse wire gets heated (Joule heating), melts and breaks the circuit.

(b) Microwave oven: $I = 880/220 =$ **4 A** (less than 5 A) – it can be used safely on the 5 A circuit.

Cooktop: $I = 2200/220 =$ **10 A** (more than 5 A) – it must be connected to the **15 A** circuit, which is meant for appliances with higher power ratings.

(c) The **earth wire**, which has **green** insulation. (It provides a low-resistance path, so any leakage of current to the metal body does not give the user a severe shock.)

Marking: (a) 1100 W and I = 14 A – ½ mark; fuse melts and breaks the circuit (overloading / Joule heating) – ½ mark · (b) Microwave 4 A → 5 A circuit – ½ mark; cooktop 10 A → 15 A circuit – ½ mark · (c) Earth wire – ½ mark; green insulation – ½ mark

Examiner tip: Add the powers of appliances working together before using I = P/V; give the conclusion about the fuse, not just the number.

Q.38 Case-based question. (4 marks) **[4]**

38 The Deshmukh family in Nashik uses the following electrical appliances every day. The electricity board charges ₹ 8 per unit (kWh).

Appliance	Number	Power of each	Use per day
LED bulb	5	10 W	6 h
Ceiling fan	2	50 W	8 h
Television	1	100 W	4 h

They also have an electric iron rated 880 W, 220 V.

(A) What is meant by 1 unit of electrical energy? Express it in joules. (1)

(B) Calculate the current drawn by the iron and its resistance when it is operated at 220 V. (1)

Attempt either sub-part C or D.

(C) Calculate the electrical energy consumed by the bulbs, fans and television in 30 days, and the cost of this energy. (2)

OR

(D) Earlier the family used five 40 W filament bulbs in place of the 10 W LED bulbs, for the same 6 hours a day. How many extra units did the bulbs consume in 30 days, and how much extra did the family pay? (2)

Answer (4 marks)

(A) 1 unit is 1 kilowatt hour (kWh) – the energy used in one hour at the rate of 1000 W (1 kW).

1 kWh = 1000 W × 3600 s = **3.6×10^6 J**

(B) I = P/V = 880/220 = **4 A**; R = V/I = 220/4 = **55 Ω**

(C) Energy per day:

Bulbs = 5 × 10 W × 6 h = 300 Wh

Fans = 2 × 50 W × 8 h = 800 Wh

TV = 1 × 100 W × 4 h = 400 Wh

Total per day = 1500 Wh = 1.5 kWh

In 30 days = 1.5 × 30 = **45 kWh (45 units)**

Cost = 45 × ₹ 8 = **₹ 360**

OR

(D) Extra power = 5 × (40 W – 10 W) = 150 W = 0.15 kW

Extra energy in 30 days = 0.15 kW × 6 h × 30 = **27 kWh (27 units)**

Extra cost = 27 × ₹ 8 = **₹ 216**

Marking: (A) Definition – ½ mark; 3.6×10^6 J – ½ mark · (B) 4 A – ½ mark; 55 Ω – ½ mark · (C) Daily energy 1.5 kWh – 1 mark; 45 units – ½ mark; ₹ 360 – ½ mark · OR (D) Extra power 150 W – ½ mark; 27 extra units – 1 mark; ₹ 216 – ½ mark

Examiner tip: Change Wh to kWh (divide by 1000) before multiplying by the rate. 1 unit = 1 kWh, not 1 W.

Q.39 Long answer question. Attempt either option (A) or (B). (5 marks) **[5]**

(A) Seventy-year-old Mr. Patil can see distant hills clearly, but he can no longer read a newspaper held at 25 cm from his eyes; he has to hold it much farther away. His granddaughter Riya, a Class 10 student, reads her book easily but cannot read the writing on the blackboard clearly from the last bench.

I. Name the defect of vision Riya has. Where is the image of the blackboard formed in her eye? (1)

II. Mr. Patil's defect is caused by ageing. Name this defect and state its cause. (1)

III. A few years later Mr. Patil also finds it difficult to see distant objects clearly. What type of spectacle lenses will he then need? Describe the two parts of such a lens. (1)

IV. Difficulty in seeing nearby objects is corrected in the same way as hypermetropia. Draw ray diagrams to show (a) how a hypermetropic eye forms the image of an object placed at N, the near point of a normal eye, and (b) how this defect is corrected. (2)

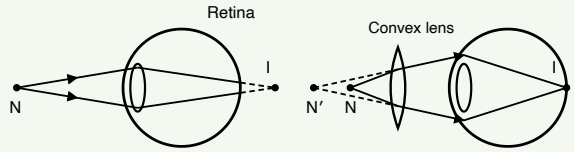
Answer (5 marks)

I. **Myopia** (near-sightedness). The image of the distant blackboard is formed **in front of the retina**.

II. **Presbyopia**. The power of accommodation of the eye decreases with ageing; it arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens, so the near point recedes.

III. **Bi-focal lenses**. The upper portion is a concave lens, which helps in distant vision; the lower part is a convex lens, which helps in near vision (reading).

IV. See figure: (a) rays from N are focused at a point behind the retina, because the near point of this eye (N′) is farther than 25 cm; (b) a convex lens of suitable power makes the rays from N appear to come from N′, so the eye lens now focuses them on the retina.



(a) Hypermetropic eye: image of N formed behind the retina

(b) Corrected with a convex lens: image formed on the retina

Marking: I myopia – ½ mark; image in front of retina – ½ mark · II presbyopia – ½ mark; weakening of ciliary muscles / reduced flexibility of eye lens – ½ mark · III bi-focal lenses – ½ mark; upper concave for distant vision, lower convex for near vision – ½ mark · IV each correct ray diagram with arrows and labels – 1 + 1 mark

Examiner tip: In ray diagrams, show arrow-heads on rays and mark N, N′ and the retina; for hypermetropia the image falls behind the retina and the correcting lens is convex.

OR

(B) Light travels through a transparent plastic at a speed of 1.8×10^8 m/s. (Speed of light in vacuum = 3×10^8 m/s)

I. Find the refractive index of the plastic. (1)

II. A ray of light passes obliquely from air into this plastic. Will it bend towards or away from the normal? Give a reason. (1)

III. Draw a labelled ray diagram to show the refraction of a ray of light through a rectangular glass slab. Mark the angle of incidence, angle of refraction, angle of emergence and the lateral displacement. (2)

IV. Why is the emergent ray parallel to the incident ray in the case of a rectangular glass slab? (1)

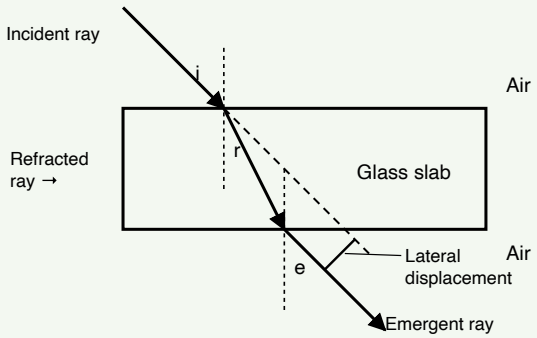
Answer (5 marks)

I. $n = c/v = (3 \times 10^8)/(1.8 \times 10^8) = 5/3 \approx$ **1.67**

II. It bends **towards the normal**. The ray goes from an optically rarer medium (air) to an optically denser medium (plastic, $n \approx 1.67$), in which light travels more slowly.

III. See figure: the ray bends towards the normal on entering the glass and away from the normal on leaving it; ∠i, ∠r, ∠e and the lateral displacement are marked.

IV. The extent of bending of the ray at the opposite parallel faces (air–glass and glass–air) is equal and opposite, so the angle of emergence equals the angle of incidence (∠e = ∠i) and the emergent ray is parallel to the incident ray (only shifted sideways).



Marking: I $n = c/v = 5/3 \approx 1.67$ – 1 mark · II towards the normal – ½ mark; rarer to denser / slower in plastic – ½ mark · III correct diagram – 1 mark, labels (i, r, e, lateral displacement) – 1 mark · IV equal and opposite bending, ∠e = ∠i – 1 mark

Examiner tip: Draw the normals at both faces; the emergent ray must be parallel to the incident ray, and the lateral displacement is the perpendicular distance between them.

All the best for your exam!