SCIENCE – CODE NO. 086

SAMPLE QUESTION PAPER – 2 : STEP-BY-STEP SOLUTIONS & MARKING SCHEME
CLASS – X (2026-27)

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

General Instructions:

(i) This question paper consists of **39** questions in **3** sections. **Section A is Biology** (Q.1–16, 30 marks), **Section B is Chemistry** (Q.17–29, 25 marks) and **Section C is Physics** (Q.30–39, 25 marks).

(ii) All questions are compulsory. However, an internal choice is provided in some questions. A student is expected to attempt only one of the alternatives in such questions.

(iii) Multiple choice and Assertion-Reason questions carry 1 mark each. Other questions carry 2, 3, 4 (case/source-based) or 5 marks, as indicated against each question.

(iv) Answers should be brief and to the point. Draw neat, labelled diagrams wherever required.

(v) Use of calculators is not permitted.

SECTION – A (BIOLOGY)

Questions 1 to 16

1. Which of the following organisms obtains its nutrition from a living plant without killing it? **1**

A. Amoeba
B. Cuscuta (amar-bel)
C. Mushroom
D. Paramoecium

Solution:

Ans: B – Cuscuta is a parasite: it derives nutrition from plants without killing them. Mushroom breaks down food outside its body; Amoeba and Paramoecium take in food particles. [1]

2. The enzyme that digests proteins in the acidic medium of the stomach is **1**

A. trypsin
B. pepsin
C. lipase
D. salivary amylase

Solution:

Ans: B – Gastric glands release HCl and pepsin; the acid creates the medium in which pepsin acts. Trypsin acts in the small intestine. [1]

3. Blood flows only in one direction in the veins because **1**

A. veins have thick, elastic walls
B. veins contain valves
C. blood in veins is under very high pressure
D. veins are one-cell thick

Solution:

Ans: B – Veins do not need thick walls since blood is no longer under pressure; their valves ensure one-way flow. [1]

4. A person shows a swollen neck. The hormone, the gland and the dietary deficiency most likely involved are **1**

A. insulin – pancreas – sugar
B. thyroxin – thyroid – iodine
C. growth hormone – pituitary – protein
D. adrenaline – adrenal – iron

Solution:

Ans: B – Iodine is needed by the thyroid to make thyroxin; its deficiency may cause goitre, with a swollen neck. [1]

5. A Planaria is cut into several pieces and each piece grows into a complete organism. This is called **1**

A. budding
B. fragmentation
C. regeneration
D. multiple fission

Solution:

Ans: C – Regeneration is carried out by specialised cells that proliferate and develop into various cell types and tissues. [1]

6. A man with blood group A marries a woman with blood group O, and their daughter has blood group O. From this information alone we can conclude that **1**

A. blood group A is dominant
B. blood group O is dominant
C. both are equally dominant
D. it is not enough to decide which trait is dominant

Solution:

Ans: D – One family with one child is too small a sample; the result fits both possibilities, so a larger data set is needed. [1]

7. Which of the following is NOT a natural ecosystem? **1**

A. Pond
B. Forest
C. Aquarium
D. Lake

Solution:

Ans: C – An aquarium, like a garden or crop-field, is human-made. [1]

The following question(s) consist of two statements – Assertion (A) and Reason (R). Answer by selecting the appropriate option given below:

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.

8. **Assertion (A):** The ventricles of the human heart have thicker muscular walls than the atria. **1**

Reason (R): The ventricles have to pump blood into various organs of the body.

Solution:

Ans: A – Both true; R explains A. [1]

9. **Assertion (A):** Abscisic acid is a plant hormone that promotes growth of the stem. **1**

Reason (R): Plant hormones are synthesised at places away from where they act and diffuse to the area of action.

Solution:

Ans: D – A is false: abscisic acid **inhibits** growth (its effects include wilting of leaves). R is true. [1]

10. A. Why is it necessary to separate oxygenated and deoxygenated blood in mammals and birds? **2**

B. Which blood cells help to plug leaks at a point of injury, and why is this important?

Solution:

A. Separation allows a **highly efficient supply of oxygen** to the body, which mammals and birds need because of their **high energy needs** to constantly maintain their body temperature. [1]

B. Platelets – they help the blood to **clot** at the point of injury, minimising blood loss and preventing a fall in pressure that would reduce the efficiency of pumping. [1]

11. Students to attempt either option A or B. **2**

A. State one function each of thyroxin and growth hormone. What disorder results from deficiency of growth hormone in childhood?

OR

B. What happens at a synapse between two neurons? Why does a nerve impulse travel only in one direction across it?

Solution:

A. Thyroxin regulates **carbohydrate, protein and fat metabolism** for balanced growth. [½] Growth hormone regulates **growth and development** of the body. [½] Deficiency in childhood → **dwarfism**. [1]

OR

B. At the end of the axon the electrical impulse sets off the **release of chemicals**; these cross the gap (synapse) and start a similar electrical impulse in a **dendrite** of the next neuron. [1] Only the axon end releases these chemicals and only the dendrite of the next neuron is set off by them, so the impulse passes in **one direction**. [1]

12. A. Why does the lining of the uterus become thick and spongy every month? **2**

B. What happens to this lining if the egg is not fertilised? Name the process and state its approximate duration.

Solution:

A. The uterus prepares itself every month to **receive and nourish a fertilised egg**; the lining thickens and is richly supplied with blood. [1]

B. The lining is not needed, so it **slowly breaks and comes out** through the vagina as blood and mucus – **menstruation**, lasting about **2 to 8 days**. [1]

13. Study the flow chart showing the break-down of glucose by different pathways. **3**

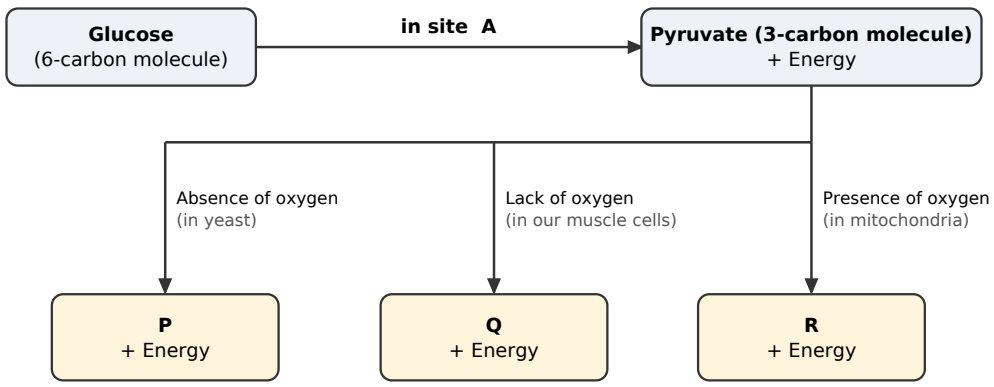


Figure: Break-down of glucose by various pathways

A. Name site A and the products R.

B. In which organism does pathway P occur and what is this process called?

C. Name the molecule in which the energy released is stored. Why is pathway R most useful for an active organism?

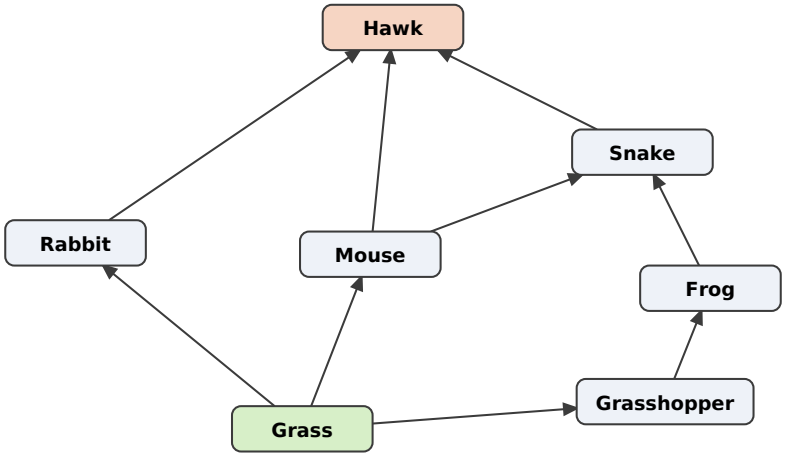
Solution:

A. Site A = **cytoplasm**; R = **carbon dioxide + water** (aerobic, in mitochondria). [½ + ½]

B. In **yeast**; P = ethanol + CO_2; the process is **fermentation** (anaerobic respiration). [½ + ½]

C. ATP (energy currency of the cell). [½] The aerobic pathway releases **a lot more energy** than the anaerobic ones, meeting the high energy needs of an active organism. [½]

14. Study the food web of a grassland ecosystem shown below. **3**



Arrows point from the organism eaten to the organism that eats it

A. Write one food chain from this web that has exactly four trophic levels.

B. If a non-biodegradable pesticide is sprayed on the grass, which organism will show the highest concentration of it? Why?

C. What will happen to the grass if all the rabbits, mice and grasshoppers are removed?

Solution:

A. Grass → Mouse → Snake → Hawk (or Grass → Grasshopper → Frog → Snake). [1]

B. The **hawk** – it occupies the top trophic level, and non-degradable chemicals accumulate progressively at each level (**biological magnification**). [1]

C. With no herbivores (primary consumers) to eat it, the grass will **grow unchecked / increase**, and the carnivores that depend on the herbivores will decline – the ecosystem's balance is disturbed. [1]

15. **Case study:** Asha crossed a pure-breeding pea plant having round, yellow seeds (RRYY) with a pure-breeding plant having wrinkled, green seeds (rryy). The F_1 plants were self-pollinated, and 1600 seeds were obtained in the F_2 generation. **4**

A. What type of seeds will the F_1 plants produce? Write their genotype. **(1)**

B. How many of the 1600 F_2 seeds are expected to be wrinkled and green? **(1)**

Attempt either sub-part C or D.

C. Which new combinations of traits, not seen in either parent, appear in F_2? How many such seeds are expected in all, and what does this show? **(2)**

OR

D. Write the four kinds of gametes formed by the F_1 plants. Why must the genes for seed shape and seed colour be on separate chromosomes for these results? **(2)**

Solution:

A. All F_1 seeds are **round and yellow**; genotype **RrYy** (round and yellow are dominant). [1]

B. F_2 ratio round-yellow : round-green : wrinkled-yellow : wrinkled-green = 9 : 3 : 3 : 1. Wrinkled-green = 1/16 × 1600 = **100**. [1]

C. New combinations: **round-green** (3/16 × 1600 = 300) and **wrinkled-yellow** (300) → **600** seeds in all. [1] This shows that the traits for seed shape and seed colour are **inherited independently**. [1]

OR

D. Gametes: **RY, Ry, rY, ry**. [1] Each gene set is present as separate chromosomes, and each germ cell takes one chromosome from each pair independently; if R and Y were on one piece of DNA they would always be inherited together and new combinations could not form. [1]

16. Students to attempt either option A or B. **5**

A. I. Trace the digestion of starch in a meal of rice, from the mouth to the small intestine, naming the enzymes or juices involved. **(3)**

II. How are the villi of the small intestine suited to their function? Why does the stomach wall not get damaged by its own acid? **(2)**

OR

B. I. Name the three major regions of the human brain. State the functions of the fore-brain, the cerebellum and the medulla. **(3)**

II. Give two differences between nervous and hormonal control in animals. **(2)**

Solution:

A. I. Mouth: food is chewed and mixed with **saliva**; **salivary amylase** breaks starch into simple sugar. [1] Food passes through the oesophagus by **peristalsis** to the stomach and then to the small intestine. [½] Small intestine: **pancreatic juice** continues the digestion and **intestinal juice** finally converts complex carbohydrates into **glucose**, which is absorbed. [1½]

II. Villi are numerous finger-like projections that **increase the surface area** for absorption and are **richly supplied with blood vessels**. [1] **Mucus** released by gastric glands protects the inner lining of the stomach from the acid. [1]

OR

B. I. Fore-brain, mid-brain and hind-brain. [½] Fore-brain: main thinking part – receives sensory impulses, interprets them in association areas and controls voluntary muscles; has the hunger centre. [1] Cerebellum: **precision of voluntary actions**, **posture and balance**. [½+½] Medulla: **involuntary actions** – blood pressure, salivation, vomiting. [½]

II. (i) Nervous control uses **electrical impulses** and is **fast**; hormonal control uses **chemicals** and is slower. (ii) Impulses reach only cells connected by nervous tissue; hormones travel in the blood and **can reach all cells**, and act steadily and persistently. [1 + 1]

SECTION – B (CHEMISTRY)

Questions 17 to 29

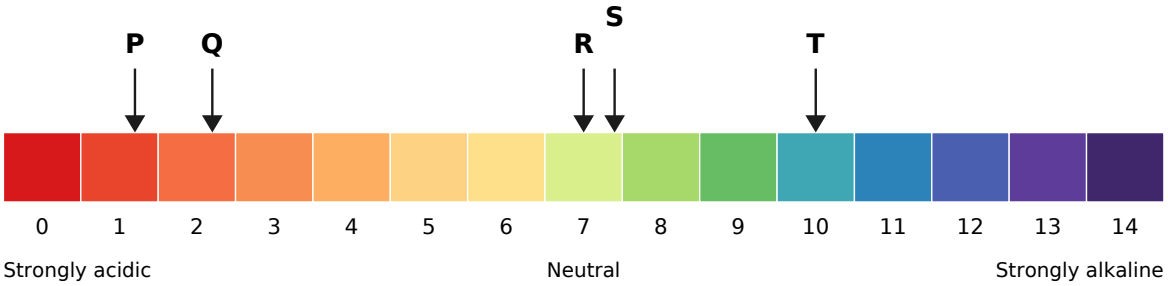
17. When green ferrous sulphate crystals are heated strongly in a dry boiling tube, the gases evolved are **1**

A. SO_2 and SO_3
B. SO_2 and O_2
C. SO_3 and H_2
D. H_2S and SO_2

Solution:

Ans: A – $2FeSO_4(s) \rightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$; smell of burning sulphur. [1]

18. Five solutions were tested with universal indicator and their pH values marked P, Q, R, S and T on the scale shown. Which of them could be milk of magnesia, and which has the highest hydrogen ion concentration? **1**



A. T; P
B. P; T
C. R; S
D. S; Q

Solution:

Ans: A – Milk of magnesia is a mild base (pH ≈ 10) → T. The lowest pH (P ≈ 1) means the highest H^+ concentration. [1]

19. An element X has electronic configuration 2, 8, 2 and an element Y has 2, 8, 7. The compound formed between them has the formula and type of bonding **1**

A. XY, covalent
B. XY_2, ionic
C. X_2Y, ionic
D. XY_2, covalent

Solution:

Ans: B – X (Mg) loses 2 electrons → X^{2+}; each Y (Cl) gains 1 → Y^-. Two Y^- balance one X^{2+}: XY_2 ($MgCl_2$), an ionic compound. [1]

20. Sodium, magnesium and calcium are obtained by **1**

A. heating their oxides with carbon
B. heating their sulphides in air
C. electrolytic reduction of their molten chlorides
D. displacement by copper from their salt solutions

Solution:

Ans: C – These metals have more affinity for oxygen than carbon, so they are obtained by electrolysis of their molten chlorides; the metal deposits at the cathode. [1]

21. The total number of single covalent bonds in a molecule of propane (C_3H_8) is **1**

A. 8
B. 10
C. 11
D. 12

Solution:

Ans: B – C–C bonds = 2; C–H bonds = 8; total = 10. [1]

22. Marble chips react with dilute hydrochloric acid with effervescence. The gas evolved and the test for it are **1**

A. hydrogen – burns with a pop sound
B. carbon dioxide – turns lime water milky
C. oxygen – relights a glowing splint
D. chlorine – bleaches moist litmus

Solution:

Ans: B – $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$; $Ca(OH)_2 + CO_2 \rightarrow CaCO_3$ (white ppt) + H_2O. [1]

23. Packets of chips are flushed with nitrogen gas to **1**

A. make the chips crispy by heating

B. prevent oxidation of fats and oils (rancidity)

C. kill germs present in the chips

D. add flavour to the chips

Solution:

Ans: B – Nitrogen is unreactive and keeps oxygen away, preventing rancidity. [1]

The following question(s) consist of two statements – Assertion (A) and Reason (R). Answer by selecting the appropriate option given below:

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

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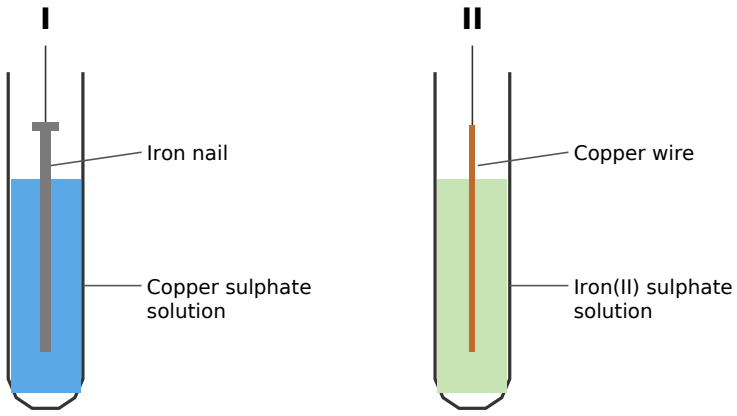
24. **Assertion (A):** Copper does not liberate hydrogen gas when added to dilute hydrochloric acid. **1**

Reason (R): Copper is placed below hydrogen in the reactivity series.

Solution:

Ans: A – Only metals above hydrogen can displace hydrogen from dilute acids. [1]

25. A student set up the two test tubes shown and left them for about 20 minutes. **2**



Both test tubes left undisturbed for about 20 minutes

A. In which test tube does a reaction take place? Write the balanced equation and state two observations.

B. What does this show about the relative reactivity of iron and copper?

Solution:

A. In test tube **I**:

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

Observations: the iron nail gets a **brownish coating** of copper; the **blue colour** of the solution **fades** (pale green $FeSO_4$). [½ + ½ + ½]

B. Iron is more reactive than copper – it displaces copper, while copper cannot displace iron (no change in tube II). [½]

26. Students to attempt either option A or B. **3**

A. (i) Explain, with the help of micelle formation, how soap removes oily dirt. (ii) Why is a larger amount of soap needed for washing in hard water, and how do detergents overcome this?

OR

B. (i) What is a homologous series? (ii) Write the molecular formulae and names of the second and third members of the alkene series. (iii) Why do members of a homologous series show similar chemical properties but gradually varying physical properties?

Solution:

A. (i) A soap molecule has an **ionic (hydrophilic) end** that interacts with water and a **long hydrocarbon (hydrophobic) tail** that interacts with oil. The tails gather around oily dirt with the ionic ends facing out, forming a **micelle**; the dirt collects in the centre, forms an emulsion and is rinsed away. [1½]

(ii) Soap reacts with **calcium and magnesium salts** in hard water to form an insoluble **scum**, wasting soap. Detergents' charged ends **do not form insoluble precipitates** with these ions, so they lather well. [1½]

OR

B. (i) A series of carbon compounds in which the **same functional group** replaces hydrogen in a carbon chain, successive members differing by $–CH_2–$. [1]

(ii) Second: **C_3H_6 – propene**; third: **C_4H_8 – butene** (first is C_2H_4, ethene). [1]

(iii) Chemical properties are decided by the **functional group**, which is the same; physical properties change gradually with **increasing molecular mass**. [1]

27. Give reasons for the following: **3**

A. Calcium starts floating when it reacts with water.

B. Ionic compounds conduct electricity in the molten state but not in the solid state.

C. Hydrogen gas is not usually evolved when a metal reacts with nitric acid.

Solution:

A. Bubbles of **hydrogen gas** formed in the reaction **stick to the surface** of calcium. [1]

B. In the solid, ions are held in a **rigid structure** and cannot move; on melting, heat overcomes the attraction and the **ions move freely** to carry current. [1]

C. HNO_3 is a **strong oxidising agent**; it oxidises the H_2 produced to water and is itself reduced to oxides of nitrogen. [1]

28. **Case study:** At an orthopaedic clinic, a doctor mixes a white powder with water and wraps it around a fractured arm; within minutes it sets into a hard mass that holds the bone in place. The powder is made by heating a naturally occurring salt that contains two molecules of water of crystallisation. Unused powder is kept in an air-tight container. **4**

A. Name the white powder and write its chemical formula. **(1)**

B. Write the chemical equation for the setting of the powder with water. **(1)**

Attempt either sub-part C or D.

C. How is the powder prepared from the naturally occurring salt? Write the equation and explain why it is stored in an air-tight container. **(2)**

OR

D. Why is only half a water molecule shown in the formula of the powder? Give two other uses of this powder. **(2)**

Solution:

A. Plaster of Paris – calcium sulphate hemihydrate, **$CaSO_4 \cdot ½H_2O$**. [½ + ½]

B. $CaSO_4 \cdot ½H_2O + 1½H_2O \rightarrow CaSO_4 \cdot 2H_2O$ (gypsum, hard mass) [1]

C. By heating **gypsum** at **373 K**:

$$CaSO_4 \cdot 2H_2O \xrightarrow{373\ K} CaSO_4 \cdot ½H_2O + 1½H_2O \quad [1]$$

Moisture would make it **set into hard gypsum** in the container, making it useless. [1]

OR

D. Two formula units of $CaSO_4$ share one molecule of water, so it is written as $½H_2O$ per formula unit. [1] Uses: making **toys** and **materials for decoration**, and making **surfaces smooth** (any two). [½ + ½]

29. Students to attempt either option A or B. **5**

A. I. Identify the type of each reaction: (i) $CaCO_3 \rightarrow CaO + CO_2$ on heating; (ii) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$; (iii) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$; (iv) $CaO + H_2O \rightarrow Ca(OH)_2$. **(2)**

II. In $ZnO + C \rightarrow Zn + CO$, identify the substance oxidised and the substance reduced, giving reasons. **(1½)**

III. What is corrosion? Give one example other than rusting of iron. **(1½)**

OR

B. I. Show the formation of sodium oxide (Na_2O) by the transfer of electrons. (Atomic numbers: Na = 11, O = 8) **(2)**

II. Why do ionic compounds have high melting points and why are they hard? **(1½)**

III. What are amphoteric oxides? Write the equations showing the reaction of aluminium oxide with an acid and with a base. **(1½)**

Solution:

A. I. (i) Thermal **decomposition**; (ii) **displacement**; (iii) **double displacement** (precipitation); (iv) **combination** (exothermic). [½ × 4]

II. Carbon is oxidised – it gains oxygen to form CO. **ZnO is reduced** – it loses oxygen to form Zn. [¾ + ¾]

III. When a metal is attacked by substances around it such as moisture and acids, it **corrodes** – corrosion. [1] Example: **black coating on silver** (silver sulphide) or **green coating on copper** (basic copper carbonate). [½]

OR

B. I. Each Na (2, 8, 1) loses one electron: $Na \rightarrow Na^+ + e^-$ (2, 8). O (2, 6) gains two electrons: $O + 2e^- \rightarrow O^{2-}$ (2, 8). Two Na atoms give their electrons to one O atom: $2Na^+ + O^{2-} \rightarrow Na_2O$ (ions held by electrostatic attraction). [2]

II. Strong **electrostatic forces** between oppositely charged ions need a large amount of energy to break (high melting point) and make them hard (though brittle). [1½]

III. Metal oxides that react with both acids and bases to give salt and water. [½]

$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$; $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$ [½ + ½]

SECTION – C (PHYSICS)

Questions 30 to 39

30. The figure shows a ray of light passing through a rectangular glass slab. Which relation between the marked angles is correct? **1**

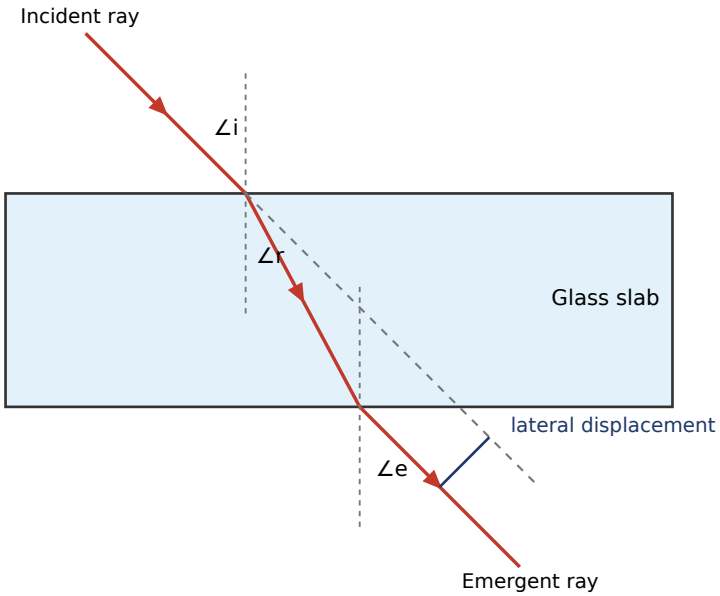


Figure: Refraction through a rectangular glass slab

A. $\angle i = \angle e$

B. $\angle i = \angle r$

C. $\angle r = \angle e$

D. $\angle i < \angle r$

Solution:

Ans: A – Refraction at two parallel faces: the ray bends towards the normal on entering and away by the same amount on leaving, so the emergent ray is parallel to the incident ray ($\angle e = \angle i$); also $\angle r < \angle i$. [1]

31. A 100 W bulb is used for 10 hours. The electrical energy consumed is **1**

A. 0.1 kW h

B. 1 kW h

C. 10 kW h

D. 1000 kW h

Solution:

Ans: B – $E = P \times t = 0.1\ kW \times 10\ h = 1\ kW\ h$ (1 unit). [1]

The following question(s) consist of two statements – Assertion (A) and Reason (R). Answer by selecting the appropriate option given below:

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

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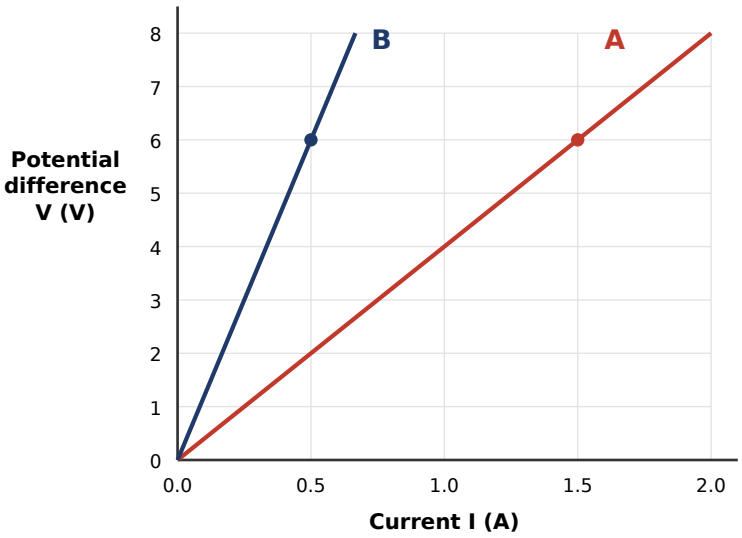
32. **Assertion (A):** Copper wires are commonly used for household electrical wiring. **1**

Reason (R): Copper has a very low electrical resistivity.

Solution:

Ans: A – Low resistivity ($1.62 \times 10^{-8}\ \Omega$ m) means little energy is wasted as heat, so copper is a good conductor for wiring. [1]

33. The V–I graphs of two wires A and B are shown. **2**



V–I graphs for two wires A and B at the same temperature

A. Find the resistance of each wire.

B. If the two wires are of the same material and the same thickness, which one is longer, and by how many times?

Solution:

A. From the marked points: $R_A = V/I = 6/1.5 =$ **4 Ω**; $R_B = 6/0.5 =$ **12 Ω**. [½ + ½]

B. $R = \rho l/A$; with the same ρ and A, $R \propto l$. $R_B/R_A = 12/4 = 3$, so **wire B is 3 times longer**. [1]

34. Students to attempt either option A or B. **2**

A. Why do stars twinkle while planets do not?

OR

B. Why does the clear sky appear blue? Why are 'danger' signal lights red in colour?

Solution:

A. Starlight is continuously refracted by the atmosphere, whose conditions keep changing, so the apparent position of a star – a **point source** – fluctuates and the light entering the eye **flickers**. [1] Planets are closer and seen as **extended sources**; variations from their many point sources **average out to zero**. [1]

OR

B. Air molecules and fine particles scatter **blue light (shorter wavelength)** much more strongly than red; the scattered blue light enters our eyes. [1] Red light is **least scattered** by fog or smoke, so it can be seen in the same colour from a distance. [1]

35. An object 6 cm tall is placed 20 cm in front of a convex mirror of focal length 30 cm. Find the position, size and nature of the image. **3**

Solution:

Given: f = +30 cm, u = –20 cm, h = +6 cm.

$1/v = 1/f - 1/u = 1/30 - 1/(-20) = 1/30 + 1/20 = (2 + 3)/60 = 5/60 = 1/12 \rightarrow$ **v = +12 cm** (behind the mirror). [1½]

$m = -v/u = -12/(-20) =$ **+0.6**; $h' = 0.6 \times 6 =$ **+3.6 cm**. [1]

Nature: **virtual, erect and diminished**. [½]

36. An electric heater draws a current of 4 A from a 220 V supply. **3**

A. Find its power and its resistance.

B. Calculate the heat produced in 30 minutes, in joules and in kW h.

Solution:

A. P = VI = 220 × 4 = **880 W**; R = V/I = 220/4 = **55 Ω**. [½ + ½]

B. t = 30 min = 1800 s. H = P × t = 880 × 1800 = **1 584 000 J = 1.584 × 10^6 J**. [1]

In kW h: 0.88 kW × 0.5 h = **0.44 kW h** (check: 1.584 × 10^6 ÷ 3.6 × 10^6 = 0.44). [1]

37. In the circuit shown, a 12 V battery is connected to R_1 = 2 Ω in series with a parallel combination of R_2 = 6 Ω and R_3 = 3 Ω. **3**

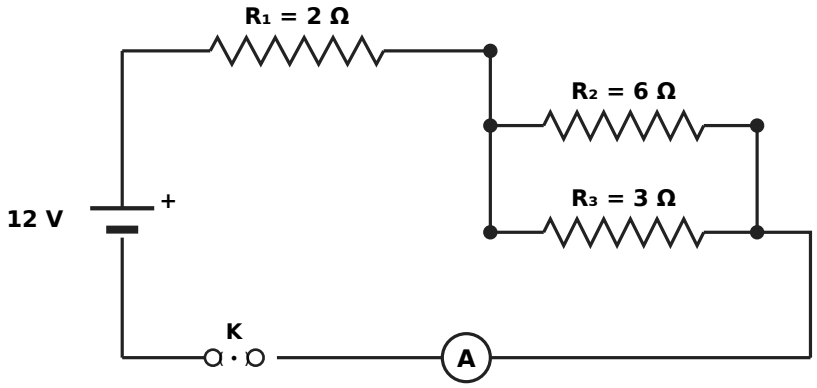


Figure: Circuit for Question 37

A. Find the current drawn from the battery.

B. Find the power dissipated in each resistor and show that their sum equals the power supplied by the battery.

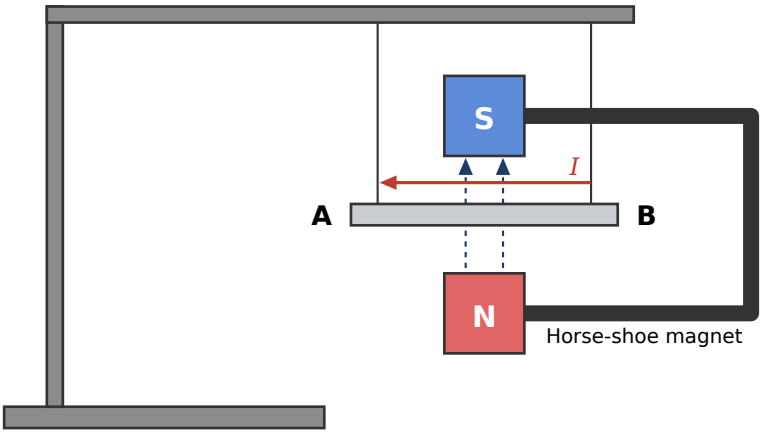
Solution:

A. R_p = (6 × 3)/(6 + 3) = 2 Ω; total R = 2 + 2 = 4 Ω; I = 12/4 = **3 A**. [1]

B. $P_1 = I^2R_1$ = 9 × 2 = **18 W**. Voltage across parallel part = 3 × 2 = 6 V: $P_2 = V^2/R_2$ = 36/6 = **6 W**; P_3 = 36/3 = **12 W**. [1½]

Sum = 18 + 6 + 12 = 36 W; power supplied = VI = 12 × 3 = **36 W** □. [½]

38. **Case study:** A small aluminium rod AB is suspended horizontally between the poles of a strong horse-shoe magnet so that the magnetic field is vertical, as shown. The ends of the rod are connected to a battery, a key and a rheostat. **4**



Field vertically upward; current from B to A (battery, key and rheostat not shown)

A. What will be observed when the key is closed? Why? **(1)**

B. What happens if the direction of the current is reversed? **(1)**

Attempt either sub-part C or D.

C. State Fleming's left-hand rule. How will the displacement of the rod change if the rheostat is adjusted to increase the current? **(2)**

OR

D. If the rod were placed parallel to the magnetic field, what would be the force on it? When is the force on the rod the greatest? Name two devices that use current-carrying conductors in magnetic fields. **(2)**

Solution:

A. The rod is **displaced** (moves sideways). A current-carrying conductor placed in a magnetic field **experiences a force**. [½ + ½]

B. The force is reversed, so the rod is displaced in the **opposite direction**. [1]

C. Stretch the thumb, forefinger and middle finger of the **left hand** mutually perpendicular: forefinger – **field**, middle finger – **current**, thumb – **force (motion)**. [1] A larger current gives a **larger force**, so the displacement **increases**. [1]

OR

D. When current is parallel to the field, the force is (practically) **zero**; the force is greatest when the current is **at right angles** to the field. [½ + ½] Devices (any two): electric motor, electric generator, loudspeaker, microphone, measuring instruments. [½ + ½]

39. Students to attempt either option A or B. **5**

A. I. An object 4 cm tall is placed 10 cm in front of a convex lens of focal length 15 cm. Find the position, size and nature of the image. **(2½)**

II. Define 1 dioptre and find the power of this lens. **(1)**

III. The refractive index of glass is 1.5. What does this mean? Find the speed of light in glass ($c = 3 \times 10^8$ m s^{-1}). **(1½)**

OR

B. I. State Ohm's law. On what factors does the resistance of a conductor depend? **(2)**

II. Three resistors of 2 Ω, 3 Ω and 6 Ω are connected in parallel to a 6 V battery. Find the equivalent resistance, the total current and the current through each resistor. **(3)**

Solution:

A. I. f = +15 cm, u = –10 cm, h = +4 cm. 1/v = 1/f + 1/u = 1/15 – 1/10 = (2 – 3)/30 = –1/30 → **v = –30 cm** (same side as the object). [1½] m = v/u = (–30)/(–10) = **+3**; h′ = 3 × 4 = **12 cm** → **virtual, erect, enlarged**. [1]

II. 1 dioptre is the power of a lens of focal length **1 m**. P = 1/0.15 ≈ **+6.67 D**. [½ + ½]

III. The ratio of the speed of light in air (vacuum) to that in glass is 1.5. v = c/n = (3×10^8)/1.5 = **2×10^8 m s^{-1}**. [½ + 1]

OR

B. I. The potential difference across a metallic wire is **directly proportional to the current** through it, provided its **temperature remains the same** (V = IR). [1] Resistance depends on **length** (R ∝ l), **area of cross-section** (R ∝ 1/A) and the **nature of the material** (resistivity); also on temperature. [1]

II. $1/R_p = 1/2 + 1/3 + 1/6 = (3 + 2 + 1)/6 = 1 \rightarrow \mathbf{R_p = 1\ \Omega}$. [1] I = 6/1 = **6 A**. [½] Each resistor has 6 V across it: $I_{2\Omega} = 3$ A, $I_{3\Omega} = 2$ A, $I_{6\Omega} = 1$ A (sum 6 A □). [1½]