B.K. Birla Centre For Education

Date: 13-12-2025 PRE BOARD EXAMINATION-II **Duration**: 3 Hrs

Class: X Science **Total Marks** : 80

Instructions to the Students

- Write only question numbers clearly outside the margin (1, 2, 3.i, 5.b, 4.c.ii, etc.).
- Do not write questions or any titles. (For ex. - Do not write **II. Answer the following**).
- After every answer, give a one-line space.
- For Multiple choice Questions - Both Option and Answer should be written.
- This question paper consists of 3 sections: Section A - Biology, Section B - Chemistry and Section C - Physics.
- All questions are compulsory. However, an internal choice is provided in some questions. A student is expected to attempt only one of these questions.
- Bullet points & Sub-points should be written inside the margin.
- Do not fold / staple the paper.

Section A

1. Why is leaf fall considered a method of excretion in plants? [1]

a) Leaves store oxygen that plants don't need
b) Leaves store water for future use
c) Waste products are stored in leaves, which are then shed
d) Leaves block sunlight needed for photosynthesis

Answer

c) Waste products are stored in leaves, which are then shed (1)

2. Which of the following statements about autotrophs is incorrect? [1]

a) They synthesize food from inorganic raw materials.
b) They use solar energy to convert inorganic matter into food.
c) They are the producers in an ecosystem.
d) They directly consume other organisms for food.

Answer

d) They directly consume other organisms for food. (1)

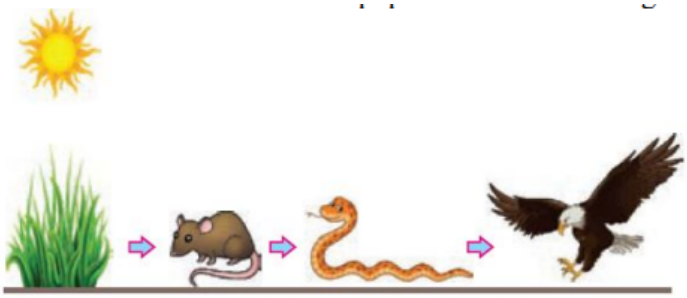
3. Why do arteries have thicker walls than veins? [1]

a) They carry oxygenated blood
b) They have to withstand high pressure from the heart
c) They contain valves to prevent backflow
d) They transport nutrients only

Answer

b) They have to withstand high pressure from the heart (1)

4. Which of these statements would be correct if the population of snakes is greatly increased? [1]



a) Population of green plants will decrease.
b) Population of mice will decrease.
c) Population of hawk will decrease
d) Both (a) and (c)

Answer

b) Population of mice will decrease. (1)

5. The incorrect statement about ozone is [1]
a) It is a deadly poisonous gas.
b) It shields the surface of the earth from UV radiation from sun.
c) It is used as a refrigerant and in fire-extinguishers.
d) It is formed by combining oxygen molecule with free oxygen atom.

Answer

c) It is used as a refrigerant and in fire-extinguishers. (1)

6. **Statement 1:** During heavy exercise, muscle cramps are caused due to the accumulation of lactic acid. [1]
Statement 2: The formation of lactic acid in muscles occurs due to the complete breakdown of glucose in the presence of oxygen.
a) Both Statements 1 and 2 are true
b) Both Statements 1 and 2 are false
c) Statement 1 is true and Statement 2 is false
d) Statement 1 is false and Statement 2 is true

Answer

c) Statement 1 is true and Statement 2 is false (1)

7. Why is the spinal cord protected by the vertebral column? [1]
a) It controls voluntary actions.
b) It needs protection from mechanical injury.
c) It supports muscle movement.
d) It stores neurotransmitters.

Answer

b) It needs protection from mechanical injury. (1)

8. **Assertion (A):** Tallness of a pea plant is controlled by an enzyme. [1]
Reason (R): The gene for that enzyme makes proteins which help the plant to be tall.
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 correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer ⇨

a) Both (A) and (R) are true and (R) is the correct explanation of (A) (1)

9. **Assertion (A):** Plastics decompose quickly in the environment because bacteria produce enzymes that break them down efficiently. [1]
Reason (R): Non-biodegradable substances resist breakdown by biological processes and persist for a long time in the environment, causing pollution.
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 correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer ⇨

d) (A) is wrong but (R) is correct (1)

10. **Give reason:** We do not have to think consciously to breathe, digest food, or make our heart beat. [2]

Answer ⇨

These actions are involuntary and are controlled by the medulla in the hind-brain. (1)

The medulla regulates vital functions such as breathing, heartbeat, salivation, and blood pressure automatically, without requiring conscious thought. (1)

11.A. Why is it important for mammals and birds to have a four-chambered heart, whereas amphibians can survive with a three-chambered heart? [2]

Answer ⇨

Mammals and birds are warm-blooded and need a constant body temperature, which requires a high metabolic rate and efficient oxygen delivery. A four-chambered heart ensures complete separation of oxygenated and deoxygenated blood, allowing maximum oxygen supply to tissues. (1)

Amphibians are cold-blooded; their body temperature fluctuates with the environment, so they have lower oxygen demands and can tolerate some mixing of blood in a three-chambered heart. (1)

(OR)

11.B. Riya's father is suffering from kidney failure and is in urgent need of a transplant. Riya offers to donate one of her kidneys. Based on your understanding of organ donation, explain whether this is possible and under what conditions it can be done. [2]

Answer

Yes, this is possible because a kidney is one of the organs that can be donated by a living person. (1)

The donation can be done with proper medical evaluation and consent from both Riya and her family, ensuring that it is safe for both the donor and the recipient. (1)

12. A cartoon is provided below. [2]

Aquarium need to be cleaned once in a while whereas ponds or lakes do not require any cleaning: Explain

Answer

Aquarium need to be cleaned because it is not a self-sustained natural ecosystem. It is man-made or artificial ecosystem. (1)

Ponds and lakes are self-sustained naturals ecosystem in which nutrient cycle and energy flow occur naturally. (1)

13. Define a reflex arc. Why have reflex arcs evolved in animals? Trace the sequence of events, which occur, when you suddenly touch a hot object. [3]

Answer

A shortest pathway taken by a nerve impulse. (1)

It has evolved to protect the organism from any injury. (1)

stimulus——---> receptor—->sensory neuron ——--> spinal reflex——--> relay or interneuron——-----> motor neuron——---->effector ——--> response (1)

Stimulus- heat, receptor- thermoreceptor , effector—-> hand muscle response - pull the hand (1)

14. The gene combination of purple flowered pea plants is denoted as (WW) and that of white flowered pea plants as (ww), when these two plants are crossed F_1 generation is obtained. [3]

i) List two observations made by Mendel in F_1 generation plants.

ii) Give the (a) percentage white flowered plants and (b) ratio of the gene combinations WW, Ww and ww in F_2 generation.

iii) Write one difference between dominant and recessive trait.

Answer

i)

All plants were purple flowered (0.5)

Only dominant parental trait was observed (0.5)

No mixed coloured flowers were observed (0.5)

No white flowered plants were observed (0.5)

ii)

a) 25% (0.5)

b) 1 WW : 2 Ww : 1 ww (0.5)

iii)

Dominant Trait: A trait that can express itself in the presence of its unexpressed contrasting trait (0.5)

Recessive Trait: A trait that remains unexpressed in the presence of its contrasting form. (0.5)

15. **Read the following text carefully and answer the questions that follow:**

The human digestive system is a tube running from mouth to anus. Its main function is to break down complex molecules present in the food which cannot be absorbed as such into smaller molecules. These molecules are absorbed across the walls of the tube, and the absorbed food reaches each and every cell of the body where it is utilized for obtaining energy.

15.A. Name the glands present in the buccal cavity and write the components of food on which the secretion of these glands act upon. [1]

Answer

Salivary glands; (0.5)

Starch/Carbohydrate (0.5)

15.B. Two organs have a sphincter muscle at their exit. Name them. [1]

Answer

Stomach, Anus (1)

Any valid response (1)

15.C. What will happen if: [2]

a. mucus is not secreted by the gastric glands.

b. Villi are absent in the small intestine.

Answer ⊶

a. The inner lining of the stomach will not be protected from the action of acid. (1)

b. Digested food will not be absorbed. / Absorption area will be reduced. (1)

(OR)

15.D. Bile juice does not contain any enzyme, yet it has important roles in digestion. Justify the statement. [2]

Answer ⊶

Emulsification of fats. (1)

Acidic medium has to be made alkaline for the pancreatic enzymes to act. (1)

16. Puneet wanted to grow banana plants

16.A.i. Based on your knowledge on plant reproduction should he opt for seeds or any alternate method of reproduction. Justify your answer. [2]

Answer ⊶

Puneet should not choose seeds as banana plants have lost the capacity to produce seeds. Most cultivated banana plants are seedless and sterile, so they cannot reproduce sexually by seeds. (1)

He should go for vegetative propagation of banana (by stem cutting). This method ensures that new banana plants are genetically identical to the parent and maintain the same desirable qualities (1)

16.A.ii. Offsprings of a banana plant usually show very little variation. What causes variation and are variations good or bad? Justify. [3]

Answer ⊶

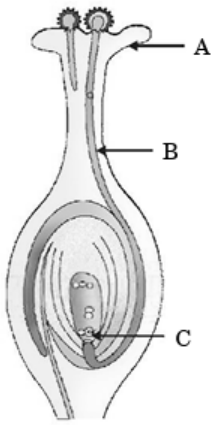
Cause of variation: Variations are mainly caused by sexual reproduction (due to recombination of genes) and sometimes by mutations in DNA. (1)

Variation is good as it can help a population tide over unfavourable conditions by survival of some variants. (1)

Bananas reproduce asexually (by vegetative propagation), so the offspring are genetically identical to the parent plant, showing very little variation. (1)

(OR)

16.B.i. Identify A, B and C in the diagram given below and write one function of each. [3]



Answer

A – Stigma: Receives pollen and provides suitable environment for its germination (1)

B –Pollen tube: Carries males germ cells (gametes) to the female gamete situated in the ovary (1)

C – Egg Cell (Female germ cell): Fuses with male gamete and forms zygote. (1)

16.B.ii. Compare the processes of Pollination and germination [2]

Answer

Pollination

The process in which the pollen grains from stamen are transferred to the stigma of pistil. (0.5)

External agents like air, water or an animal are required. (0.5)

After pollination the pollen tube is produced which contains male germ cell. (0.5)

Germination

It is the process in which a tiny seed gives rise to a future plant in the form of radicle and plumule (0.5)

Generally, it takes place in the soil under appropriate conditions. (0.5)

After germination the plumule (future stem) and radicle (future root) are developed. (0.5)

Section B

17. **Statement 1:** A balanced chemical equation obeys the law of conservation of mass. [1]

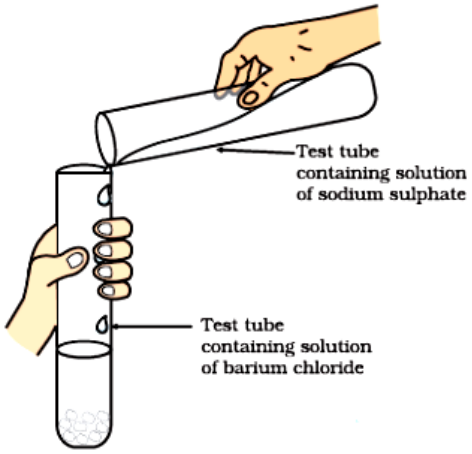
Statement 2: Mass can be created during a chemical reaction.

a) Both Statements 1 and 2 are true
b) Both Statements 1 and 2 are false
c) Statement 1 is true and Statement 2 is false
d) Statement 1 is false and Statement 2 is true

Answer ⇨

c) Statement 1 is true and Statement 2 is false (1)

18. [1]



Identify the product which represents the solid state in the above reaction.

a) Barium chloride b) Barium sulphate c) Sodium chloride d) Sodium sulphate

Answer ⇨

b) Barium sulphate (1)

19. A curry stain on a white cloth is yellow in colour. When soap is scrubbed on it, the stain turns reddish-brown. What is the nature of soap and why does the colour change? [1]

a) Soap is acidic, and it reacts with the stain.
b) Soap is neutral, and it cleans the stain.
c) Soap is basic, and the turmeric in the curry acts as a natural indicator.
d) Soap is acidic, and it bleaches the colour of the stain.

Answer ⇨

c) Soap is basic, and the turmeric in the curry acts as a natural indicator. (1)

20. In the chlor-alkali process, which gas is released at the anode? [1]

a) Hydrogen b) Chlorine c) Oxygen d) Nitrogen

Answer ⇨

b) Chlorine (1)

21. Aluminium utensils do not corrode easily because: [1]

a) Aluminium is unreactive.
b) Aluminium reacts with air forming a weak acid.
c) Aluminium forms a protective oxide layer.
d) Aluminium dissolves in air moisture.

Answer

c) Aluminium forms a protective oxide layer. (1)

22. Which of the following statements about metal oxides and their reactions is correct? [1]

a) All metal oxides are soluble in water and produce acids.
b) Aluminium oxide reacts with both acids and bases, so it is amphoteric.
c) Sodium oxide is insoluble in water and does not form an alkali.
d) Copper and gold react vigorously with oxygen at room temperature.

Answer

b) Aluminium oxide reacts with both acids and bases, so it is amphoteric. (1)

23. A student is given three metals: sodium, iron, and copper. She keeps all three in separate containers under identical conditions for one week. [1]

After a week:

i) Sodium reacts vigorously and forms a new compound.

ii) Iron shows rust formation.

iii) Copper remains mostly unchanged.

Which of the following conclusions can be correctly drawn?

a) All metals react at the same rate with air.
b) Copper is sonorous and therefore does not react.
c) Iron does not react with air, only with water.
d) Reactivity of metals depends on their position in the reactivity series.

Answer

d) Reactivity of metals depends on their position in the reactivity series. (1)

24. **Assertion (A):** Burning of natural gas (methane) is an endothermic process. [1]

Reason (R): Methane reacts with oxygen to form carbon dioxide and water, releasing heat energy.

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 correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer

d) (A) is wrong but (R) is correct (1)

25. Cinnabar is an ore of a metal 'X'. When this ore is heated in air, it is first converted into oxide of 'X' (XO) and then reduced to metal 'X' on further heating. [2]
Identify metal X and write chemical equations for the reactions that occur in the above processes.

Answer

Metal X

'X' is Mercury. (1)

Reaction involved in its extractions are:

$$2HgS + 3O_2 \xrightarrow{\Delta} 2HgO + 2SO_2$$ (0.5)

$$2HgO \xrightarrow{\Delta} 2Hg + O_2$$ (0.5)

26. i) State the electron-dot structure for calcium and sulphur. [3]
ii) Show the formation of CaS by the transfer of electrons.
iii) Name the ions present in this compound CaS. [Atomic number of Ca = 20, O = 16.]

Answer

i) Ca - (2, 8, 8, 2) S - (2, 8, 6) (0.5)

iii) Ca^{2+} and S^{2-} ions are present in CaS (0.5)

$Ca \longrightarrow Ca^{2+} + e^-$

$S + 2e^- \longrightarrow S^{2-}$

$Ca \times\!\!\times \longrightarrow :\ddot{S}:$ or (Ca^{2+}) $(:\ddot{S}:^{2-})$

ii) Formation of CaS (2)

27.A. A student dipped an iron nail in copper sulphate solution and left it for a day. [3]
i) What observation is recorded?
ii) Write the balanced equation.
iii) Identify the reaction type and justify.

Answer

1) i) Blue solution fades, reddish-brown deposit on nail (1)

2) ii) $Fe\ (s) + CuSO_4\ (aq) \rightarrow FeSO_4\ (aq) + Cu\ (s)$ (1)

3) iii) Displacement reaction – Iron is more reactive and replaces copper from the solution (1)

(OR)

27.B. Iron railings kept outside a house rust over time, while packets of chips stay fresh for weeks even though both are exposed to air. Explain this difference by analyzing the role of oxidation in both cases and mention how oxidation is prevented. [3]

Answer ⊶

In iron railings, exposure to oxygen and moisture leads to oxidation of iron, forming rust (iron oxide). This is a form of corrosion, which weakens and damages the metal over time. (1)

In chips, the fats and oils undergo oxidation when exposed to air, leading to rancidity, which spoils the taste and smell of the food. (1)

Chips are packed in airtight bags filled with nitrogen gas, which prevents oxidation and keeps them fresh. (0.5)

Iron railings, if left unprotected, corrode easily. To prevent rusting, they should be painted, galvanized (coated with zinc), or oiled to block air and moisture. (0.5)

28. At a hospital, doctors use a white powder which, when mixed with water, sets into a hard solid mass to support fractured bones. This substance is obtained by carefully heating gypsum at 373 K.

28.A. Write its chemical name and chemical formula. [1]

Answer ⊶

Chemical name: Calcium sulphate hemihydrate (0.5)

Chemical formula: $CaSO_4 \cdot \frac{1}{2}H_2O$ or $CaSO_4 \cdot H_2O$ (as commonly written) (0.5)

28.B. Explain why this substance must be stored in a moisture-proof container. [1]

Answer ⊶

Plaster of Paris readily absorbs moisture from the atmosphere and reacts with it to form the hard solid mass gypsum. To prevent unwanted setting, POP must be stored in a moisture-proof container. (1)

28.C. Write the balanced chemical equation for the preparation of this substance from gypsum. [2]

Answer ⊶

(2)

$$CaSO_4 \cdot 2H_2O(s) \xrightarrow{373K} CaSO_4 \cdot \frac{1}{2}\,H_2O(s) + \frac{3}{2}\,H_2O(g)$$

(OR)

28.D. Write the balanced chemical equation for the reaction that occurs when this powder is mixed with water. [2]

Answer 🔑

$$CaSO_4 \cdot \frac{1}{2} H_2O(s) + \frac{3}{2} H_2O(l) \rightarrow CaSO_4 \cdot 2H_2O(s)$$ (2)

29.A. Alkanes, Alkenes, and Alkynes are the three main classes of aliphatic hydrocarbons. [5]

i) What is meant by a homologous series? List any two characteristics of the members of such a series.

ii) Write the general formula for alkanes and alkynes.

iii) Explain why alkanes generally burn with a clean flame while alkenes and alkynes burn with a sooty flame.

Answer 🔑

i) A homologous series is a group of organic compounds having the same functional group and similar chemical properties, in which successive members differ by a – CH_2– (methylene) group. (1)

All members can be represented by a single general formula / any relevant point (0.5)

Each successive member differes from the next by -Ch2 group / any relevant point (0.5)

ii) Alkanes: Cn H2n + 2 (0.5)

Alkynes: CnH2n-2 (0.5)

iii) Alkanes have a higher hydrogen-to-carbon ratio, meaning they contain more hydrogen and less carbon. → On burning, they undergo complete combustion, producing carbon dioxide and water, giving a clean (non-sooty) flame. (1)

Alkenes and Alkynes have higher carbon content and less hydrogen. → On burning, they undergo incomplete combustion, leading to the formation of unburnt carbon particles (soot), producing a sooty (yellow) flame. (1)

(OR)

29.B. i) What are soaps? Write the structure of a soap molecule. [5]

ii) Explain the cleansing action of soap with the help of a labelled diagram.

iii) Why do soaps not work well in hard water? How can we overcome this problem?

Answer

i) Soaps are sodium or potassium salts of long chain carboxylic acids. (1)

Soap molecule consists of a hydrophobic(water repelling)end and a hydrophilic (water loving)end. (1)

Diagram 1, 2 (1)

Answer

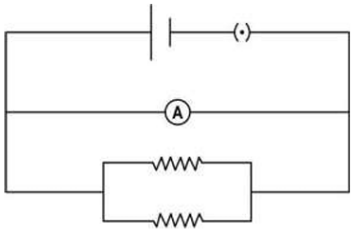
ii) Most dirt is oily in nature, oil does not dissolve in water. The ionic-end (hydrophilic) of soap interacts with water while the carbon chain(hydrophobic) interacts with oil. The soap molecules reacts with dirt, thus form structures called micelles. This forms an emulsion in water. The soap micelle thus helps in pulling out the dirt in water and we can wash our clothes clean (1)

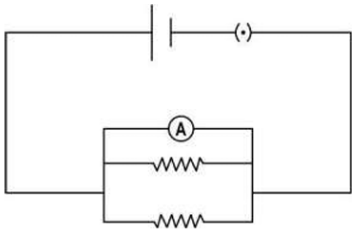
iii) Hard water contains salts of Ca and Mg, which reacts with soap to form scum (an insoluble substance) and no foam is formed (1)

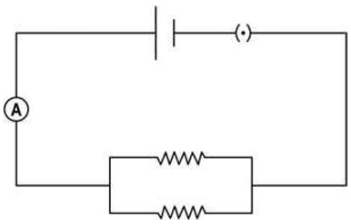
By using detergents as cleaning agents, removing hardness of water. (1)

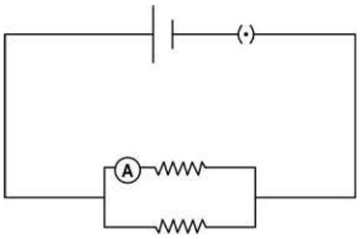
Section C

30. Arun connects two resistors in parallel. He wants to measure the total current through the two resistors. Which of the following shows the correct arrangement to measure the current through Ammeter 'A'? [1]

a) 

b) 

c) 

d) 

Answer

c) (1)

31. While describing the image formation by a convex lens, a student noted the following: [1]

I. When the object is placed at $2F_1$, the image is formed at $2F_2$ and is the same size.

II. When the object is placed between F_1 and $2F_1$, the image is real, inverted, and magnified.

III. When the object is placed at F_1, the image is formed at infinity.

Choose from the following the correct option that lists the correct statements

a) I and II b) I and III c) I, II and III d) II and III

Answer

c) I, II and III (1)

32. **Assertion (A):** The current is different in different components of a circuit. [1]
Reason (R): Different components offer different resistances to the flow of electric current; good conductors have low resistance, resistors have moderate resistance, and insulators have very high resistance.

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 correct but (R) is wrong
d) (A) is wrong but (R) is correct

Answer ⊶

a) Both (A) and (R) are true and (R) is the correct explanation of (A) (1)

33. Why do stars appear to twinkle, while planets do not, even though both are visible in the night sky? [2]

Answer ⊶

Stars appear to twinkle because they are very far from the Earth and behave like point sources of light. As their light passes through the turbulent atmosphere, it undergoes continuous refraction due to varying air densities. (1)

Planets, on the other hand, are closer to Earth and appear as extended sources of light. The variations in atmospheric refraction average out over their larger apparent size, so their brightness appears steady, and they do not twinkle. (1)

34.A. If refractive index of water is 1.33, then determine the speed of light in this medium, if the speed of light in vacuum is given by 3×10^8 ms^{-1} [2]

Answer ⊶

Since refractive index of water can be given by μw = Speed of light in vacuum /Speed of light in water (1)

$\Rightarrow 1.33 = 3 \times 10^8$ /Speed of light in water (1)

Speed of light in water = $\frac{3 \times 108}{1.33}$ (1)

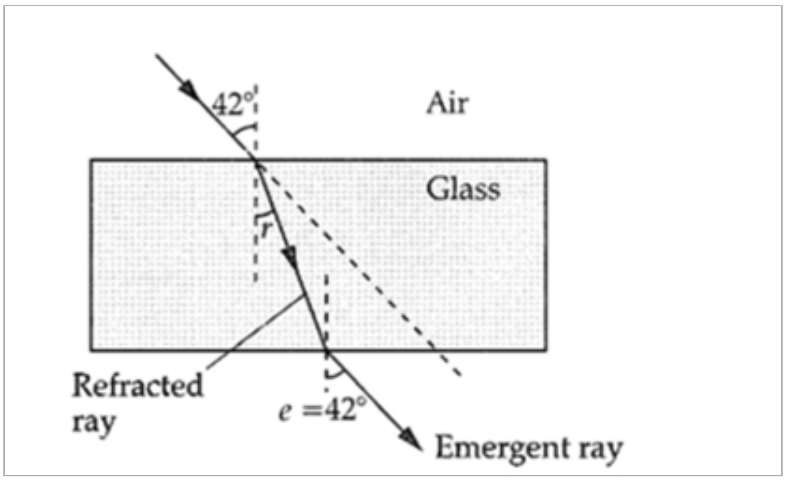
(OR)

34.B. A ray of light strikes the surface of a rectangular glass block such that the angle of incidence is [2]

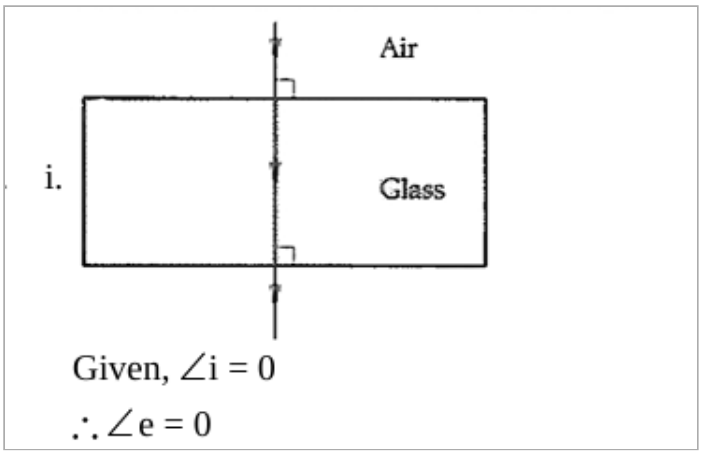
i. 0° ii. 42°

Sketch a diagram to show the approximate path taken by the ray in each case as it passes through the glass block and emerges.

Answer

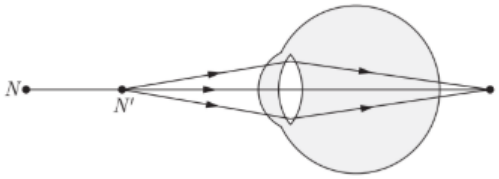


b) Given, i = 42° therfore angle e = 42° (1)



a) Given, angle i = 0 Therefore angle e = 0 (1)

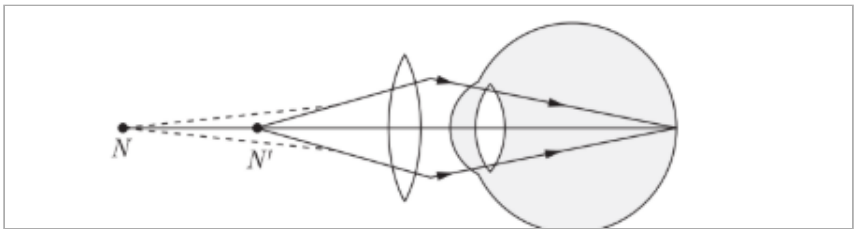
35. Study the diagram given below and answer the questions that follow: [3]



(i) Name the defect of vision represented in the diagram. Give reason for your answer.
(ii) List two causes of this defect.
(iii) With the help of a diagram show how this defect of vision is corrected.

Answer

defect is hyper-metropia because for point is situated at infinity but the near point has shifted away from D = 25 cm (1)



(iii) Convex lens of suitable focal length is required to correct this defect (1)

Answer

(ii) Causes of hypermetromia: (a) Focal length of eye lens is too long. (b) Eye ball has become too small. (1)

36. A 10 W bulb, a 50 Ω toaster, and a water filter of 500 Ω are connected in parallel to a 220 V source.

36.i. Explain why domestic appliances are connected in parallel rather than in series. [2]

Answer

because each device in a parallel circuit receives the same potential difference from the supply, so every appliance works at its rated voltage. If connected in series, the current passing through all appliances would be the same, which would not allow devices with different current requirements to function properly. (1)

Also, if one appliance connected in series fails, the entire circuit stops working, whereas in a parallel connection, the other devices continue to work even if one appliance is switched off or damaged. (1)

36.ii. What happens to the resistance of the circuit when devices are added in parallel? [1]

Answer

When more branches are added in parallel, the total resistance of the circuit becomes smaller because the current finds additional paths to flow through. As more devices are added in parallel, the reciprocal of the total resistance increases, which results in a decrease in the overall resistance of the circuit. (1)

37. (i) Why can't two magnetic field lines cross each other? [3]
(ii) State the conclusion which can be drawn from the pattern of magnetic field lines inside the solenoid.
(iii) Name any two factors on which the magnitude of the magnetic field due to this solenoid depends.

Answer

i)Two magnetic field lines can never cross each other because if they did, it would mean the magnetic field has two directions at the same point, which is impossible. (1)

ii)The magnetic field inside a long, straight solenoid is strong, uniform, and parallel, similar to that of a bar magnet. (1)

iii)Two factors affecting the magnetic field of a solenoid: Current through the solenoid. Number of turns per unit length (turns density). (1)

38. Study the data given below showing the focal length of three concave mirrors A, B and C and the respective distances of objects placed in front of the mirrors:

Case	Mirror	Focal Length (cm)	Object Distance (cm)
1	A	20	45
2	B	15	30
3	C	30	20

38.A. In which one of the above cases the mirror will form a diminished image of the object? Justify your answer. [1]

Answer

Case-1, because the object is placed beyond the centre of curvature (u > 2f), so the concave mirror forms a diminished, real and inverted image. (1)

38.B. List any two properties of the image formed in Case-2. [1]

Answer ⊶

Real and inverted, (0.5)

Same size as the object (0.5)

Any valid response (1)

38.C. An object is placed at a distance of 18 cm from the pole of a concave mirror of focal length 12 cm. Find the position of the image formed in this case. [2]

Answer ⊶

Object distance: u=−18cm; Focal length: f=−12cm; (1)

Mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

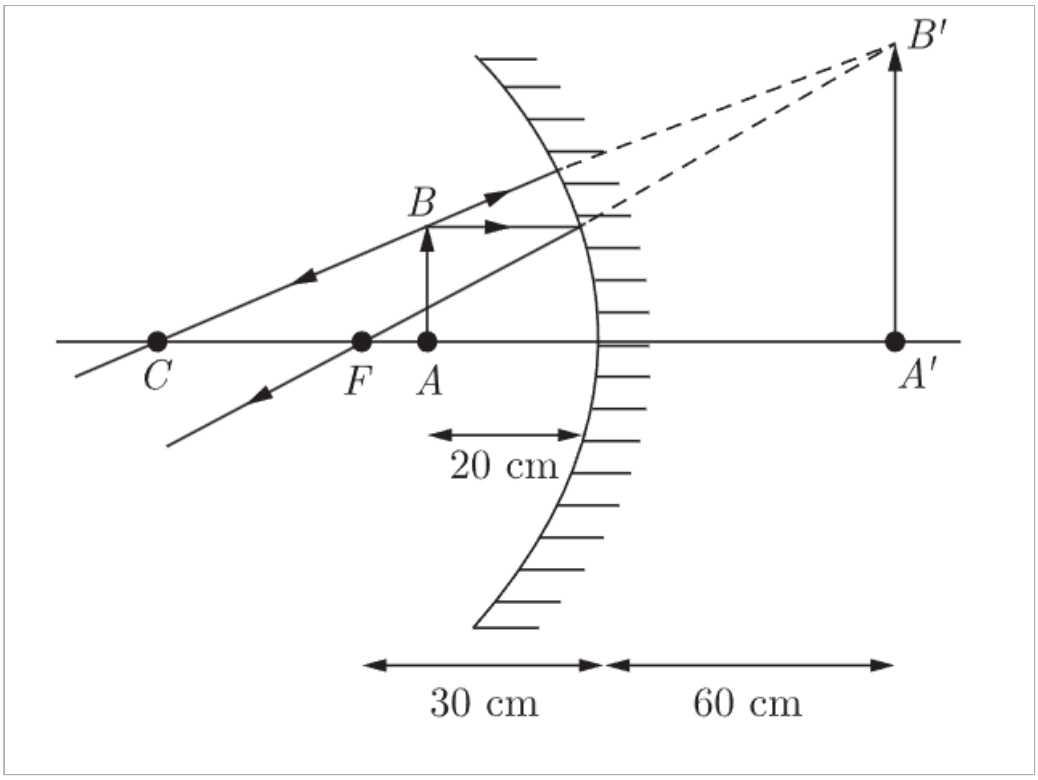
$\frac{1}{-12} = \frac{1}{v} + \frac{1}{-18}$; $\frac{1}{v} = -\frac{3}{36} + \frac{2}{36} = -\frac{1}{36}$; (1)

$v = -36\ cm$

(OR)

38.D. Case 3: An object is placed 20 cm in front of a concave mirror of focal length 30 cm. Draw a ray diagram to show the formation of the image. [2]

Answer ⊶



Ray diagram showing the formation of the image. (2)

39. A school plans to install decorative LED strips powered by a 12 V battery. The engineer recommends using four resistors of equal resistance connected in parallel to reduce overheating.

39.A.i. Explain how the equivalent resistance of this setup helps reduce the heating of the circuit. [2]

Answer ⇜

When resistors are connected in parallel, the current in the circuit divides into separate branches instead of passing through a single path. (1)

Because the current is shared between the parallel resistors, the total resistance of the circuit becomes less than the resistance of any one resistor. A lower total resistance results in the current being distributed more evenly across the resistors, which prevents excessive heating in any one part of the circuit and keeps the overall heating effect controlled and safe. (1)

39.A.ii. Derive the expression for equivalent resistance of four identical resistors R connected in parallel. [2]

Answer ⇜

For four identical resistors connected in parallel, each resistor has resistance, R. In a parallel connection, the reciprocal of the equivalent resistance is equal to the sum of the reciprocals of individual resistances. (1)

Therefore, $\frac{1}{R_p} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$

$\frac{1}{R_p} = \frac{4}{R}$; $R_p = \frac{R}{4}$ (1)

39.A.iii. If each resistor is 8 Ω, calculate the total resistance and the current drawn from a 12 V battery. [1]

Answer ⇜

Given each resistor has resistance R=8Ω.; (0.5)

$R_p = \frac{8}{4} = 2\Omega$

$I = \frac{V}{R} = \frac{12}{2} = 6A$ (0.5)

(OR)

39. A student is designing a heating device using nichrome wire for laboratory use. She has two nichrome wires of the same material:

- Wire A: Length = 1 m, diameter = 0.3 mm
- Wire B: Length = 1 m, diameter = 0.6 mm

She wants the device to reach higher temperatures faster.

39.B.i. Which wire should she choose? Why? [1]

Answer ⇜

Wire A, because it has a smaller diameter and therefore a smaller cross-sectional area, which gives it a higher (1)

resistance, and a wire with higher resistance produces more heat, allowing the device to reach higher temperatures faster.

39.B.ii. Justify your answer using the relationship between resistance and dimensions of a conductor. [2]

Answer

The resistance of a conductor depends directly on its length and inversely on its area of cross-section. Since both wires have the same material and the same length, the only factor affecting resistance is the cross-sectional area. (1)

A smaller diameter gives a smaller area of cross-section, which increases resistance. Therefore, Wire A will have greater resistance than Wire B. (1)

39.B.iii. If the resistance of Wire A at 20°C is 26 Ω, calculate the resistance of Wire B. [1]

Answer

The diameter of Wire B is double that of Wire A, so its cross-sectional area becomes four times larger because area is proportional to the square of the diameter. Since resistance is inversely proportional to area, the resistance of Wire B will be one-fourth of the resistance of Wire A. (0.5)

Given that the resistance of Wire A is 26 Ω, the resistance of Wire B is $\frac{26}{4} = 6.5\Omega$. (0.5)

39.B.iv. Explain how the chosen wire affects heat generation using Joule's law. [1]

Answer

According to Joule's law of heating, the heat produced in a conductor is directly proportional to the resistance when current flows through it. Therefore, a wire with higher resistance produces more heat for the same current, so Wire A will heat up faster and reach higher temperatures. (1)