CBSE EXAMINATION PAPER-2023

SCIENCE

(Solved)

Time allowed : 3 hours | Maximum Marks : 77

General Instructions :

Read the following instructions carefully and follow them :

i. This question paper contains **35 questions.** All questions are **compulsory.**

ii. This question paper is divided into **5 sections.**

iii. **Section A** – questions number **1 to 1** are case based questions

iv. **Section B** – questions number **2 to 13** are multiple choice questions

v. **Section C** – questions number **14 to 22** are very short answer

vi. **Section D** – questions number **23 to 31** are short answer

vii. **Section E** – questions number **32 to 35** are long answer

viii. There is no overall choice given in the question paper. However, an internal choice has been provided in few questions.

ix. Use of calculator is NOT allowed.

Section A

Question 1. The ability of a medium to refract light is expressed in terms of its optical density. Optical density is not the same as mass density. When comparing two media, the one with the larger refractive index is optically denser than the other. The other medium with a lower refractive index is optically rarer. The speed of light through a medium is inversely proportional to its optical density.

(1)

Determine the speed of light in diamond if the refractive index of diamond with respect to vacuum is 2.42. Speed of light in vacuum is 3×10^{8} m/s

[1 Marks]

Answer: The refractive index of diamond is 2.42, which means light travels 2.42 times slower in diamond than in vacuum. Given speed of light in vacuum is $3*10^{8}$ m/s, speed in diamond = $3*10^{8}/2.42 = 1.24*10^{8}$ m/s. This shows diamond is optically denser as mentioned in the case paragraph.

Key Points: Refractive index relates to optical density - Speed of light in medium = speed in vacuum / refractive index - Diamond has refractive index 2.42 and speed of light is $1.24*10^{8}$ m/s

(2)

Refractive indices of glass, water and carbon disulphide are 1.5, 1.33 and 1.62 respectively. If a ray of light is incident in these media at the same angle (say θ), then write the increasing order of the angle of refraction in these media.

[1 Marks]

Answer: The angle of refraction is larger in the optically rarer medium, which has smaller refractive index. Given refractive indices: carbon disulphide (1.62), glass (1.5), water (1.33). Thus, water is the most optically rarer, so it has the largest angle of refraction and carbon disulphide the smallest. The increasing order of angle of refraction is carbon disulphide < glass < water as explained from the case passage that larger refractive index means optically denser and smaller angle of refraction.

Key Points: Refractive index shows optical density - Larger refractive index means optically denser medium - Larger angle of refraction occurs in optically rarer medium

(3)

The speed of light in glass is 2×10^8 m/s and in water is 2.25×10^8 m/s.
(a) Which one of the two is optically denser and why?
(b) A ray of light is incident normally at the water-glass interface when it enters a thick glass container filled with water. What will happen to the path of the ray after entering the glass? Give reason.

[2 Marks]

Answer: (a) Glass is optically denser than water because the speed of light in glass ($2*10^8$ m/s) is less than in water ($2.25*10^8$ m/s). According to the case passage, lower speed means higher optical density.
(b) When light is incident normally on the water-glass interface, it will pass straight into the glass without bending. This is because refraction occurs only when light strikes at an angle other than 90 degrees. Since the incidence is normal, the path of the ray does not bend after entering the optically denser glass medium.

Key Points: Optical density related to refractive index - Lower speed of light means higher optical density - Light incident normally does not bend on refraction

(4)

The absolute refractive indices of water and glass are 4/3 and 3/2 respectively. If the speed of light in glass is 2×10^{8} m/s, find the speed of light in
(i) vacuum and
(ii) water.

[2 Marks]

Answer: Given refractive indices are n_{water} = 4/3 and n_{glass} = 3/2. The speed of light in glass is 2 * 10^8 m/s. Refractive index n = speed of light in vacuum / speed of light in medium. So, speed of light in vacuum = n_{glass} * speed in glass = (3/2) * 2 * 10^8 = 3 * 10^8 m/s. Using the same formula, speed of light in water = speed in vacuum / n_{water} = 3 * 10^8 / (4/3) = 2.25 * 10^8 m/s. This shows how light travels fastest in vacuum and slower in optically denser mediums, as explained in the case passage.

Key Points: Refractive index is ratio of speed of light in vacuum to medium - Speed in vacuum = refractive index of glass * speed in glass - Speed in water = speed in vacuum / refractive index of water

Section B

Question 2. When Sodium bicarbonate reacts with dilute hydrochloric acid, the gas evolved is:

[1 Marks]

(A) Hydrogen; it gives pop sound with burning match stick.

(B) Hydrogen; it turns lime water milky.

(C) Carbon dioxide; it turns lime water milky.

(D) Carbon dioxide; it blows off a burning match stick with a pop sound.

Explanation: The correct answer is 'Carbon dioxide; it turns lime water milky.' When sodium bicarbonate ($NaHCO_3$) reacts with dilute hydrochloric acid (HCl), carbon dioxide (CO_2) gas is produced along with water and sodium chloride. The produced carbon dioxide turns lime water milky due to the formation of calcium carbonate, confirming the gas evolved is carbon dioxide. This is supported by the given context which explains the reaction and how CO_2 is identified.

Question 3.

When aqueous solutions of potassium iodide and lead nitrate are mixed, an insoluble substance separates out. The chemical equation for the reaction involved is:

[1 Marks]

(A) $KI + PbNO_3 \rightarrow PbI + KNO_3$

(B) $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$

(C) $KI + Pb(NO_3)_2 \rightarrow Pb + KNO_3$

(D) $KI + PbNO_3 \rightarrow PbI_2 + KNO$

Explanation: When aqueous solutions of potassium iodide (KI) and lead nitrate $Pb(NO_3)_2$ are mixed, a double displacement reaction occurs forming lead iodide (PbI_2), which is an insoluble yellow precipitate, and potassium nitrate (KNO_3), which remains dissolved in solution. The balanced chemical equation is: $2KI + Pb(NO_3)_2 \rightarrow PbI_2 + 2KNO_3$. This equation correctly shows the formation of the precipitate PbI_2 and the stoichiometric coefficients for all reactants and products.

Question 4.

A metal ribbon 'X' burns in oxygen with a dazzling white flame forming a white ash 'Y'. The correct description of X, Y and the type of reaction is:

[1 Marks]

(A) X = Ca; Y = CaO; Type of reaction = Decomposition

(B) X = Zn; Y = ZnO; Type of reaction = Endothermic

(C) X = Al; Y = Al_2O_3; Type of reaction = Thermal decomposition

(D) X = Mg; Y = MgO; Type of reaction = Combination

Explanation: The correct option is: X = Mg; Y = MgO; Type of reaction = Combination. This is because magnesium burns in oxygen with a bright white flame and forms magnesium oxide as a white powder. The reaction involves the combination of magnesium and oxygen to form magnesium oxide, which is a synthesis (combination) reaction.

Question 5. Acid present in tomato is:

[1 Marks]

(A) Acetic acid

(B) Methanoic acid

(C) Lactic acid

(D) Oxalic acid

Explanation: The acid present in tomato is Oxalic acid. According to the provided context, tomatoes contain oxalic acid, which is a naturally occurring organic acid. Other acids like acetic acid, methanoic acid, and lactic acid are not mentioned as constituents of tomato in the given information.

Question 6. Sodium hydroxide is termed an alkali while Ferric hydroxide is not because:

[1 Marks]

(A) Sodium hydroxide is a strong base, while Ferric hydroxide is a weak base.

(B) Sodium hydroxide is a base which is soluble in water while Ferric hydroxide is also a base but it is not soluble in water.

(C) Sodium hydroxide and Ferric hydroxide both are strong base but the solubility of Sodium hydroxide in water is comparatively higher than that of Ferric hydroxide.

(D) Sodium hydroxide is a strong base while Ferric hydroxide is a strong acid.

Explanation: Sodium hydroxide is called an alkali because it is a base that dissolves readily in water, releasing hydroxide ions (OH^-) and thus making the solution alkaline. Ferric hydroxide, although a base, does not dissolve significantly in water and therefore is not classified as an alkali. Hence, the correct explanation is that Sodium hydroxide is a base soluble in water while Ferric hydroxide is a base but insoluble in water.

Question 7.

The name of the salt used to remove permanent hardness of water is:

[1 Marks]

(A) Sodium hydrogen carbonate ($NaHCO_3$)

(B) Sodium carbonate decahydrate ($Na_2CO_3 \cdot 10H_2O$)

(C) Sodium chloride (NaCl)

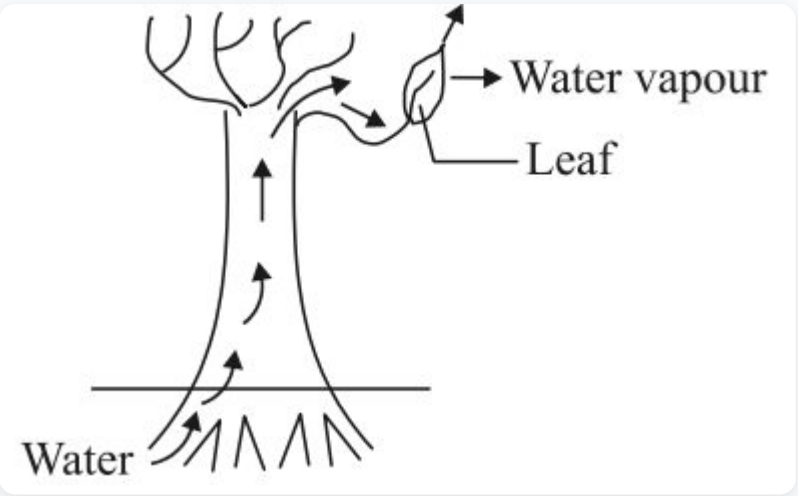
(D) Calcium sulphate hemihydrate ($CaSO_4 \cdot \frac{1}{2}H_2O$)

Explanation: The correct option is Sodium carbonate decahydrate ($Na_2CO_3 \cdot 10H_2O$), also known as washing soda. It is used to remove permanent hardness of water because it reacts with calcium and magnesium salts present in hard water to form insoluble precipitates, thereby softening the water. Other salts listed do not effectively remove permanent hardness.

Question 8.

Observe the following diagram and identify the process and its significance from the following options:

[1 Marks]



(A) Translocation : helps in transporting materials from one cell to another.

(B) Transpiration : creates a suction force which pulls water inside the plant.

(C) Evaporation : maintains water contents in leaf cells.

(D) Excretion : helps in excreting out waste water from the plant.

Explanation: The correct option is 'Transpiration : creates a suction force which pulls water inside the plant.' Transpiration is the process where water evaporates from the leaf surface (through stomata) as water vapor. This evaporation creates a suction force that helps pull water upward from the roots through the xylem vessels to the leaves. This process is crucial for cooling the plant, maintaining nutrient flow, and supporting the plant's structure. Other options describe different processes, but the description of water moving upward and evaporating from leaves specifically refers to transpiration.

Question 9. In plants the role of cytokinin is:

[1 Marks]

(A) Promote cell division.

(B) Wilting of leaves.

(C) Promote the opening of stomatal pore.

(D) Help in the growth of stem.

Explanation: The correct option is 'Promote cell division.' Cytokinins are plant hormones that promote cell division and are found in high concentrations in areas of rapid cell division such as fruits and seeds. They help in promoting growth by stimulating cell division.

Question 10. The number of chromosomes in parents and offsprings of a particular species undergoing sexual reproduction remain constant due to:

[1 Marks]

(A) doubling of chromosomes after zygote formation.

(B) halving of chromosomes after zygote formation.

(C) doubling of chromosomes before gamete formation.

(D) halving of chromosomes at the time of gamete formation.

Explanation: The correct answer is 'halving of chromosomes at the time of gamete formation.' During sexual reproduction, the chromosome number remains constant because germ cells (gametes) undergo meiosis, a special type of cell division that halves the chromosome number. When two gametes combine during fertilization, the zygote restores the original chromosome number of the species. Thus, the halving of chromosomes in gametes ensures the stability of chromosome number across generations.

Question 11. Two LED bulbs of 12W and 6W are connected in series. If the current through 12W bulb is 0.06A the current through 6W bulb will be:

[1 Marks]

(A) 0.04A

(B) 0.06A

(C) 0.08A

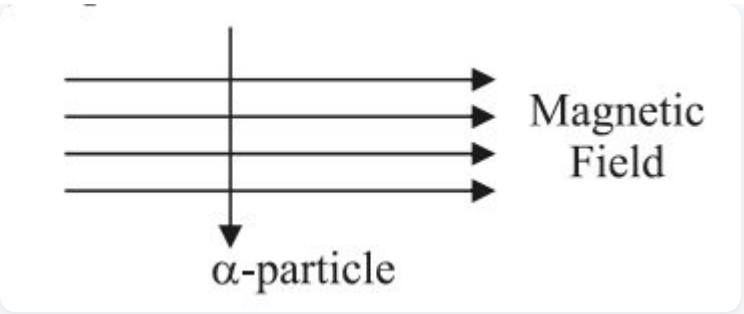
(D) 0.12A

Explanation: When two bulbs are connected in series, the same current flows through each bulb because there is only one path for the current. Therefore, the current through the 6W bulb will be the same as the current through the 12W bulb, which is 0.06A.

Question 12.

An alpha particle enters a uniform magnetic field as shown. The direction of force experienced by the alpha particle is:

[1 Marks]



(A) into the page

(B) out of the page

(C) towards right

(D) towards left

Explanation: The correct answer is 'into the page'. According to Fleming's left hand rule, the direction of force on a charged particle moving in a magnetic field is perpendicular to both the direction of the magnetic field and the velocity of the particle. Since an alpha particle is positively charged and its motion and the magnetic field direction are given, applying Fleming's left hand rule shows that the force direction is into the page.

Question 13.

Assertion (A): Reaction of Quicklime with water is an exothermic reaction.

Reason (R): Quicklime reacts vigorously with water releasing a large amount of heat.

[1 Marks]

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

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

(C) (A) is false but (R) is true.

(D) (A) is true but (R) is false.

Explanation: Both (A) and (R) are true and (R) is the correct explanation of (A). Quicklime, which is calcium oxide, reacts vigorously with water to form slaked lime (calcium hydroxide). During this reaction, a large amount of heat is released, making the mixture warm. Since heat is released during this chemical change, the reaction is exothermic. Therefore, the reason correctly explains the assertion.

Section C

Question 14.

A student took a small amount of copper oxide in a conical flask and added dilute hydrochloric acid to it with constant stirring. He observed a change in colour of the solution.

(i) Write the name of the compound formed and its colour.

(ii) Write a balanced chemical equation for the reaction involved.

[2 Marks]

Answer: (i) When dilute hydrochloric acid is added to copper oxide, copper(II) chloride is formed. The colour of this compound in solution is blue-green.
(ii) The balanced chemical equation for the reaction is:
$CuO + 2HCl \rightarrow CuCl_2 + H_2O$
Here, copper oxide (CuO) reacts with hydrochloric acid (HCl) to form copper(II) chloride ($CuCl_2$) and water (H_2O). The blue-green colour indicates the presence of $CuCl_2$ in the solution.

Key Points: Copper(II) chloride formed - Blue-green colour of solution - Balanced equation CuO + 2HCl → CuCl2 + H2O

Question 15. The industrial process used for the manufacture of caustic soda involves electrolysis of an aqueous solution of compound 'X'. In this process, two gases 'Y' and 'Z' are liberated. 'Y' is liberated at cathode and 'Z', which is liberated at anode, on treatment with dry slaked lime forms a compound 'B'. Name X, Y, Z and B.

[2 Marks]

Answer: In the chlor-alkali process, an aqueous solution of sodium chloride (brine) is electrolyzed. Here, compound X is sodium chloride solution. Gas Y, hydrogen, is liberated at the cathode. Gas Z, chlorine, is liberated at the anode. When chlorine gas is treated with dry slaked lime, it forms bleaching powder, which is compound B. Thus, X is sodium chloride solution, Y is hydrogen gas, Z is chlorine gas, and B is bleaching powder.

Key Points: X is aqueous sodium chloride (brine)-Y is hydrogen gas (at cathode)-Z is chlorine gas (at anode)-B is bleaching powder (formed by chlorine and dry slaked lime)

Question 16.

Name the part of brain which is responsible for the following actions:

(i) Maintaining posture and balance

(ii) Beating of heart

(iii) Thinking

(iv) Blood pressure

[2 Marks]

Answer:

(i) The cerebellum is responsible for maintaining posture and balance. It controls precise voluntary movements and helps in coordination.

(ii) The medulla, part of the hind-brain, controls the beating of the heart by regulating heartbeat automatically.

(iii) Thinking is a function of the cerebrum, the largest part of the brain involved in thinking, reasoning, memory, and voluntary actions.

(iv) Blood pressure is regulated by the medulla, which controls various involuntary functions including blood pressure.

Key Points: Cerebellum-controls posture and balance-Medulla-controls heartbeat and blood pressure-Cerebrum-responsible for thinking and voluntary actions-Involuntary actions controlled by medulla and mid-brain

Question 17.

Where are auxins synthesized in a plant? Which organ of the plant shows:

(i) Positive phototropism

(ii) Negative geotropism

(iii) Positive hydrotropism

[2 Marks]

Answer: Auxins are primarily synthesized in the tips of the shoots and young leaves of a plant. (i) Positive phototropism is shown by the shoot of the plant, as it grows towards the light source. (ii) Negative geotropism is also shown by the shoot, as it grows upwards, away from the direction of gravity. (iii) Positive hydrotropism is exhibited by roots, which grow towards moisture or water sources.

Key Points: Auxins are produced in shoot tips and young leaves-Shoots show positive phototropism by growing towards light-Shoots exhibit negative geotropism by growing upwards, against gravity-Roots show positive hydrotropism by growing towards water

Question 18.

Write one specific function each of the following organs in relation with excretion in human beings:

(i) Renal Artery

(ii) Urethra

(iii) Glomerulus

(iv) Tubular part of nephron

[2 Marks]

Answer:

(i) Renal Artery: It carries oxygen-rich blood containing waste products to the kidneys for filtration.

(ii) Urethra: It is the tube through which urine is expelled out of the body from the urinary bladder.

(iii) Glomerulus: It filters blood in the kidneys, allowing waste and excess substances to pass into the nephron.

(iv) Tubular part of nephron: It reabsorbs useful substances like glucose, salts, and water back into the blood and allows waste to remain to form urine.

Key Points: Renal Artery carries blood with waste to kidneys-Urethra expels urine out of the body-Glomerulus filters blood in nephron-Tubular part reabsorbs useful substances and retains waste

Question 19. Two green plants are kept separately in oxygen free containers, one in the dark and other in sunlight. It was observed that plant kept in dark could not survive longer. Give reason for this observation.

[2 Marks]

Answer: The plant kept in the dark could not survive longer because it was unable to perform photosynthesis. Photosynthesis requires sunlight to produce food for the plant. Without sunlight, the plant cannot make food and hence it will eventually die. The plant in sunlight can carry out photosynthesis, producing food and oxygen, which supports its survival.

Key Points: Plants require sunlight for photosynthesis-Photosynthesis produces food for the plant in the form of glucose-Darkness prevents photosynthesis so no food is made-Plant in dark starves and cannot survive-Plant in sunlight survives due to continuous food production

Question 20. Use of several pesticides which results in excessive accumulation of pesticides in rivers or ponds, is a matter of deep concern. Justify this statement.

[2 Marks]

Answer: The excessive use of pesticides leads to their accumulation in rivers and ponds, causing water pollution. These chemicals harm aquatic life by poisoning fish and other organisms. Pesticides

can also enter the food chain through such water bodies, resulting in biological magnification, which means the concentration of these toxic substances increases as they move up the food chain. This makes water unsafe for drinking and affects human health. Moreover, pesticides damage the soil's natural organisms, reducing fertility. Therefore, their excessive use is harmful to the environment and living beings.

Key Points: Excessive pesticide use leads to water pollution-Pesticides harm aquatic life-Pesticides enter the food chain causing biological magnification-Pesticides reduce soil fertility and harm microorganisms-These factors make the environment and food unsafe

Question 21.

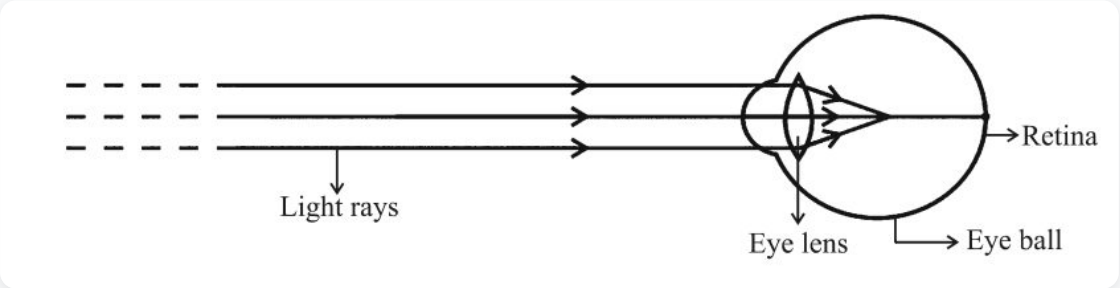
Observe the following diagram and answer the questions following it :

(i) Identify the defect of vision shown.

(ii) List its two causes.

(iii) Name the type of lens used for the correction of this defect.

[2 Marks]



Answer:

(i) The defect of vision shown is Myopia or Near-sightedness.

(ii) Its two causes are: (1) The focal length of the eye lens is too short, and (2) The eyeball is too long.

(iii) The type of lens used for the correction of this defect is a concave lens.

Key Points: Defect identified as Myopia-Near-sightedness-Myopia caused by either short focal length of eye lens or elongated eyeball-Concave lens used to correct myopia by diverging light rays

Question 22.

The colour of clear sky from the earth appears blue but from the space it appears black. Why ?

[2 Marks]

Answer: The sky appears blue from Earth because the atmosphere contains air molecules and tiny particles that scatter sunlight. These particles scatter blue light, which has a shorter wavelength, more effectively than other colours. This scattered blue light reaches our eyes, making the sky look blue. From space, there is no atmosphere to scatter sunlight, so the sky appears black against the backdrop of stars and space.

Key Points: Atmosphere scatters sunlight-Blue light has shorter wavelength-Blue light scattered more than other colours-No atmosphere in space means no scattering from space-No scattered blue light seen from space-Sky appears blue on Earth and black in space

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Section D

Question 23.

(i) While electrolysing water before passing the current some drops of an acid are added. Why? Name the gases liberated at cathode and anode. Write the relationship between the volume of gas collected at anode and the volume of gas collected at cathode.

(ii) What is observed when silver chloride is exposed to sunlight? Give the type of reaction involved.

[3 Marks]

Answer:

(i) Before electrolysis of water, a few drops of acid (like dilute sulfuric acid) are added to increase the water's conductivity because pure water is a poor conductor of electricity. During electrolysis, hydrogen gas is liberated at the cathode (negative electrode) due to the reduction of water molecules, and oxygen gas is liberated at the anode (positive electrode) due to the oxidation of water molecules. The volume of hydrogen gas collected at the cathode is twice the volume of oxygen gas collected at the anode. This is because water (H_2O) decomposes into H_2 and O_2 in a 2:1 molar ratio.

(ii) When silver chloride ($AgCl$) is exposed to sunlight, it decomposes into silver metal (Ag) and chlorine gas (Cl_2). The silver chloride turns grey due to the formation of silver particles. This type of reaction is called a photochemical reaction or photodecomposition reaction because it occurs in the presence of light.

Key Points: Acid added to increase conductivity of water-Hydrogen gas liberated at cathode-Oxygen gas liberated at anode-Volume of hydrogen is twice that of oxygen-Decomposition of silver chloride under sunlight-Formation of silver metal-Photochemical reaction

Question 24.

(i) Suggest a safe procedure of diluting a strong concentrated acid.

(ii) Name the salt formed when sulphuric acid is added to sodium hydroxide and write its pH.

(iii) Dry HCl gas does not change the colour of dry blue litmus paper. Why?

[3 Marks]

Answer:

(i) Safe procedure for diluting a strong concentrated acid: Always add acid to water, not water to acid. This is because concentrated acid is highly exothermic when mixed with water and adding water to acid may cause splashing of the acid. First, take some water in a beaker and then slowly add the acid to it while stirring continuously to dissipate the heat. This ensures safety during dilution.

(ii) Salt formed and its pH: When sulphuric acid (H_2SO_4) is added to sodium hydroxide (NaOH), the salt formed is sodium sulphate (Na_2SO_4) and water. The reaction is a neutralization reaction. The pH of the resulting solution is neutral, approximately 7.

(iii) Why dry HCl gas does not change the colour of dry blue litmus paper: Dry HCl gas does not change the colour of dry blue litmus paper because the acidic character of HCl is due to the presence of hydronium ions (H_3O^+) formed when HCl dissolves in water. Since dry HCl gas lacks moisture, it cannot produce these ions and hence does not turn blue litmus paper red. However, wet blue litmus paper changes colour because water is present to ionize HCl into H_3O^+ ions.

Key Points: Add acid to water safely-Sodium sulphate forms on neutralization-Neutral pH around 7-Dry HCl gas lacks moisture-Blue litmus paper does not change without water-Acidic nature of HCl depends on presence of water for ionization

Question 25.

(i) How does Paramecium obtain its food?

(ii) List the role of each of the following in our digestive system:

(a) Hydrochloric acid (b) Trypsin (c) Muscular walls of stomach (d) Salivary amylase

[3 Marks]

Answer: (i) How does Paramecium obtain its food?
Paramecium obtains its food by using its cilia, which are tiny hair-like structures covering its surface. The cilia beat rhythmically to move the paramecium through water and also help sweep food particles into a mouth-like opening called the oral groove. The food particles are then enclosed in food vacuoles where digestion takes place.

(ii) Roles of the following in our digestive system:
(a) Hydrochloric acid: It is present in the stomach and helps to create an acidic environment, which activates the enzyme pepsin to digest proteins and also kills harmful bacteria in food.
(b) Trypsin: This is an enzyme produced by the pancreas that breaks down proteins into smaller peptides in the small intestine.
(c) Muscular walls of stomach: They help in churning and mixing the food with digestive juices, turning it into a semi-liquid substance called chyme, aiding digestion.
(d) Salivary amylase: This enzyme is present in saliva and begins the digestion of carbohydrates by breaking down starch into simpler sugars in the mouth.

> **Key Points: Paramecium uses cilia to move and sweep food into oral groove - Food digestion occurs in food vacuoles - Hydrochloric acid creates acidic conditions and kills bacteria in stomach - Trypsin breaks proteins into peptides in the small intestine - Muscular walls of stomach churn food to mix with gastric juices - Salivary amylase begins carbohydrate digestion in the mouth**

Question 26.

(i) What is double circulation?

(ii) Why is the separation of the right side and the left side of the heart useful? How does it help birds and mammals?

[3 Marks]

Answer:

(i) Double circulation means that the blood passes through the heart twice during one complete cycle in the body. In double circulation, blood first goes from the heart to the lungs to get oxygenated (pulmonary circulation) and then returns to the heart. From there, the heart pumps the oxygen-rich blood to the rest of the body (systemic circulation). This system is different from fish, where blood passes through the heart only once per cycle.

(ii) The separation of the right and left sides of the heart is useful because it prevents the mixing of oxygen-poor blood (deoxygenated) from the body and oxygen-rich blood from the lungs. The partition called the septum divides the heart into two halves, ensuring clean and separate blood flows.

This separation is especially important for birds and mammals as they have high energy requirements to maintain their constant body temperature. By keeping oxygen-rich and oxygen-poor blood separate, the heart efficiently supplies oxygen and nutrients to the body cells, supporting their active lifestyles and energy needs.

Key Points: Definition of double circulation-Blood passes through heart twice in one cycle-First to lungs for oxygenation (pulmonary circulation)-Then to body (systemic circulation)-Septum separates left and right heart chambers-Prevents mixing of oxygenated and deoxygenated blood-Ensures efficient oxygen supply-Important for high energy needs of birds and mammals-Helps maintain constant body temperature

Question 27. An object of height 10 cm is placed 25 cm away from the optical centre of a converging lens of focal length 15 cm. Calculate the image-distance and height of the image formed.

[3 Marks]

Answer: Given, object height (h) = 10 cm, object distance (u) = -25 cm (since the object is in front of the lens), and focal length (f) = +15 cm (for a converging lens). Using the lens formula: 1/f = 1/v - 1/u, we get 1/v = 1/f + 1/u = 1/15 + 1/(-25) = (5 - 3)/75 = 2/75, so v = 75/2 = 37.5 cm. The positive value of v indicates that the image is formed on the opposite side of the lens. To find the height of the image (h'), use magnification m = v/u = 37.5 / -25 = -1.5. Therefore, h' = m × h = -1.5 × 10 = -15 cm. The negative sign shows the image is inverted. Hence, the image is real, inverted, magnified, formed at 37.5 cm from the lens, and its height is 15 cm.

Key Points: Identify given values - object height, object distance, focal length- Use the lens formula (1/f = 1/v - 1/u) to find image distance- Sign conventions for object distance (negative) and focal length (positive for converging lens)- Calculate magnification (m = v/u)- Determine image height using magnification (h' = m × h)- Interpret signs of image distance and height to describe image nature (real or virtual, inverted or upright)

Question 28. The power of a lens is +4D. Find the focal length of this lens. An object is placed at a distance of 50 cm from the optical centre of this lens. State the nature and magnification of the image formed by the lens and also draw a ray diagram to justify your answer.

[3 Marks]

Answer: Power (P) of the lens is +4D. The focal length (f) in meters is given by the formula f = 1/P. So, f = 1/4 = 0.25 meters or 25 cm. Since the power is positive, the lens is convex. Given, object distance (u) = -50 cm (object distance is taken negative as per sign convention, assuming light travels from left to right). Using lens formula, 1/f = 1/v - 1/u, we get 1/v = 1/f + 1/u = 1/25 + 1/(-50) = (2 - 1)/50 = 1/50. So, image distance v = +50 cm. The positive image distance indicates that the image is real and formed on the opposite side of the lens. Magnification (m) = v/u = +50 / (-50) = -1. The negative magnification means the image is inverted and magnification value 1 means the image is of the same size as the object. Thus, the image is real, inverted and of the same size, formed at 50 cm on the

opposite side of the lens. A ray diagram for a convex lens shows rays from the top of the object converging at the image point on the opposite side, confirming this result.

Key Points: Calculate focal length using f = 1/P- Recognize that positive power indicates a convex lens- Use lens formula 1/f = 1/v - 1/u with correct sign conventions- Determine image distance and its sign meaning- Calculate magnification and interpret its sign and magnitude- Conclude nature of image (real, inverted, same size)- Mention and explain the ray diagram

Question 29.

(i) Why is an alternating current (A.C.) considered to be advantageous over direct current (D.C.) for the long distance transmission of electric power?

(ii) How is the type of current used in household supply different from the one given by a battery of dry cells?

(iii) How does an electric fuse prevent the electric circuit and the appliances from a possible damage due to short-circuiting or overloading?

[3 Marks]

Answer:

(i) Alternating current (A.C.) is preferred for long-distance transmission of electric power because it can be easily transformed to higher or lower voltages using transformers. High voltage transmission reduces the current flowing through the wires, which in turn reduces energy loss due to the resistance of the wires. Direct current (D.C.) cannot be easily transformed, so transmitting electricity over long distances using D.C. causes greater energy loss.

(ii) The current supplied to households is alternating current (A.C.), which periodically reverses its direction. In contrast, the current given by a battery of dry cells is direct current (D.C.), which flows in only one direction. The A.C. supply in homes typically has a constant frequency (e.g., 50 Hz) and voltage, unlike the steady, unidirectional flow from a battery.

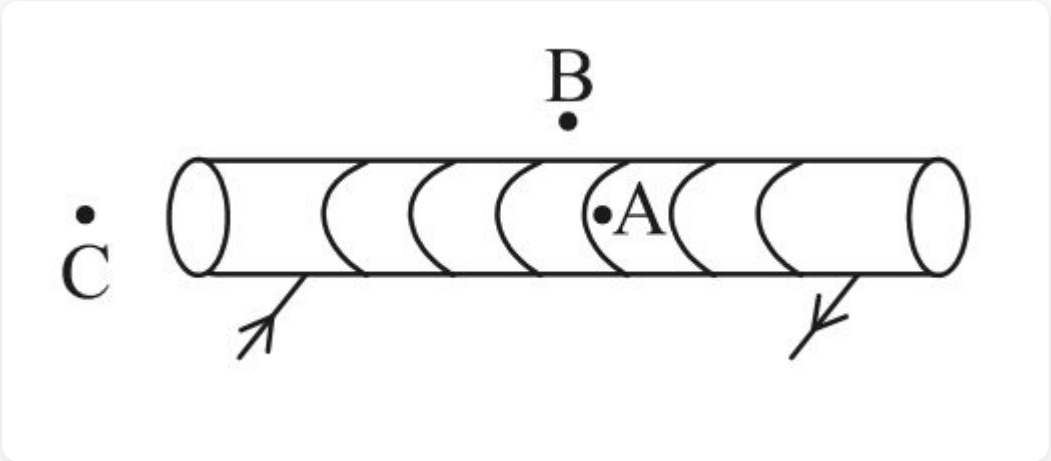
(iii) An electric fuse protects the circuit and appliances from damage caused by short-circuiting or overloading by breaking the circuit when the current exceeds a safe limit. It contains a thin wire that melts when excess current flows, stopping the flow of electricity and preventing potential damage or fire hazards.

Key Points: A.C. can be easily stepped up or down using transformers - Stepping up voltage reduces energy loss over long-distance transmission - D.C. cannot be easily transformed - Household supply uses A.C., which reverses direction periodically - Battery provides D.C., current flows only in one direction - Fuse contains a thin wire that

melts on excess current - Fuse breaks the circuit to prevent damage from overloading or short circuits

Question 30. For the current carrying solenoid as shown, draw magnetic field lines and give reason to explain that out of the three points A, B and C, at which point the field strength is maximum and at which point it is minimum?

[3 Marks]



Answer: The magnetic field lines around a current-carrying solenoid are similar to those of a bar magnet. Inside the solenoid, the magnetic field lines are nearly parallel and very close to each other, indicating a strong and uniform magnetic field. Outside the solenoid, the field lines spread out and loop from one end of the solenoid to the other, showing a weaker magnetic field. Among the three points A, B, and C, point C is inside the solenoid where the field lines are dense and parallel, so the magnetic field strength is maximum there. Points A and B are near the ends of the solenoid where magnetic field lines start and return, so the field strength is less compared to inside. Hence, the magnetic field strength is minimum at points A and B, and maximum at point C inside the solenoid.

Key Points: Magnetic field lines inside solenoid are parallel and close indicating strong uniform field-Outside the solenoid lines spread out showing weaker field-Point C is inside solenoid with maximum field strength-Points A and B are at ends with weaker field-Field lines pattern similar to bar magnet-Field direction from south to north inside and from north to south outside

Question 31. Write one difference between biodegradable and non-biodegradable wastes. List two impacts of each type of the accumulated waste on environment if not disposed properly.

[3 Marks]

Answer: Biodegradable wastes are substances that can be broken down by natural processes and microorganisms, whereas non-biodegradable wastes cannot be decomposed easily and persist in the environment for a long time. If biodegradable waste is not disposed properly, it promotes the growth of harmful bacteria and creates foul odor, leading to unhygienic conditions. On the other hand, accumulated non-biodegradable waste can harm the ecosystem by polluting soil and water and can take hundreds of years to degrade, causing long-lasting environmental damage.

Key Points: Difference between biodegradable and non-biodegradable wastes - Impacts of accumulated biodegradable waste on environment (growth of harmful bacteria, foul odor, unhygienic conditions) - Impacts of accumulated non-biodegradable waste on environment (soil and water pollution, long-term persistence harming ecosystem)

Section E

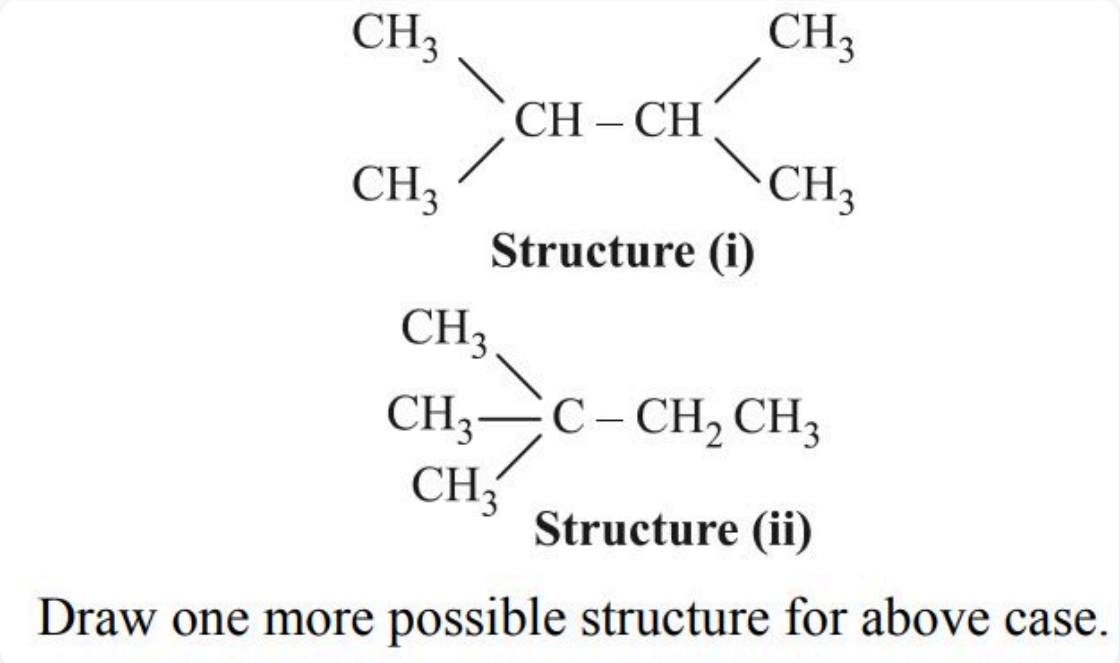
Question 32.

(i) Draw the structure of the following compounds : (a) Butanoic acid (b) Chloropentane

(ii) How are structure (i) and structure (ii) given below related to one another ? Give reason to justify your answer.

(iii) Differentiate between saturated and unsaturated carbon compounds on the basis of their general formula.

[5 Marks]



Answer: (i) (a) **Structure of Butanoic acid (C_3H_7COOH):** CH_3-CH_2-CH_2-COOH. It consists of a four carbon chain with a carboxyl group (-COOH) attached at the end.
(b) **Structure of Chloropentane:** CH_3-CHCl-CH_2-CH_2-CH_3. It is a five carbon chain (pentane) where a chlorine atom (Cl) replaces one hydrogen atom, usually shown on the second carbon.
(ii) The two structures are **isomers** of each other. They have the same molecular formula but different structural arrangements. Butanoic acid has a carboxyl group (-COOH) making it a carboxylic acid, whereas chloropentane has a chlorine atom substituted in the hydrocarbon chain. This difference in functional groups changes their properties.

(iii) **Difference between saturated and unsaturated carbon compounds based on general formula:** Saturated compounds contain only single bonds between carbon atoms and have the general formula C_nH_{2n+2}. Unsaturated compounds contain one or more double or triple bonds and have fewer hydrogen atoms than saturated compounds; their general formula is C_nH_{2n} (for alkenes) or C_nH_{2n-2} (for alkynes). Saturated compounds are usually less reactive, whereas unsaturated compounds are more reactive due to the presence of multiple bonds.

Key Points: Structure of butanoic acid - Structure of chloropentane - Isomerism and difference in functional groups - General formula of saturated compounds CnH2n+2 - General formula of unsaturated compounds CnH2n or CnH2n-2

Question 33.

(i) What happens when a small piece of sodium is dropped in ethanol? Write the equation for this reaction.

(ii) Why is glacial acetic acid called so?

(iii) What happens when ethanol is heated at 443 K in the presence of conc. H_2SO_4? Write the role of conc. H_2SO_4 in this case.

(iv) Write an equation showing saponification.

[5 Marks]

Answer: (a) When a small piece of sodium is dropped in ethanol, it reacts vigorously to form sodium ethoxide and hydrogen gas is released. This is a typical reaction of alcohols with active metals like sodium.
Reaction: $2Na + 2C_2H_5OH \rightarrow 2C_2H_5ONa + H_2$

(b) Glacial acetic acid is called "glacial" because it solidifies just below room temperature at about 16.7 deg C, forming ice-like crystals. It is a pure and water-free form of acetic acid.

(c) When ethanol is heated at 443 K in the presence of concentrated sulfuric acid, it undergoes dehydration to form ethene (an alkene) and water. Concentrated H_2SO_4 acts as a dehydrating agent and catalyst here.
Reaction: $C_2H_5OH \rightarrow C_2H_4 + H_2O$ (with hot conc. H_2SO_4)

(d) Saponification is the hydrolysis of an ester in the presence of a base to form alcohol and soap (salt of fatty acid).
Example reaction:
$CH_3COOC_3H_7 + NaOH \rightarrow CH_3COONa + C_3H_7OH$
(Propyl acetate + sodium hydroxide $\rightarrow$ sodium acetate + propanol)

Key Points: Sodium reacts with ethanol to form sodium ethoxide and hydrogen gas - Glacial acetic acid is called so because it forms ice-like crystals below 16.7 deg C - Ethanol dehydrates at 443 K with conc. H_2SO_4 to form ethene - Conc. H_2SO_4 acts as dehydrating agent and catalyst - Saponification is base hydrolysis of ester producing soap and alcohol

Question 34.

(i) Name and explain the two modes of asexual reproduction observed in hydra.

(ii) What is vegetative propagation ? List two advantages of using this technique.

[5 Marks]

Answer: (i) The two modes of asexual reproduction observed in hydra are budding and regeneration.
Budding: In budding, a new organism develops as an outgrowth or bud from the parent hydra. This bud grows while attached to the parent and after maturing, it detaches to live independently as a new hydra. It is a common method of reproduction in hydra.
Regeneration: Although not a mode of reproduction in the true sense, hydra can regenerate its lost parts. If a hydra is cut into pieces, each piece can grow into a new individual hydra.

(ii) **Vegetative propagation** is a type of asexual reproduction in plants where new plants are produced from the vegetative parts like roots, stems, or leaves without the formation of seeds.
Advantages of vegetative propagation:
1. It produces plants faster compared to growing from seeds.
2. It helps in producing plants that are genetically identical to the parent, preserving desirable traits.

Key Points: Budding in hydra - Regeneration in hydra - Definition of vegetative propagation - Advantages: faster plant production and genetic uniformity

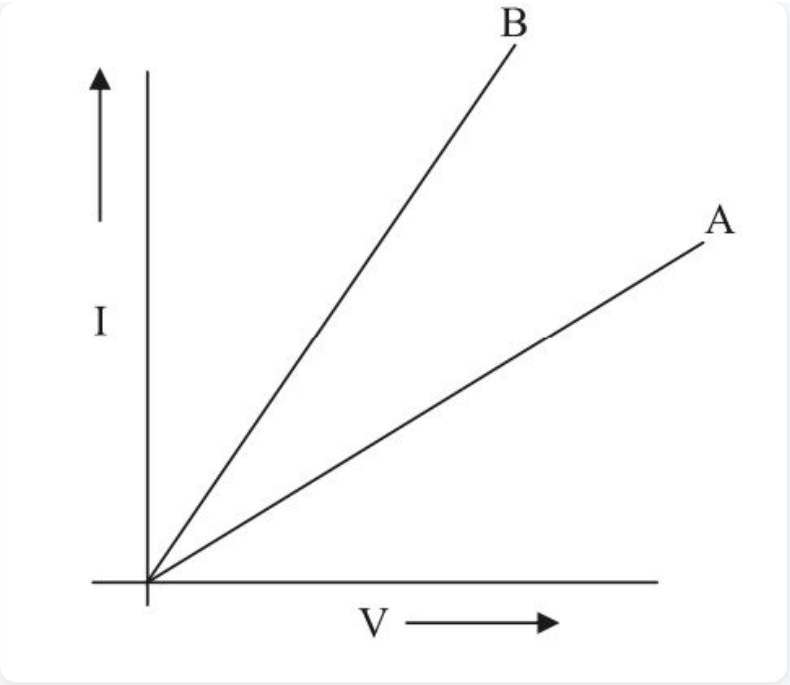
Question 35.

(i) How is electric current related to the potential difference across the terminals of a conductor ? Draw a labelled circuit diagram to verify this relationship.

(ii) Why should an ammeter have low resistance ?

(iii) Two V - I graphs A and B for series and parallel combinations of two resistors are as shown. Giving reason state which graph shows (a) series, (b) parallel combination of the resistors.

[5 Marks]



Answer:

(i) Electric current (I) through a conductor is directly proportional to the potential difference (V) across its terminals, provided the temperature and other physical conditions remain constant. This relationship is known as Ohm's Law and can be written as $V = I \times R$, where R is the resistance of the conductor. To verify this, a simple circuit is set up with a battery, a resistor, an ammeter connected in series to measure the current, and a voltmeter connected in parallel to measure the voltage across the resistor.

The circuit diagram includes:

- A battery providing the potential difference.
- A resistor connected in series.
- An ammeter connected in series to measure current.
- A voltmeter connected in parallel across the resistor to measure voltage.
- Connecting wires with negligible resistance.

By varying the voltage and measuring current, the proportionality is confirmed as a straight line when V is plotted against I.

(ii) An ammeter should have very low resistance because it is connected in series in a circuit. If it had high resistance, it would reduce the overall current flowing through the circuit, thus affecting the circuit's normal operation and giving incorrect current readings. Low resistance ensures that the ammeter does not alter the current it is intended to measure.

(iii) In the V-I graphs given for series and parallel combinations of resistors:

- **(a) Series Combination:** In series, the equivalent resistance is higher, so for the same voltage, the current is less making the slope of the V-I graph steeper. The graph with a steeper slope (lower current for same voltage) corresponds to the series combination.

- **(b) Parallel Combination:** In parallel, the equivalent resistance is lower, so for the same voltage, the current is higher making the slope of the V-I graph less steep. The graph with a gentler slope (higher current for the same voltage) corresponds to the parallel combination.

Key Points: Ohm's Law: current proportional to potential difference - Circuit elements: battery, resistor, ammeter (series), voltmeter (parallel) - Ammeter must have low resistance to avoid affecting circuit current - Series combination has higher equivalent resistance, lower current at same voltage, steeper V-I graph - Parallel combination has lower equivalent resistance, higher current at same voltage, less steep V-I graph