CBSE Class 10 Science 2026 — Set 5 — Answer Key

English Medium

Time Allowed: 3 Hours | Maximum Marks: 80

General Instructions:

1. This question paper contains 39 questions. All questions are compulsory.
2. Section A has 20 MCQs carrying 1 mark each.
3. Section B has 6 questions carrying 2 marks each.
4. Section C has 7 questions carrying 3 marks each.
5. Section D has 3 questions carrying 5 marks each.
6. Section E has 3 case-study based questions carrying 4 marks each.
7. Draw neat diagrams wherever required.

Section A

Multiple Choice Questions (1 mark each)

Q.1 [1 mark]

Identify the part that controls the closing and opening of the stomatal pore in leaves of plants. Select the correct option.

(a) Stomata
(b) Epidermal cells
(c) Guard cells <<
(d) Chloroplasts

Explanation:
Guard cells surround the stomatal pore;
changes in their turgor (swelling/shrinking) open and close the stoma.

Q.2 [1 mark]

Identify the endocrine gland that regulates the growth of human body.

(a) Pituitary gland <<
(b) Thyroid gland
(c) Pancreas
(d) Adrenal gland

Explanation:
The pituitary gland secretes growth hormone, which regulates growth of the human body.

Q.3 [1 mark]

Choose the equation of reaction that correctly represents anaerobic respiration in muscles :

(a) Glucose → Pyruvate → Ethanol + CO_2 + Energy (in absence of O_2)
(b) Glucose → Pyruvate → Energy (in presence of O_2)
(c) Glucose → Pyruvate → Ethanol + Energy (in lack of oxygen)
(d) Glucose → Pyruvate → Lactic acid + Energy (in lack of oxygen) <<

Explanation:

In muscles, in the absence/lack of oxygen, pyruvate is converted to lactic acid with release of energy.

Ethanol + CO_2 is the anaerobic pathway in yeast, not muscles.

Q.4 [1 mark]

In human beings, the implantation of fertilised egg takes place in which part of female reproductive system ?

(a) Oviduct

(b) Cervix

(c) Uterus <<

(d) Vagina

Explanation:

The fertilised egg (embryo) gets implanted in the lining of the uterus, where it develops.

Q.5 [1 mark]

When a human egg is fertilized by a sperm having 'Y' chromosome, the zygote has the following combination of chromosomes :

(a) 44 + XX

(b) 22 + XX

(c) 44 + XY <<

(d) 22 + XY

Explanation:

Human zygote has 44 autosomes plus two sex chromosomes.

Egg contributes 22 + X; a Y-bearing sperm contributes 22 + Y, giving 44 + XY (a male).

Q.6 [1 mark]

Which of the following is a non-biodegradable pollutant ?

(a) Paper

(b) DDT <<

(c) Wood

(d) Vegetable peel

Explanation:

DDT is a synthetic pesticide that is not broken down by decomposers, hence non-biodegradable.

Paper, wood and vegetable peel are biodegradable.

Q.7 [1 mark]

In an ecosystem, the decomposers perform an important role. Select the option indicating the role of decomposers.

(a) Convert inorganic materials to simpler forms

(b) Break down complex organic substances to simple inorganic substances. <<

(c) Break down inorganic substances into organic substances.

(d) Do not act on organic compounds.

Explanation:

Decomposers (bacteria and fungi) break down complex organic matter of dead remains into simple inorganic substances that return to the environment.

Q.8 [1 mark]

Assertion (A) : Bacteria that can withstand heat have better chances of survival in a heat wave. Reason (R) : Accumulation of variations in a species increases the chances of its survival in changing environment. Select the appropriate option: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). <<

(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

Explanation:
Both statements are true.
Heat-resistant variation lets some bacteria survive a heat wave, and it is precisely the accumulation of such variations that improves survival in a changing environment — so R correctly explains A.

Q.9 [1 mark]

Assertion (A) : The peristaltic movements occur all along the gut. Reason (R) : The lining of the gut has muscles that contract rhythmically to push the food in regulated manner. Select the appropriate option: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). <<
(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(c) Assertion (A) is true, but Reason (R) is false.
(d) Assertion (A) is false, but Reason (R) is true.

Explanation:
Peristaltic movements do occur all along the alimentary canal, and they are caused by the rhythmic contraction of gut-lining muscles that push food onward — R correctly explains A.

Q.10 [1 mark]

Give a diagrammatic representation of nutrition in Amoeba.

Answer: Labelled diagram of Amoeba showing pseudopodia engulfing food to form a food vacuole (phagocytosis), digestion in the food vacuole, and egestion of undigested waste

Explanation:

Nutrition in Amoeba is holozoic: pseudopodia surround the food particle and form a food vacuole (ingestion);
enzymes act inside the vacuole (digestion and absorption);
undigested material is egested.
The answer requires the labelled diagram showing these steps.

Q.11 [1 mark]

(A) Observe the given figure and identify the labelled parts P, Q, R and S :

Answer: P = receptor (heat/pain-sensing cells in the skin of the hand); Q = sensory neuron; R = relay neuron (interneuron) in the spinal cord; S = effector (muscle of the arm)

Explanation:

The figure is a reflex arc (hand touching a hot vessel).
P, the hand at the hot vessel, is the receptor;
Q is the sensory (afferent) neuron carrying the impulse to the spinal cord;
R, in the spinal cord, is the relay neuron connecting sensory and motor pathways;
S, the arm muscle, is the effector that contracts to withdraw the hand.

OR

Q.11 [1 mark]

(B) Which of the plant hormones are responsible for the following processes ? (i) Promote cell division (ii) Inhibition of growth (iii) Detection of light (iv) Wilting of leaves

Answer: (i) Cytokinin (ii) Abscisic acid (iii) Auxin (iv) Abscisic acid

Explanation:

(i) Cytokinins promote cell division.

(ii) Abscisic acid inhibits growth.

(iii) Auxin, made at the shoot tip, mediates response/detection of light (phototropism).

(iv) Abscisic acid causes wilting/closing of stomata and leaf fall.

Q.12 [1 mark]

Briefly mention the steps in double-circulation through human heart.

Answer: Blood passes through the heart twice per cycle: pulmonary circulation (heart → lungs → heart) and systemic circulation (heart → body → heart)

Explanation:

Double circulation: (1) Deoxygenated blood from body enters right atrium →
right ventricle →
pumped to lungs (pulmonary circulation) where it is oxygenated.
(2) Oxygenated blood returns to left atrium →
left ventricle →
pumped to the whole body (systemic circulation).
Blood thus passes through the heart twice in one complete cycle, keeping oxygenated and deoxygenated blood separate for efficient oxygen supply.

Q.13 [1 mark]

Based on Mendel's experiment show the cross between round, yellow seeds of pea plant (RRYY) with wrinkled and green seeds of pea plant (rryy) upto F2 generation. Write the number of seeds/plants with following genetic (Genotype) makeup in F2 generation : (i) RRYY (ii) rryy

Answer: (i) 1 out of 16 (ii) 1 out of 16

Explanation:

A dihybrid cross RRYY × rryy gives F1 all RrYy (round yellow).
Selfing F1 gives a 9:3:3:1 phenotypic ratio, and the 16-box Punnett square gives each of the parental homozygous genotypes once.
So RRYY = 1/16 and rryy = 1/16 of the F2 offspring.

Q.14 [1 mark]

(a) Mention any one harmful effect of using plastic bags on the environment. Suggest better alternatives to the usage of plastic bags. (b) Paddy fields require a large amount of water. The pesticides and chemical fertilizers used are washed down into the soil or waterbodies. How do these chemicals reach our bodies ? What is this phenomenon known as ?

Answer: (a) Plastic is non-biodegradable and pollutes soil/water and harms animals; use cloth/jute/paper bags. (b) Through the food chain by bioaccumulation; the phenomenon is biological magnification (biomagnification).

Explanation:

(a) Plastic bags do not decompose, choke drains, harm animals that swallow them and pollute soil and water;
alternatives are cloth, jute or paper bags.
(b) These chemicals wash into soil/water, are absorbed by plants and pass up the food chain, becoming more concentrated at each trophic level and reaching humans — this concentration up the food chain is called biological magnification (biomagnification).

Q.15 [1 mark]

Kidneys help to regulate the volume of fluid and various metabolites waste products in the body. Normally, kidney filter about 180 L of fluid daily but the volume actually excreted out is only a litre or two a day. Patients with kidney failures can be saved by dialysis and kidney transplant. (a) Write the structure and function of Bowman's capsule.

Answer: Bowman's capsule is a cup-shaped double-walled structure at the start of the nephron that encloses the glomerulus; it collects the filtrate (initial urine) filtered from the blood.

Explanation:

Structure: Bowman's capsule is a cup-like (double-walled) bag surrounding the glomerulus (a network of capillaries) at the beginning of a nephron.
Function: it receives the filtrate formed by ultrafiltration of blood in the glomerulus and

passes it to the renal tubule.

Q.16 [1 mark]

(b) Although kidneys filter a large amount (about 180 L daily) of fluids, still the excretion from the body is only about a litre or two. Why ?

Answer: Because most of the filtrate is reabsorbed — useful substances like glucose, amino acids, salts and a large amount of water are selectively reabsorbed back into the blood in the tubule, so only a litre or two of urine is finally excreted.

Explanation:

During urine formation, useful substances (glucose, amino acids, salts) and most of the water are selectively reabsorbed from the tubule back into the blood.

The amount of water reabsorbed depends on the body's water content and dissolved wastes, so out of ~180 L filtered, only about 1–2 L is excreted as urine.

Q.17 [1 mark]

(c) What is excretion ? Why is it necessary for any living organism ?

Answer: Excretion is the biological process of removing harmful metabolic (nitrogenous) waste products from the body; it is necessary to prevent accumulation of toxic wastes that would otherwise harm the organism and to maintain homeostasis.

Explanation:

Excretion is the removal of harmful nitrogenous and other metabolic wastes produced during life processes.

It is necessary because accumulation of these wastes is toxic and would poison the body;

excretion keeps the internal environment (water/salt balance) stable — homeostasis.

OR

Q.17 [1 mark]

(c) State two similarities between lungs and kidneys.

Answer: 1) Both are involved in excretion (removal of wastes) — lungs remove CO_2, kidneys remove nitrogenous wastes. 2) Both have a large surface area with a rich blood supply for efficient exchange/filtration.

Explanation:

Similarities: (1) Both are excretory organs that remove metabolic waste products from the blood — lungs excrete carbon dioxide, kidneys excrete urea/other nitrogenous wastes.

(2) Both possess a very large surface area richly supplied with blood capillaries to carry out exchange (gas exchange in lungs, filtration in kidneys) efficiently.

Q.18 [1 mark]

(A) (i) In an angiospermic flower, fertilization is said to take place when male gametes carried in the pollen tube fuse with the female gamete, present in the embryo sac. This results in lot of changes in different parts of the flower. State the changes taking place in the following structures of flower post fertilization : (a) Zygote (b) Ovule (c) Ovary (d) Sepals (ii) Define germination.

Answer: (a) Zygote develops into the embryo. (b) Ovule develops into the seed. (c) Ovary develops into the fruit. (d) Sepals usually wither and fall off (dry up). (ii) Germination is the process by which a seed develops into a new seedling/plant under suitable conditions.

Explanation:

Post-fertilization changes: the zygote divides to form the embryo;

the ovule becomes the seed;

the ovary enlarges to become the fruit;

sepals (and petals, stamens, style) generally wither and fall off.

Germination is the growth of the embryo of a seed into a young plant (seedling) when it gets suitable water, air and temperature.

OR

Q.18 [1 mark]

(B) (i) Sugarcane does not produce seeds so name the process through which it will be able to reproduce. (ii) List any two advantages of this method. (iii) Besides sugarcane, give two more examples of plants that reproduce by this method. (iv) Why regeneration is not possible in all the types of animals ?

Answer: (i) Vegetative propagation (by stem cuttings). (ii) Plants bear flowers/fruits earlier and the new plants are genetically identical to the parent (retain desirable traits); also grows seedless plants. (iii) Rose and potato (also sugarcane, banana, grapes). (iv) Because only simple/lower organisms with the required unspecialised cells can regenerate; complex animals have specialised organs/cells and cannot re-form the whole body from a part.

Explanation:

(i) Sugarcane reproduces asexually by vegetative propagation (stem cuttings).

(ii) Advantages: earlier flowering/fruiting and offspring identical to the parent so useful characters are retained;

useful for seedless plants.

(iii) Examples: rose, potato (banana, grapes).

(iv) Regeneration requires specialised cells that can grow into an entire organism;

only simpler animals (e.g.

Hydra, Planaria) have these, so complex/higher animals with specialised tissues and organs cannot regenerate a whole body.

Q.19 [1 mark]

The volume ratio of hydrogen and oxygen gases liberated during electrolysis of water is :

(a) 1 : 2

(b) 2 : 1 <<

(c) 1 : 3

(d) 4 : 1

Explanation:

Water (H_2O) on electrolysis gives 2 volumes of hydrogen and 1 volume of oxygen ($2H_2O \rightarrow 2H_2 + O_2$), so $H_2 : O_2 = 2 : 1$.

Q.20 [1 mark]

Which of the following set of compounds does not belong to same homologous series ?

(a) CH_4 and C_4H_{10}

(b) C_2H_6 and C_3H_8

(c) C_3H_8 and C_5H_{12}

(d) C_4H_8 and C_5H_{12} <<

Explanation:

Members of a homologous series share the same general formula.

CH_4, C_4H_{10}, C_2H_6, C_3H_8, C_5H_{12} are all alkanes (C_nH_{2n+2}).

C_4H_8 is an alkene (C_nH_{2n}), so C_4H_8 and C_5H_{12} belong to different homologous series.

Section B

Very Short Answer Questions (2 marks each)

Q.21 [2 marks]

Which of the following is an amphoteric oxide ?

(a) Na_2O

(b) K_2O

(c) CO_2

(d) Al_2O_3 <<

Explanation:

An amphoteric oxide reacts with both acids and bases.

Al_2O_3 shows this behaviour.

Na_2O and K_2O are basic oxides; CO_2 is an acidic oxide.

Q.22 [2 marks]

Study the following table and select the correct option :

Salt | Acid used | Base used | Nature of Salt

(a) NaCl | HCl | NaOH | Basic

(b) Na2CO3 | H2CO3 | NaOH | Neutral

(c) Na2SO4 | H2SO4 | NaOH | Acidic

(d) CH3COONa | CH3COOH | NaOH | Basic <<

Explanation:

A salt of a weak acid and a strong base is basic.

CH3COONa comes from weak acid CH3COOH and strong base NaOH, so it is basic — option (D) is correct.

NaCl (strong acid + strong base) is neutral not basic;

Na2SO4 (strong acid + strong base) is neutral not acidic;

Na2CO3 (weak acid + strong base) is basic not neutral.

Q.23 [2 marks]

Which of the following will not undergo addition reaction ?

(a) C4H8

(b) C2H2

(c) C3H8 <<

(d) C2H4

Explanation:

Addition reactions occur across double/triple bonds (unsaturated compounds).

C4H8 (alkene) and C2H4 (alkene) and C2H2 (alkyne) are unsaturated and add.

C3H8 (propane) is a saturated alkane and does not undergo addition reactions.

Q.24 [2 marks]

Four solutions, namely fructose, ethanol, hydrochloric acid and sodium hydroxide filled in four separate beakers are connected one by one in an electric circuit with a bulb. The solutions in which the bulb will glow when current is passed are :

(a) ethanol and hydrochloric acid
(b) fructose and ethanol
(c) fructose and sodium hydroxide
(d) hydrochloric acid and sodium hydroxide <<

Explanation:
The bulb glows only for solutions that conduct electricity, i.e. those with free ions.
HCl (strong acid) and NaOH (strong base) ionise to give ions and conduct.
Fructose and ethanol are non-electrolytes (do not ionise), so the bulb does not glow for them.

Q.25 [2 marks]

Which gas is evolved when magnesium metal reacts with very dilute HNO_3 ?

(a) Oxygen
(b) Nitrogen
(c) Hydrogen <<
(d) Nitrogen Dioxide

Explanation:
Nitric acid is generally an oxidising acid and does not give hydrogen with metals, but magnesium (and manganese) react with very dilute HNO_3 to liberate hydrogen gas.

Q.26 [2 marks]

In the question two statements are given – one labelled as Assertion (A) and other labelled as Reason (R). Answer this question selecting the appropriate option from (A), (B), (C) and (D) given below : Assertion (A) : Reaction of quick lime with water is an exothermic reaction. Reason (R) : A large amount of heat is evolved on the reaction of quick lime and water. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is

true.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). <<

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

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true.

Explanation:

Quick lime (CaO) reacting with water to form slaked lime releases a large amount of heat, so it is exothermic — A is true.

Evolving a large amount of heat is exactly what makes a reaction exothermic, so R is true and correctly explains A.

Section C

Short Answer Questions (3 marks each)

Q.27 [3 marks]

Define the following terms : (i) Olfactory indicator (ii) Water of crystallization

Answer: (i) Olfactory indicator: a substance whose smell (odour) changes in acidic and basic media, used to test acids and bases (e.g. onion, vanilla, clove oil). (ii) Water of crystallization: the fixed number of water molecules chemically combined in one formula unit of a salt (e.g. $CuSO_4 \cdot 5H_2O$).

Explanation:

(i) Olfactory indicators are substances whose odour changes in acidic or basic solutions (onion, clove oil, vanilla essence) and are used to detect acids/bases, especially for the visually impaired.

(ii) Water of crystallization is the definite number of water molecules present in one formula unit of a hydrated salt, e.g.

copper sulphate pentahydrate $CuSO_4 \cdot 5H_2O$ has 5 molecules of water of crystallization.

Q.28 [3 marks]

What happens when (i) lead (II) nitrate is heated ? (ii) iron (II) sulphate is heated ? (iii) silver chloride is exposed to sunlight ? Write balanced chemical equations of the reactions involved in support of your answer.

Answer: (i) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$ (brown fumes of NO_2). (ii) $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$. (iii) $2AgCl \rightarrow 2Ag + Cl_2$ (grey silver forms in sunlight).

Explanation:

(i) Lead(II) nitrate on heating decomposes to lead oxide, brown nitrogen dioxide gas and oxygen: $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$.

(ii) Ferrous sulphate (green) on heating gives reddish-brown ferric oxide and gases SO_2 and SO_3: $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$.

(iii) White silver chloride decomposes in sunlight (photochemical) to grey silver metal and chlorine gas: $2AgCl \rightarrow 2Ag + Cl_2$.

Q.29 [3 marks]

(A) (a) Give the chemical name and formula of Plaster of Paris. (b) Write the chemical equation of its preparation. (c) Give any two uses of it.

Answer: (a) Calcium sulphate hemihydrate, $CaSO_4 \cdot \frac{1}{2}H_2O$. (b) $CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O$ (gypsum heated at ~373 K). (c) Used for setting fractured bones (plaster casts) and for making toys/decorative statues/smoothing surfaces.

Explanation:

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

(b) It is made by heating gypsum ($CaSO_4 \cdot 2H_2O$) at about 373 K (100°C): $CaSO_4 \cdot 2H_2O \rightarrow CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O$.

(c) Uses: making casts to support fractured bones, and making toys, statues, decorative materials and smoothing wall surfaces.

OR

Q.29 [3 marks]

(B) (a) Name the acid present in ant's sting. (b) Give reason : (i) While diluting an acid, it is recommended that the acid should be added to water. (ii) Baking soda is used as an antacid.

Answer: (a) Formic acid (methanoic acid). (b)(i) Because dilution is highly exothermic; adding acid to water spreads the heat safely, whereas adding water to acid can cause violent boiling/spurting. (b)(ii) Baking soda (sodium hydrogencarbonate) is mildly basic; it neutralises excess acid in the stomach, relieving acidity.

Explanation:

(a) The sting of an ant contains formic (methanoic) acid.

(b)(i) Mixing acid and water releases a large amount of heat;

if water is added to concentrated acid the mixture can boil and splash out, so acid is added slowly to a large amount of water so the heat is absorbed/dissipated safely.

(b)(ii) Baking soda, $NaHCO_3$, is a weak base and neutralises the excess hydrochloric acid in the stomach, so it acts as an antacid to relieve acidity.

Q.30 [3 marks]

Alcohol forms a homologous series with general formula $C_nH_{2n+1}–OH$ and –OH group as functional group. Ethanol is commonly called alcohol and is used in alcoholic drinks. It is good solvent, used in medicines, cough syrups, tonics etc. (a) Write structural formula and name of 4th member of alcohol homologous series. (b) What happens when ethanol is heated with alkaline $KMnO_4$? Write chemical equation involved. (c) Write the chemical equation of reaction of ethanol with ethanoic acid in the presence of concentrated H_2SO_4. Write the name of this reaction.

Answer: (a) Butanol, $CH_3–CH_2–CH_2–CH_2–OH$ (C_4H_9OH). (b) Ethanol is oxidised to ethanoic (acetic) acid: $CH_3CH_2OH + 2[O] \xrightarrow{\text{alk. } KMnO_4} CH_3COOH + H_2O$. (c) $CH_3COOH + C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$; the reaction is esterification.

Explanation:

(a) 4th member of alcohols (n=4) is butanol, $CH_3CH_2CH_2CH_2OH$ (C_4H_9OH).

(b) Alkaline $KMnO_4$ (an oxidising agent) oxidises ethanol to ethanoic acid: $CH_3CH_2OH + 2[O] \rightarrow CH_3COOH + H_2O$.

(c) Ethanol reacts with ethanoic acid in presence of conc. H_2SO_4 to form ethyl ethanoate (an ester) and water: $CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$; this is called esterification.

OR

Q.30 [3 marks]

(c) What happens when ethanol is heated with excess concentrated sulphuric acid at 443 K ? Write chemical equation involved. What is the role of concentrated sulphuric acid in this reaction ?

Answer: Ethanol is dehydrated to ethene (ethylene): $C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4,\ 443\ K} CH_2=CH_2 + H_2O$. Concentrated sulphuric acid acts as a dehydrating agent (removes water).

Explanation:

On heating ethanol with excess concentrated sulphuric acid at 443 K, a water molecule is removed and ethene gas is formed: $C_2H_5OH \rightarrow CH_2=CH_2 + H_2O$ (conc. H_2SO_4, 443 K).

Here concentrated H_2SO_4 acts as a dehydrating agent, removing water from ethanol.

Q.31 [3 marks]

(A) (i) Give reasons for the following : (I) Ionic compound have generally high melting points and boiling points. (II) Solder, an alloy of lead and tin, is used for welding electrical wires. (III) Carbon cannot reduce the oxides of Na or Mg. (ii) The reaction of compound 'X' with aluminium is used to join railway tracks : (I) Identify the compound 'X'. (II) Name the reaction. (III) Write the balanced chemical equation of the reaction of compound 'X' with aluminium.

Answer: (i)(I) Strong electrostatic forces between oppositely charged ions need a

lot of energy to break, so high m.p./b.p. (II) Solder has a low melting point, so it melts easily and is used for joining (welding) electrical wires. (III) Na and Mg are more reactive than carbon (they have greater affinity for oxygen), so carbon cannot reduce their oxides. (ii)(I) X = Ferric oxide, Fe_2O_3. (II) Thermite reaction. (III) $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$ (+ heat).

Explanation:

(i)(I) Ionic compounds have strong electrostatic (ionic) bonds between ions; breaking these requires large energy, giving high melting and boiling points.

(II) Solder (lead + tin alloy) has a low melting point so it melts and solidifies easily to join wires.

(III) Sodium and magnesium are placed above carbon in the reactivity series (more reactive, stronger affinity for oxygen), so carbon cannot displace/reduce their oxides.

(ii) The thermite reaction: $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$, highly exothermic; the molten iron produced is used to weld broken railway tracks.

X is ferric oxide (Fe_2O_3).

OR

Q.31 [3 marks]

(B) (i) Write the balanced chemical equations when : (I) A mixture of Cu_2O and Cu_2S is heated. (II) ZnS is heated in the presence of oxygen. (ii) Give reasons for the following : (I) The wires carrying current in homes have a coating of PVC. (II) To make hot water tanks, copper is used and not steel. (iii) Show the formation of ionic compound CaO with electron dot structure. [Atomic number : Ca = 20, O = 8]

Answer: (i)(I) $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$. (i)(II) $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$. (ii)(I) PVC is an insulator and protects users from electric shock. (ii)(II) Copper does not react with hot water/steam and is a good conductor of heat, whereas iron/steel reacts (rusts) with hot water and steam. (iii) Ca (2,8,8,2) loses 2 electrons to O (2,6) which gains 2 electrons, forming Ca^{2+} and O^{2-} with 8 electrons around each in the dot structure, held by ionic bond as CaO.

Explanation:

(i)(I) Self-reduction of copper: $2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$.

(i)(II) Roasting of zinc sulphide: $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$.

(ii)(I) PVC coating is a good electrical insulator that prevents electric shocks and short circuits.

(ii)(II) Copper is unreactive towards hot water and steam and conducts heat well, so hot-water tanks are made of copper;

steel/iron would rust on contact with hot water and steam.

(iii) Calcium (2,8,8,2) transfers its two outer electrons to oxygen (2,6);

Ca becomes Ca^{2+} (2,8,8) and O becomes O^{2-} (2,8);

the electron-dot structure shows O with 8 dots and the ionic compound CaO held by electrostatic attraction.

Q.32 [3 marks]

Rays from the sun converge at a point 25 cm behind a convex lens. The distance at which an object be placed in front of the lens to get a virtual image, is :

(a) 20 cm <<

(b) 40 cm

(c) 50 cm

(d) More than 50 cm

Explanation:

Rays from the sun (parallel) converge at the focus, so focal length f = 25 cm.

A convex lens forms a virtual (erect, magnified) image only when the object is placed between the lens and its focus, i.e.

at a distance less than f = 25 cm.

Of the options, only 20 cm is less than 25 cm, so the object must be placed at 20 cm.

Q.33 [3 marks]

To restore clear vision in persons whose size of the eye ball has reduced, he/she is suggested to use suitable

(a) Converging lens <<

(b) Diverging lens

(c) Bifocal lens

(d) Cylindrical lens

Explanation:

If the eyeball has become too short, the image of near objects forms behind the retina — this is hypermetropia (long-sightedness).

It is corrected using a converging (convex) lens.

Section D

Long Answer Questions (5 marks each)

Q.34 [5 marks]

Assertion (A) : The needle of a magnetic compass kept in strong external magnetic field, always aligns itself in north-south direction on the earth. Reason (R) : Behaviour of the needle of a compass is same as that of a freely suspended bar magnet. (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (C) Assertion (A) is true, but Reason (R) is false. (D) Assertion (A) is false, but Reason (R) is true.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

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

(c) Assertion (A) is true, but Reason (R) is false.

(d) Assertion (A) is false, but Reason (R) is true. <<

Explanation:

In a strong external magnetic field the compass needle aligns along that external field, not necessarily north-south — so Assertion A is false.

Reason R (a compass needle behaves like a freely suspended bar magnet) is a true statement.

Hence A is false but R is true.

Q.35 [5 marks]

(a) Relate the speed of light in the given medium with its optical density. (b) Using the information given in the table below, arrange the medium A, B and C in the ascending order of their optical density.

Medium | Speed of light (m/s)

A | 2.25×10^8

B | 2×10^8

C | 2.08×10^8

Answer: (a) The higher the optical density of a medium, the lower the speed of light in it (speed of light is inversely related to optical density). (b) Ascending order of optical density: A < C < B.

Explanation:

(a) Optical density is inversely related to the speed of light: a denser medium (optically) has a lower speed of light and higher refractive index.

(b) Slower light means higher optical density.

Speeds: A = 2.25×10^8 (fastest), C = 2.08×10^8, B = 2×10^8 (slowest).

So optical density increases as speed decreases: A (lowest) < C < B (highest).

Q.36 [5 marks]

(A) (i) How does the change in curvature of the eye lens helps us in the process of seeing the nearby objects clearly ? (ii) State the range of the power of accommodation of a normal human eye.

Answer: (i) Ciliary muscles contract to increase the curvature (thickness) of the eye lens, decreasing its focal length so that the diverging rays from a nearby object are focused sharply on the retina (accommodation). (ii) The power of accommodation is about 4 D; i.e. the eye can vary its focal length so it can see clearly from the near point (~25 cm) to infinity.

Explanation:

(i) For a nearby object the ciliary muscles contract, making the eye lens more curved/thicker;

this shortens the focal length so that the rays from the close object converge exactly on the retina — this ability is accommodation.

(ii) A normal eye can see objects clearly from its near point (25 cm) to infinity;

the maximum change (power of accommodation) is about 4 D.

OR

Q.36 [5 marks]

(B) Draw a ray diagram to show the correction of eye defect of an old man who can not see an object placed closer than 1 m from his eye, clearly.

Answer: Ray diagram of hypermetropia (presbyopia) correction: use a convex (converging) lens that forms a virtual image at the person's near point (1 m) of an object held at 25 cm, so the eye can focus it clearly.

Explanation:

An old man unable to see objects nearer than 1 m has a receded near point (hypermetropia/presbyopia).

A convex (converging) lens is placed before the eye;

it forms an erect, virtual image of a nearby object (held at 25 cm) at his own near point (1 m), which the eye can then focus onto the retina.

The ray diagram shows the object, convex correcting lens, the virtual image at 1 m, and the eye focusing it on the retina.

Section E

Case Study Based Questions (4 marks each)

Q.37 [4 marks]

(a) Draw the ray diagram for refraction of light through a glass prism and mark angle of refraction and angle of deviation. (b) When the path of a light ray refracted through a glass prism is reversed how will the angle of deviation change ? Explain.

Answer: (a) Ray diagram showing incident ray, refraction at first face (angle of refraction r), emergent ray bent towards the base, with the angle of deviation D between the incident and emergent ray directions. (b) The angle of deviation remains the same, because light is reversible — reversing the ray traces the same path and gives the same deviation.

Explanation:

(a) The ray diagram of a prism shows the incident ray refracting into the glass (angle of refraction r at the first surface), travelling through and emerging bent towards the base;

the angle between the produced incident ray and the emergent ray is the angle of deviation D.

(b) By the principle of reversibility of light, if the emergent ray is sent back along the reversed path it retraces the same route, so the angle of deviation D stays unchanged.

Q.38 [4 marks]

(a) A ray of light after reflection from a concave mirror becomes parallel to its principal axis. Draw a labelled ray diagram to show this. (b) (i) Differentiate between the virtual images formed by a convex mirror and concave mirror. (ii) "The value of magnification 'm' for a mirror is –2." Calculate the height of object if the height of image is 20 cm.

Answer: (a) A ray passing through the focus F of a concave mirror is reflected parallel to the principal axis (labelled diagram). (b)(i) Convex mirror always forms a virtual, erect, diminished image; a concave mirror forms a virtual image only when the object is between pole and focus, and this image is erect and magnified (enlarged). (b)(ii) Height of object = 10 cm.

Explanation:

(a) A ray incident through the principal focus F of a concave mirror is reflected back parallel to the principal axis (converse of the parallel-ray rule).

(b)(i) Convex mirror: virtual image is always erect and diminished;

concave mirror: virtual image (object between P and F) is erect and enlarged (magnified).

(b)(ii) m = h_image / h_object →
−2 = 20 / h_object →
h_object = 20 / (−2) = −10; taking magnitude, the object height = 10 cm (the negative m indicates a real, inverted image so the image is inverted relative to object).

Q.39 [4 marks]

(a) Why does an electric bulb become dim when an electric heater in parallel circuit is switched ON ? (b) How to connect three resistors each of resistance 8 Ω, so that the equivalent resistance of the combination is 12 Ω ? Draw diagram of the combination and justify your answer.

Answer: (a) Switching on the heater (low resistance) in parallel draws a large current, increasing the total current through the mains/supply wires; the voltage drop across the connecting wires increases so less voltage reaches the bulb, making it dim. (b) Connect two 8 Ω resistors in parallel (= 4 Ω) and this combination in series with the third 8 Ω resistor: 4 + 8 = 12 Ω.

Explanation:

(a) A heater has low resistance, so on switching it on the total resistance of the parallel circuit falls and the current drawn from the supply rises.
The larger current causes a larger voltage drop across the supply/lead wires, so the voltage across the bulb decreases and it glows dimmer.
(b) Two 8 Ω resistors in parallel give 1/R = 1/8 + 1/8 = 2/8, R = 4 Ω.
Putting this 4 Ω in series with the remaining 8 Ω gives 4 + 8 = 12 Ω.
Diagram: two resistors in parallel, then in series with the third.

Q.40

Three students Shweta, Ayesha and Samridhi were performing an experiment to understand the factors on which the resistance of a conductor depends. Each one of them completed electric circuit with the help of a cell, an ammeter, a plug key and wire. Shweta put nichrome wire of length 'l' in the circuit and after plugging the key, noted current in the ammeter. Ayesha put nichrome wire of same thickness but twice the length i.e. '2l' in the circuit and after plugging the key, noted current in the ammeter. Samridhi took

copper wire of length 'l' and same thickness in the circuit and after plugging the key, noted current in the ammeter. (a) If the ammeter reading is X ampere with nichrome wire of length 'l', then what will be the ammeter reading if the length of nichrome wire is doubled with same area of cross-section ?

Answer: X/2 ampere

Explanation:

Resistance R is directly proportional to length ($R \propto l$).

Doubling the length doubles the resistance (2R).

For the same voltage, current $I = V/R$, so doubling R halves the current.

Original current = X, so new ammeter reading = X/2 ampere.

Q.41

(b) What happens to the ammeter reading if the area of cross-section of nichrome wire is doubled, keeping the length of wire 'l' the same ?

Answer: The ammeter reading doubles (becomes 2X)

Explanation:

Resistance is inversely proportional to area of cross-section ($R \propto 1/A$).

Doubling the area halves the resistance (R/2).

For the same applied voltage, current $I = V/R$, so halving R doubles the current.

Hence the ammeter reading becomes twice its original value (2X).

Q.42

(c) Define 'resistivity'. Write its SI unit. Compare the resistivity of an alloy with its constituents metals.

Answer: Resistivity is the resistance of a conductor of unit length and unit area of cross-section (a material property); SI unit ohm-metre (Ω m). The resistivity of an alloy is generally higher than that of its constituent (pure) metals.

Explanation:

Resistivity (ρ) is defined by R = ρl/A, so ρ is the resistance offered by a material of unit length and unit cross-sectional area;
it depends only on the material and temperature.
Its SI unit is ohm-metre (Ω·m).
Alloys (e.g.
nichrome) have higher resistivity than their constituent pure metals, which is why they are used in heating elements.

OR

Q.42

(c) Give reason : (i) Tungsten is used almost exclusively for making the filament of electric lamps. (ii) Conductors of bread-toasters are made of an alloy rather than a pure metal.

Answer: (i) Tungsten has a very high melting point and high resistivity, so it glows white-hot without melting when current passes. (ii) Alloys have high resistivity and do not oxidise (burn) readily at high temperature, so they produce more heat and last longer than pure metals.

Explanation:

(i) Tungsten is used for lamp filaments because it has a very high melting point (~3400°C) and retains most of the heat, so it can be heated to a high temperature to emit light without melting;
it also has high resistivity.
(ii) Heating elements of toasters are made of an alloy (like nichrome) because alloys have higher resistivity than pure metals (producing more heat) and do not oxidise/burn readily at high temperatures, giving longer life.

Q.43

(A) (i) Draw a diagram showing the magnetic field lines around a bar magnet. Write any two characteristics of magnetic field lines. (ii) Write the statement of Right hand thumb rule. (iii) The concentric circles representing the magnetic field around a current carrying straight wire become larger and

larger as we move away from the wire. How does magnetic field change on these concentric circles ?

Answer: (i) Diagram of field lines emerging from N pole and entering S pole (outside), forming closed loops; two characteristics: (1) field lines never intersect each other, (2) they are closer where the field is stronger (near poles) and farther apart where it is weaker. (ii) Right-hand thumb rule: if a current-carrying conductor is held in the right hand with the thumb pointing in the direction of current, the curled fingers show the direction of the magnetic field lines. (iii) The magnetic field decreases (becomes weaker) as we move away from the wire (larger circles), since field strength is inversely related to distance from the wire.

Explanation:

(i) Magnetic field lines of a bar magnet run from N to S outside the magnet forming closed loops.

Characteristics: they do not intersect (a compass has only one direction at a point) and their crowding indicates field strength (crowded = stronger near poles, spread out = weaker).

(ii) Right-hand thumb rule (Maxwell's rule): grasp the wire in the right hand with the thumb along the current;

the encircling fingers give the direction of the magnetic field.

(iii) On larger concentric circles (farther from the wire) the magnetic field is weaker — field strength decreases with increasing distance from the current-carrying wire.

OR

Q.43

(B) (i) Draw a diagram, showing the magnetic field lines in and around the current carrying solenoid. Write any two salient features of these lines. (ii) What is an electromagnet and how is it made ?

Answer: (i) Diagram of a solenoid with parallel, uniform straight field lines inside and looping field lines outside (like a bar magnet, with N and S ends); two features: (1) the field inside is uniform and strong (lines parallel and equally spaced), (2) the pattern outside resembles that of a bar magnet. (ii) An

electromagnet is a temporary magnet made by winding an insulated coil around a soft iron core; when current flows through the coil the core becomes strongly magnetic, and it loses magnetism when the current is switched off.

Explanation:

(i) A current-carrying solenoid produces a magnetic field like a bar magnet: field lines inside are straight, parallel and evenly spaced (uniform strong field), and outside they curve from one end (N) to the other (S).

Two features: uniform field inside;

one end acts as N pole, other as S pole (behaves like a bar magnet).

(ii) An electromagnet is a magnet formed by passing electric current through a coil (solenoid) wound on a soft iron core;

the iron core becomes strongly magnetised while the current flows and demagnetises when the current stops, so it is a temporary/controllable magnet.