CBSE Class 10 Science 2026 — Set 2 — 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]

The genotype of green stemmed tomato plant is denoted by 'GG' and that of purple stemmed tomato plant as 'gg'. Hybrid of a cross between these two were self-pollinated to obtain F2 progeny. What will be the ratio of GG, Gg and gg in this F2 progeny ?

(a) 2:1:1
(b) 3:1:0
(c) 1:1:2
(d) 1:2:1 <<

Explanation:
A monohybrid cross Gg × Gg gives genotypic ratio 1 GG : 2 Gg : 1 gg = 1:2:1.
Option (D).

Q.2 [1 mark]

Identify the type of tropic movement that is responsible for the movement of the pollen tube towards an ovule from the following options.

(a) Hydrotropism
(b) Geotropism
(c) Chemotropism <<
(d) Phototropism

Explanation:
The growth of the pollen tube towards the ovule is a response to chemical stimuli, hence chemotropism.
Option (C).

Q.3 [1 mark]

Spirogyra, despite being a multi-cellular organism, still shows a simple reproductive method. Select the correct option with regard to reproduction in

Spirogyra :

(a) Asexual reproduction by division of cells into two cells

(b) Sexual reproduction by division of cells into many cells

(c) Asexual reproduction by breaking up of Spirogyra filaments into smaller parts <<

(d) Sexual reproduction by the formation of gametes after meiosis of cells of filaments followed by fusion of male and female gametes

Explanation:

Spirogyra reproduces asexually by fragmentation — its filaments break up into smaller pieces, each growing into a new individual.

Option (C).

Q.4 [1 mark]

The carbohydrates, which are not used immediately in plants, are stored in the form of 'a', which serves as an internal energy reserve. What does 'a' stand for ?

(a) Starch <<

(b) Sugar

(c) Fat

(d) Protein

Explanation:

Plants store surplus carbohydrate as starch, a storage polysaccharide and internal energy reserve.

Option (A).

Q.5 [1 mark]

The following events occur during the process of photosynthesis. Choose the option that indicates the correct events. (i) Oxidation of carbon dioxide to carbohydrates (ii) Conversion of light energy into chemical energy (iii) Absorption of light energy by chlorophyll (iv) Conversion of hydrogen and oxygen into water Options :

(a) (i) and (ii)

(b) (ii) and (iii) <<

(c) (iii) and (iv)

(d) (i) and (iv)

Explanation:

During photosynthesis chlorophyll absorbs light energy (iii) and light energy is converted into chemical energy (ii).

CO_2 is reduced (not oxidized), and water is split (not formed).

Option (B).

Q.6 [1 mark]

In the given figure, identify the trophic level having maximum concentration of harmful chemicals.

(a) T1

(b) T5 <<

(c) T4

(d) T3

Explanation:

Harmful chemicals (e.g.

pesticides) are non-biodegradable and biomagnify — their concentration increases at each higher trophic level.

T5 is the topmost level in the pyramid, so it has the maximum concentration.

Option (B).

Q.7 [1 mark]

Which of the following limits the number of trophic levels in a food chain ?

(a) Availability of water

(b) Deficient food supply

(c) Decrease in energy at higher levels <<

(d) Pollution in air

Explanation:

Only about 10% of energy is passed to each successive trophic level, so energy decreases at higher levels, limiting the number of trophic levels.

Option (C).

Q.8 [1 mark]

Assertion (A) : Blood plasma transports carbon dioxide in dissolved form, while oxygen is transported by respiratory pigments. Reason (R) : Carbon dioxide is more soluble in water than in oxygen. Select the correct answer: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of 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 Assertion (A). <<

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

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

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

Explanation:

CO_2 is more soluble in water so it is carried dissolved in plasma, whereas oxygen (low solubility) is carried by respiratory pigment (haemoglobin).

Both true and R correctly explains A.

Option (A).

Q.9 [1 mark]

Assertion (A) : There are generally a greater number of individuals at the lower trophic levels of an ecosystem. Reason (R) : The greatest number is of the producers. Select the correct answer: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B)

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

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

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

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

Explanation:

In an ecosystem numbers are highest at lower trophic levels, and producers (the lowest level) are most numerous — R correctly explains A.

Option (A).

Q.10 [1 mark]

"The timing and the amount of hormone secreted by a gland are regulated in the human body." Justify this statement with the help of an example.

Answer: Feedback mechanism regulates hormone secretion (e.g. blood sugar controls insulin release)

Explanation:

Hormone secretion is controlled by feedback mechanisms.

Example: when blood glucose rises, pancreatic cells detect it and secrete more insulin to lower it;

when glucose falls, insulin secretion decreases.

Thus both timing and amount are regulated.

OR

Q.10 [1 mark]

Electrical impulse is an excellent means to transmit information in the animal body, but there are some limitations to the use of electrical impulses. State any two limitations.

Answer: (1) Reach only cells connected by nervous tissue; (2) once generated, a cell takes time to reset before generating a new impulse (limited rapidity)

Explanation:

Limitations of electrical impulses: (1) They reach only those cells that are connected by nervous tissue, not every cell of the body.

(2) After transmitting an impulse a nerve cell needs time to reset its mechanisms before it can generate and transmit a new one, so impulses cannot be sent continuously/very rapidly.

Q.11 [1 mark]

"Variation is useful for the survival of species over time." Explain this statement with the help of an example.

Answer: Variations help a species survive environmental changes (e.g. heat-resistant bacteria survive a temperature rise)

Explanation:

Variations give some individuals an advantage when the environment changes.

Example: in a population of bacteria, if some have heat-resistance variations and temperature rises, those variants survive and reproduce while others die — so variation ensures the species' survival over time.

Q.12 [1 mark]

Suggest one best way to dispose of the following wastes : (i) Kitchen waste (ii) Metallic waste (iii) Plastic bottles (iv) Sanitary waste

Answer: (i) Composting; (ii) Recycling; (iii) Recycling/reuse; (iv) Incineration

Explanation:

(i) Kitchen (biodegradable) waste → composting to make manure.

(ii) Metallic waste → recycling (remelting).

(iii) Plastic bottles → recycling/reuse.

(iv) Sanitary waste → incineration (safe burning).

Q.13 [1 mark]

Complete the pathways given below, showing the breakdown of glucose. Identify 'A', 'B', 'C', 'D', 'E' and 'F'.

Answer: A = Glycolysis (in the cytoplasm); B and C = Ethanol and CO_2 (in yeast, no oxygen); D = Lactic acid (in muscle cells, no oxygen); E and F = CO_2 and H_2O (in mitochondria, with oxygen)

Explanation:

Glucose is first broken down to pyruvate in the cytoplasm by glycolysis (A).

Without oxygen, in yeast pyruvate gives ethanol + CO_2 (B, C) and in muscle cells lactic acid (D).

With oxygen, in mitochondria pyruvate is broken down to CO_2 + H_2O (E, F).

Energy is released in every pathway.

Q.14 [1 mark]

(a) Giving two examples, justify the statement that the sex of the offspring in all animals is not always genetically determined. (b) Differentiate between the sex chromosomes of male and female human beings.

Answer: (a) In some animals sex is decided by the environment, e.g. temperature of egg incubation in turtles/some reptiles; e.g. in snails an individual can change sex. (b) Female = XX (both X); Male = XY (one X, one Y)

Explanation:

(a) Sex is not always genetic: in reptiles like turtles the temperature at which fertilised eggs are kept determines the sex of the offspring;

in some animals (e.g.

snails) an individual can even change sex — showing environmental/non-genetic determination.

(b) Human females have two X chromosomes (XX); males have one X and one Y chromosome (XY).

Q.15 [1 mark]

Read the following passage and answer the questions that follow : A

middle-aged person is facing some cognitive changes in himself. His early symptoms included mild forgetfulness. For example, forgetting where he left his mobile or failing to find words to complete his sentences. He was facing problems in driving a car, climbing up and down the stairs, inserting a plug into an outlet. He slowly developed a sad mood and anxiety. (a) What are voluntary actions ?

Answer: Actions performed consciously under the control of the will/thinking part of the brain (fore-brain), e.g. writing, walking

Explanation:

Voluntary actions are those that are performed consciously, according to our will, controlled by the fore-brain (cerebrum) — e.g.
writing, talking, walking, driving.

Q.16 [1 mark]

(Passage from Q15 continued.) (b) Which part of the brain is responsible for precision of voluntary actions ?

Answer: Cerebellum

Explanation:

The cerebellum (part of the hind-brain) is responsible for precision of voluntary actions and maintaining posture and balance of the body.

Q.17 [1 mark]

(Passage from Q15 continued.) (c) (i) Explain the role of the medulla.

Answer: The medulla (in the hind-brain) controls involuntary actions such as blood pressure, salivation, vomiting, heartbeat and breathing

Explanation:

The medulla oblongata, part of the hind-brain, controls many involuntary actions including blood pressure, salivation, vomiting, heart rate and breathing.

OR

Q.17 [1 mark]

(Passage from Q15 continued.) (c) (ii) How do the animal muscles move ?

Answer: Muscle cells change shape by rearranging their special proteins (contract/shorten) in response to nervous stimulation, producing movement

Explanation:

Muscle cells contain special contractile proteins.

On receiving a nerve impulse, these proteins change their arrangement and form, causing the muscle cells to shorten (contract).

This change in shape/length of the muscle produces movement.

Q.18 [1 mark]

Attempt either (a) or (b) : (a) (i) Name an organ that helps in the formation of male germ cells in humans and also mention the condition that favours the formation of male germ cells. (ii) In male reproductive system, write the pathway followed to deliver male germ cells to the site of fertilisation. (iii) Mention the main physical feature of the male germ cell that helps it move towards the female germ cell.

Answer: (i) Testes; a temperature lower than body temperature (which is why testes lie in the scrotum outside the abdomen). (ii) Testis → vas deferens → (joined by urethra from urinary bladder) → urethra → out; delivered via the penis into the female tract. (iii) A long tail (flagellum) that enables the sperm to swim/move.

Explanation:

(i) Male germ cells (sperms) are formed in the testes, favoured by a temperature about 1–2°C lower than body temperature, so the testes lie in the scrotum outside the abdominal cavity.

(ii) Pathway: testes →

vas deferens →

urethra (the urethra also carries secretions of the prostate and seminal vesicles) →

out through the penis into the female reproductive tract.

(iii) The sperm has a long whip-like tail (flagellum) that helps it move towards the egg.

OR

Q.18 [1 mark]

(b) Radha has three children. She does not want to have more children. Radha visits a nearby hospital, to know the methods to prevent pregnancy. (i) Mention the name of any two ways other than the surgical methods, following which Radha can avoid unwanted pregnancies. (ii) Name the surgical methods to prevent pregnancy. (iii) Give one example each of sexually transmitted diseases caused by bacteria and virus.

Answer: (i) Any two of: use of oral contraceptive pills, use of copper-T/loop (IUD), use of condoms/barrier methods. (ii) Tubectomy (in females) and vasectomy (in males). (iii) Bacterial STD — Syphilis/Gonorrhoea; Viral STD — AIDS (HIV) / warts.

Explanation:

(i) Non-surgical contraception: oral contraceptive pills (change hormonal balance) and IUD/Copper-T, or barrier methods like condoms.

(ii) Surgical (permanent) methods: tubectomy — blocking the fallopian tubes in females;

vasectomy — blocking the vas deferens in males.

(iii) Bacterial STD example: gonorrhoea or syphilis;

viral STD example: AIDS (caused by HIV) or warts.

Q.19 [1 mark]

Which of the following are combination reactions ? (i) $2KClO3 \rightarrow 2KCl + 3O2$ (ii) $MgO + H2O \rightarrow Mg(OH)2$ (iii) $4Al + 3O2 \rightarrow 2Al2O3$ (iv) $Zn + FeSO4 \rightarrow ZnSO4 + Fe$ Options :

(a) (i) and (iii)

(b) (iii) and (iv)

(c) (ii) and (iv)

(d) (ii) and (iii) <<

Explanation:

A combination reaction is where two or more reactants form a single product.

(ii) $MgO + H_2O \rightarrow Mg(OH)_2$ and (iii) $4Al + 3O_2 \rightarrow 2Al_2O_3$ are combinations.

(i) is decomposition; (iv) is displacement.

Option (D).

Q.20 [1 mark]

A metal carbonate reacts with a solution X which forms a salt, water and a gas Y. What are X and Y ?

(a) X – Sodium hydroxide, Y – Carbon dioxide

(b) X – Sodium hydroxide, Y – Hydrogen

(c) X – Hydrochloric acid, Y – Carbon dioxide <<

(d) X – Hydrochloric acid, Y – Hydrogen

Explanation:

Metal carbonate + acid → salt + water + CO_2.

So X is an acid (hydrochloric acid) and Y is carbon dioxide.

Option (C).

Section B

Very Short Answer Questions (2 marks each)

Q.21 [2 marks]

When ferrous sulphate crystals are heated in a test tube, we observe that :

(a) A colourless gas with no smell is evolved.

(b) A brown gas is evolved.

(c) The green colour of the salt fades and a gas with the smell of burning sulphur is evolved. <<

(d) The green colour of the salt fades and no gas is evolved.

Explanation:

On heating, ferrous sulphate (green) loses water then decomposes to Fe_2O_3, evolving SO_2 and SO_3 gases which have the smell of burning sulphur;

the green colour fades.

Option (C).

Q.22 [2 marks]

When Mg metal is treated with hot water, it starts floating on the surface of the water. The reason for its different behaviour is :

(a) Mg is a lighter element than water.

(b) Mg reacts with water to produce H2 gas which helps in floating. <<

(c) Mg reacts with water to produce N2 gas which helps in floating.

(d) Mg reacts with water to form CO2 gas which helps in floating.

Explanation:

Mg reacts with hot water to give Mg(OH)2 and hydrogen gas;
the bubbles of H2 stick to the metal surface and make it float.
Option (B).

Q.23 [2 marks]

The pH of the gastric juices released during digestion is :

(a) Less than 7 <<

(b) More than 7

(c) Equal to 7

(d) Equal to 0

Explanation:

Gastric juice contains hydrochloric acid, so it is acidic with pH less than 7 (about 1–2).
Option (A).

Q.24 [2 marks]

Baking powder is a mixture of :

(a) Sodium carbonate + Acetic acid

(b) Sodium carbonate + Tartaric acid

(c) Sodium hydrogen carbonate + Tartaric acid <<

(d) Sodium hydrogen carbonate + Acetic acid

Explanation:

Baking powder is a mixture of sodium hydrogen carbonate (baking soda) and a mild edible acid such as tartaric acid.

Option (C).

Q.25 [2 marks]

A student notices that her silver jewellery turned dull and had a grey-black coating over it after wearing for a few months. What results in the change in colour of the silver metal ?

(a) The polish over the jewellery was removed after wearing for a few months.

(b) The jewellery comes in contact with air, moisture and acids and corrodes. <<

(c) Dust particles over the jewellery change its colour.

(d) Its colour changes due to rusting.

Explanation:

Silver corrodes (tarnishes) when it reacts with air (H2S/sulphur), moisture and acids, forming a grey-black coating of silver sulphide.

Option (B).

Q.26 [2 marks]

Assertion (A) : Carbon compounds can form chains, branched and ring structures. Reason (R) : Carbon exhibits the property of catenation. Select the correct answer: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of 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 Assertion (A). <<

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

correct explanation of Assertion (A).

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

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

Explanation:

Catenation is the ability of carbon atoms to link with one another forming long chains, branched chains and rings.

So R correctly explains A.

Option (A).

Section C

Short Answer Questions (3 marks each)

Q.27 [3 marks]

Read the following passage and answer the questions that follow : One student was comparing the reactivity of different metals for his science project. He added iron filings in four test tubes A, B, C and D containing aqueous solutions of ZnSO4, CuSO4, FeSO4 and Al2(SO4)3. (i) In which of the test tubes will he observe the reaction to be the most vigorous and why ?

Answer: (i) Test tube B (CuSO4), because iron is more reactive than copper and displaces it. (ii) Fe + CuSO4 → FeSO4 + Cu

Explanation:

Iron displaces only those metals below it in the reactivity series.

Zn, Al are more reactive than Fe (no reaction in A and D); Fe cannot displace itself (C).

Iron is more reactive than copper, so it displaces copper from CuSO4 in test tube B — the most (only) vigorous reaction.

Balanced equation: Fe + CuSO4 → FeSO4 + Cu.

Q.28 [3 marks]

Attempt either (a) or (b) : (a) (i) Write one example each of one metal that is so soft that it can be cut with a knife, and one non-metal that is a good conductor of electricity. (ii) Using the electronic configuration, explain how

Mg atom combines with oxygen to form magnesium oxide by transfer of electrons. [Atomic number : Mg = 12, O = 8]

Answer: (i) Soft metal cut with a knife — sodium (Na) [or potassium]; non-metal good conductor of electricity — graphite (carbon). (ii) Mg (2,8,2) loses 2 electrons → Mg^{2+} (2,8); O (2,6) gains 2 electrons → O^{2-} (2,8); electrostatic attraction forms MgO.

Explanation:

(i) Sodium/potassium are soft metals that can be cut with a knife;
graphite is a non-metal that conducts electricity.
(ii) Mg electronic configuration 2,8,2 loses its 2 valence electrons to become Mg^{2+} (2,8, stable).
Oxygen 2,6 gains these 2 electrons to become O^{2-} (2,8, stable).
The oppositely charged ions attract by electrostatic (ionic) bonding to form $Mg^{2+}O^{2-}$ = MgO.

OR

Q.28 [3 marks]

(b) Give reasons : (i) Metal sulphides and carbonates should be converted to their metal oxides in the process of extraction of metals. (ii) Aluminium oxide is considered as an amphoteric oxide. (iii) Metals like Na, K, Ca and Mg are never found in their free state in nature.

Answer: (i) Because it is easier to obtain a metal from its oxide (by reduction) than from its sulphide or carbonate; so ores are first converted to oxides (roasting/calcination). (ii) Because Al_2O_3 reacts with both acids and bases to give salt and water. (iii) Because they are very reactive metals, so they occur only in combined form (as compounds), never free.

Explanation:

(i) Metal oxides are more easily reduced to the metal than sulphides/carbonates, so sulphide ores are roasted and carbonate ores calcined to give the oxide first.
(ii) Aluminium oxide reacts with acids (like a base) and with bases (like an acid) forming salt and water, so it is amphoteric.

(iii) Na, K, Ca, Mg are highly reactive and readily combine with other elements, so in nature they exist only as compounds, never in the free (native) state.

Q.29 [3 marks]

Seema took a small amount of copper powder in a china dish and heated it. What changes will she observe on heating ? When H2 gas is passed over this heated substance, what visible changes will be seen in it ? Give the chemical equations of the reactions involved, along with the names and colours of the products in each case.

Answer: On heating: reddish-brown copper turns black as copper(II) oxide (CuO) forms — 2Cu + O2 → 2CuO (black). On passing H2 over hot CuO: black CuO turns reddish-brown copper again — CuO + H2 → Cu + H2O.

Explanation:

Heating copper in air: 2Cu + O2 → 2CuO.

The reddish-brown copper is coated with a black layer of copper(II) oxide.

Passing hydrogen over hot CuO reduces it: CuO + H2 →

Cu + H2O; the black CuO turns back to reddish-brown copper (Cu) and water is formed.

Q.30 [3 marks]

Read the following passage and answer the questions that follow : In the given diagram, when electricity is passed through an aqueous solution of a common salt, a substance 'Z' is produced, along with the evolution of gases 'X' and 'Y'. When a burning matchstick is brought near the gas 'Y', it burns with a pop sound, whereas 'X' is used for disinfecting drinking water. When 'X' is passed through slaked lime, an insoluble substance 'A' is produced. (a) Write the names of the gases 'X' and 'Y'.

Answer: X = Chlorine (Cl2); Y = Hydrogen (H2)

Explanation:

Electrolysis of aqueous NaCl (chlor-alkali process) gives chlorine at the anode and hydrogen at the cathode.

Y burns with a pop sound → hydrogen.

X is used to disinfect water → chlorine.

Q.31 [3 marks]

(Passage from Q30 continued.) (b) Write the balanced chemical equation for the formation of substance 'Z'.

Answer: $2NaCl + 2H_2O \rightarrow 2NaOH + Cl_2 + H_2$ (Z = sodium hydroxide, NaOH)

Explanation:

In the chlor-alkali process, substance Z is sodium hydroxide, which forms at the cathode region.

Balanced overall equation: $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$.

Q.32 [3 marks]

(Passage from Q30 continued.) (c) (i) What happens : (I) If a drop of red litmus solution is added to the aqueous solution of substance 'Z' ? (II) If CO_2 gas is passed through ammoniacal solution of aqueous NaCl ?

Answer: (I) Red litmus turns blue, because Z (NaOH) is a base/alkali. (II) Sodium hydrogencarbonate ($NaHCO_3$) is formed (precipitates) — the reaction of the ammonia–brine process: $NaCl + H_2O + CO_2 + NH_3 \rightarrow NaHCO_3 + NH_4Cl$.

Explanation:

(I) Z is NaOH, a strong base, so it turns red litmus blue.

(II) Passing CO_2 through an ammoniacal brine solution (Solvay process) forms sodium hydrogencarbonate: $NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$.

OR

Q.32 [3 marks]

(Passage from Q30 continued.) (c) (ii) Identify the substance 'A' and write the balanced chemical equation of the reaction which takes place in its preparation.

Answer: A = Bleaching powder, calcium oxychloride $Ca(OCl)Cl$ [i.e. $CaOCl_2$].

$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Explanation:

When chlorine (X) is passed over slaked lime $Ca(OH)_2$, bleaching powder (calcium oxychloride, $CaOCl_2$) — an insoluble substance A — is formed: $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$.

Q.33 [3 marks]

Attempt either (a) or (b) : (a) A carbon compound 'P' of molecular formula C_2H_6O is found to be neutral when tested with red and blue litmus. A gas that burns with a pop sound is produced when sodium metal reacts with compound 'P'. (i) Identify the compound 'P'. (ii) The carbon compound 'P' is heated with conc. H_2SO_4 at 443 K to produce compound 'Q'. (I) Write the chemical equation for the reaction. (II) What is the role of conc. H_2SO_4 in this reaction ? (iii) What is likely to be observed on heating compound 'P' with ethanoic acid with an acid as a catalyst ? Write the chemical equation for the reaction.

Answer: (i) P = Ethanol, C_2H_5OH. (ii)(I) $C_2H_5OH \xrightarrow{\text{conc.}H_2SO_4,\ 443K} C_2H_4 + H_2O$ (ethene); (II) conc. H_2SO_4 acts as a dehydrating agent. (iii) A sweet/fruity smelling ester is formed (esterification): $CH_3COOH + C_2H_5OH \xrightarrow{\text{acid catalyst}} CH_3COOC_2H_5 + H_2O$.

Explanation:

(i) C_2H_6O that is neutral to litmus and releases H_2 (pop sound) with sodium is ethanol, C_2H_5OH.

(ii) Heating ethanol with conc.

H_2SO_4 at 443 K dehydrates it to ethene: $C_2H_5OH \rightarrow C_2H_4 + H_2O$; conc.

H_2SO_4 is the dehydrating agent.

(iii) Ethanol + ethanoic acid with acid catalyst gives ethyl ethanoate (ester) with a sweet fruity smell: $CH_3COOH + C_2H_5OH \rightarrow$

$CH_3COOC_2H_5 + H_2O$.

OR

Q.33 [3 marks]

(b) (i) Write the structural formula of benzene. (ii) State the reason why carbon can neither form C4+ cation nor C4- anion. (iii) What type of bond is formed between carbon and hydrogen ? (iv) How is ethanol converted to ethanoic acid ? (v) Complete the following chemical equation : $CH_3COOC_2H_5 + NaOH \rightarrow$

Answer: (i) Benzene C_6H_6 — a hexagonal ring of 6 carbons with alternate double bonds, each C bonded to one H. (ii) Losing 4 electrons (C4+) needs too much energy and leaves 6 protons holding only 2 electrons; gaining 4 electrons (C4-) is hard for the nucleus of 6 protons to hold 10 electrons — both are energetically unfavourable, so carbon shares electrons (covalent). (iii) Covalent bond. (iv) By oxidation with alkaline $KMnO_4$ (or acidified $K_2Cr_2O_7$) and heating. (v) $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$.

Explanation:

(i) Benzene is a planar hexagonal ring, C_6H_6, with three alternating C=C double bonds.

(ii) To form C4+ carbon would have to lose 4 electrons (needs very large energy) and to form C4- it would have to gain 4 electrons which its 6-proton nucleus cannot hold — so carbon achieves noble-gas configuration by sharing electrons (covalent bonding).

(iii) Covalent bonds.

(iv) Ethanol is oxidised to ethanoic acid using alkaline $KMnO_4$ (or acidified potassium dichromate) with heating.

(v) Saponification: $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa$ (sodium ethanoate) + C_2H_5OH (ethanol).

Section D

Long Answer Questions (5 marks each)

Q.34 [5 marks]

From the following options choose the one which gives negative magnification greater than one :

(a) Concave mirror; Nature of image – real <<
(b) Concave mirror; Nature of image – virtual
(c) Convex mirror; Nature of image – real
(d) Convex mirror; Nature of image – virtual

Explanation:
Negative magnification means a real, inverted image (only concave mirrors form real images).
Magnification greater than one means the image is enlarged.
A concave mirror forming a real image can give magnification more than one (object between F and C).
Option (A).

Q.35 [5 marks]

A thin beam of white light falls on a face of a glass prism and a spectrum is obtained on a screen. Which of the following options is the correct sequence of colours from top to bottom on the screen ?

(a) Red, Green, Yellow, Violet, Blue
(b) Red, Yellow, Green, Blue, Violet <<
(c) Violet, Blue, Green, Yellow, Red
(d) Violet, Red, Green, Yellow, Blue

Explanation:
A prism deviates violet most and red least, so red appears at the top and violet at the bottom.
From top to bottom: Red, Orange, Yellow, Green, Blue, Indigo, Violet.
Among the options, Red, Yellow, Green, Blue, Violet is the correct order.
Option (B).

Q.36 [5 marks]

Assertion (A) : Direction of force exerted on a current-carrying conductor placed in a magnetic field remains same if the directions of both magnetic field and current flowing through the conductor are reversed. Reason (R) :

The direction of force exerted on a current-carrying conductor placed in an external magnetic field can be determined by using magnetic compass. Select the correct answer: (A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A). (B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of 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 Assertion (A).

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

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

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

Explanation:

By F = I L × B, reversing both current and field direction leaves the force direction unchanged, so Assertion is true.

But the direction of the force is found by Fleming's left-hand rule, not a magnetic compass, so Reason is false.

Option (C).

Section E

Case Study Based Questions (4 marks each)

Q.37 [4 marks]

With the help of the given ray diagram, calculate the refractive index of Medium 2 with respect to Medium 1. (Given that √3 = 1·732)

Answer: n = √3 ≈ 1.732

Explanation:

From the ray diagram the angle of incidence (in medium 1) is 60° and angle of refraction (in medium 2) is 30°.

By Snell's law, refractive index of medium 2 w.r.t.

medium 1 = sin(i)/sin(r) = sin60°/sin30° = (√3/2)/(1/2) = √3 = 1.732.

Q.38 [4 marks]

Attempt either (a) or (b) : (a) How does the focal length of eye lens change as the distance of the object from the eyes is altered ? Explain.

Answer: The focal length changes by the action of ciliary muscles (power of accommodation): for a near object the ciliary muscles contract, the lens becomes thicker and focal length decreases; for a distant object the muscles relax, the lens becomes thinner and focal length increases.

Explanation:

The eye adjusts its focal length by the power of accommodation.

When an object is near, the ciliary muscles contract, increasing the curvature (thickness) of the eye lens, so its focal length decreases.

When the object is far, the ciliary muscles relax, the lens becomes thin, and the focal length increases — keeping the image on the retina in both cases.

OR

Q.38 [4 marks]

(b) Why is the concave lens used as a corrective lens for a myopic eye ?

Answer: A myopic (short-sighted) eye forms the image of a distant object in front of the retina; a concave (diverging) lens of suitable power diverges the incoming rays so that the image is shifted back onto the retina, correcting the defect.

Explanation:

In myopia the eye's converging power is too high, so distant objects focus in front of the retina.

A concave (diverging) lens diverges the parallel rays from a distant object before they enter the eye, effectively reducing the eye's power so the image forms exactly on the retina — correcting the near-sightedness.

Q.39 [4 marks]

(a) Write the expression for the magnification produced by a lens in terms of

object distance and image distance. (b) A 4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. Calculate the size of the image formed, if the distance of the object from the lens is 10 cm.

Answer: (a) m = v/u = h'/h. (b) v = -20 cm, m = +2, image size = 8 cm (erect, virtual, magnified).

Explanation:

(a) Magnification m = height of image/height of object = h'/h = v/u.

(b) Given f = +20 cm, u = -10 cm.

Lens formula 1/v - 1/u = 1/f →

1/v = 1/f + 1/u = 1/20 + 1/(-10) = 1/20 - 2/20 = -1/20 →

v = -20 cm.

m = v/u = (-20)/(-10) = +2.

Image height h' = m × h = 2 × 4 = 8 cm.

The image is virtual, erect and magnified (8 cm).

Q.40

What is scattering of light ? How is scattering of light different from reflection of light ? Explain.

Answer: Scattering = redirection of light in many directions by very small particles/molecules of the medium (colour depends on particle size, e.g. blue sky). Reflection = bouncing back of light from a surface following the laws of reflection (angle of incidence = angle of reflection). Scattering is in all directions and wavelength-dependent; reflection is in a definite direction and follows fixed laws.

Explanation:

Scattering of light is the phenomenon in which light falling on tiny particles or molecules is absorbed and re-emitted (redirected) in many different directions;

the amount depends on the wavelength and particle size (this is why the sky is blue and the sun red at sunrise/sunset).

Reflection is the bouncing back of light from a smooth surface obeying the laws of reflection (angle of incidence = angle of reflection) in a definite direction.

Key differences: scattering sends light in many directions and is strongly wavelength-dependent, whereas reflection sends light in one definite direction and is independent of wavelength.

Q.41

The values of current I flowing in a given resistor for the corresponding values of potential difference V applied across the ends of resistor are given below in the table : I (Amperes): 0·4, 0·8, 1·2, 1·6, 2·0 ; V (Volts): 1·2, 2·4, 3·6, 4·8, 6·0. Plot a graph between V and I and calculate the resistance of that resistor.

Answer: R = 3 Ω

Explanation:

The V–I graph is a straight line through the origin (V ∝ I, Ohm's law), whose slope gives R.

R = V/I = 1.2/0.4 = 3 Ω (same for every pair, e.g.

6.0/2.0 = 3 Ω).

Resistance = 3 Ω.

Q.42

Read the following passage and answer the questions that follow : Swati, a class 10 student, observes that when she passes close to the refrigerator in her kitchen, she feels the heat, although the things kept inside the refrigerator are cool. (a) Describe the cause of heating in the above-mentioned case.

Answer: The heat is produced by the heating effect of electric current — current flowing through the compressor/coils of the refrigerator produces heat ($P = I^2R$), which is expelled at the back of the fridge, making it feel warm.

Explanation:

A refrigerator works by extracting heat from inside and rejecting it outside through its compressor and condenser coils.

Electric current flowing through these components produces heat by the heating effect

of current (Joule heating, H = I²Rt), which is released at the back/sides of the fridge, so Swati feels the heat while the inside stays cool.

Q.43

(Passage from Q42 continued.) (b) A current I flows through a resistor of resistance R when the potential difference across it is V. Applying Ohm's law, write the formula for amount of heat produced by the resistor in time t.

Answer: H = I²Rt (= VIt = V²t/R)

Explanation:

Joule's law of heating: H = I²Rt.

Using Ohm's law V = IR, this can also be written as H = VIt or H = V²t/R.

Heat produced H = I²Rt.

Q.44

(Passage from Q42 continued.) (c) (i) Write any two practical applications of heating effect of electric current.

Answer: Any two of: electric heaters/irons/toasters/room heaters (heating appliances) work on this effect; the filament of an electric bulb glows and gives light; an electric fuse melts to protect circuits.

Explanation:

Practical applications of the heating effect of current: (1) electric heating appliances such as electric iron, toaster, room heater, geyser and kettle;

(2) the incandescent electric bulb, whose filament is heated to glow and emit light;

(3) the electric fuse, which melts when excess current flows, protecting the circuit.

OR

Q.44

(Passage from Q42 continued.) (c) (ii) Define the commercial unit of electric energy and express it in Joules (J).

Answer: The commercial unit of electrical energy is the kilowatt-hour (kW h), 'unit'. 1 kW h = the energy used by an appliance of power 1 kilowatt in 1 hour. 1 kW h =

1000 W × 3600 s = 3.6 × 10^6 J.

Explanation:

The commercial unit of electrical energy is the kilowatt-hour (kW h), also called one 'unit'.

It is the electrical energy consumed by a device of power 1 kilowatt (1000 W) used for 1 hour (3600 s).

1 kW h = 1000 W × 3600 s = 3,600,000 J = 3.6 × 10^6 J.

Q.45

Attempt either (a) or (b) : (a) (i) State the rule which gives the direction of force acting on a current-carrying conductor placed in a magnetic field. (ii) What is a fuse ? Why is it called a safety device ? (iii) Why are electrical appliances with metallic bodies connected to the mains through a three-pin plug, whereas an electric bulb is connected with a two-pin plug ? (iv) What will be the direction of force experienced by the conductor AB due to the magnetic field, when current flows in the direction shown ? Name the law you applied to find the direction.

Answer: (i) Fleming's left-hand rule. (ii) A fuse is a short piece of wire of low melting point and high resistance placed in series in a circuit; if current exceeds a safe value it melts and breaks the circuit, protecting appliances from damage — hence a safety device. (iii) Metallic-body appliances need earthing to carry any leakage current safely to earth, so they use a three-pin plug (with an earth pin); a bulb has no exposed metal body to be touched, so a two-pin plug (live + neutral) suffices. (iv) Current in AB is upward (A at top) and the field is towards the right, so by Fleming's left-hand rule the force on AB is perpendicular to the plane of the paper, directed into the page. Law used: Fleming's left-hand rule.

Explanation:

(i) The direction of force is given by Fleming's left-hand rule (thumb = force, forefinger = field, middle finger = current).

(ii) A fuse is a thin wire of an alloy of low melting point placed in series with the

appliance;
when current rises above a safe limit it heats up and melts, breaking the circuit and protecting the appliance/wiring — so it is a safety device.
(iii) Appliances with metal bodies are earthed through the third (earth) pin so that any leakage of current goes safely to earth instead of giving a shock;
a bulb with no accessible metal body needs only live and neutral, i.e.
a two-pin plug.
(iv) Current upward and field to the right: forefinger right, middle finger up, thumb points into the page, so the force on AB is into the plane of the paper.
Law: Fleming's left-hand rule.

OR

Q.45

(b) (i) Draw the pattern of magnetic field lines through and around a current-carrying circular loop. (ii) State the rule to find out the direction of the magnetic field inside and around the circular loop. (iii) Give reasons : (I) Why should a burnt-out fuse be replaced by another fuse of identical rating only, in an electric circuit ? (II) Why is soft iron-core used in making an electromagnet ?

Answer: (i) Concentric circles near the wire that become larger and, at the centre of the loop, appear as straight lines perpendicular to the plane (field lines through the loop combine to give a nearly uniform field at the centre). (ii) Right-hand thumb rule (Maxwell's right-hand grip rule). (iii)(I) The fuse rating equals the safe maximum current; a fuse of the same rating melts at the correct current — a higher-rated fuse would not blow in time (unsafe) and a lower-rated one would blow unnecessarily. (II) Soft iron is easily and strongly magnetised when current flows and loses its magnetism as soon as the current stops, so it makes a strong temporary (controllable) electromagnet.

Explanation:
(i) Around each part of the circular wire the field lines are concentric circles;
at the centre of the loop these combine to give field lines that are straight and perpendicular to the plane of the loop (nearly uniform strong field at the centre).

(ii) The direction is found using the right-hand thumb rule (grip rule).

(iii)(I) A fuse's rating is the maximum current it can carry safely;
replacing it with one of identical rating ensures it melts at the correct (safe) current — a higher rating would fail to protect the circuit and a lower one would blow too often.

(II) Soft iron gains strong magnetism only while current flows and loses it immediately when current stops, so it is used as the core to make a strong, temporary and controllable electromagnet.