CBSE 2024 Science — 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]

Solid Calcium oxide reacts vigorously with water to form Calcium hydroxide accompanied by the liberation of heat. From the information given above it may be concluded that this reaction:

(a) is endothermic and pH of the solution formed is more than 7.

(b) is exothermic and pH of the solution formed is 7.

(c) is endothermic and pH of the solution formed is 7.

(d) is exothermic and pH of the solution formed is more than 7. <<

Explanation:

$CaO + H_2O \rightarrow Ca(OH)_2 + Heat.$

Since heat is liberated, the reaction is exothermic.

$Ca(OH)_2$ is a base, so the pH of the solution is more than 7.

Q.2 [1 mark]

Juice of tamarind turns blue litmus to red. It is because of the presence of an acid called:

(a) methanoic acid

(b) acetic acid

(c) tartaric acid <<

(d) oxalic acid

Explanation:

Tamarind contains tartaric acid, which is responsible for its sour taste and the ability to turn blue litmus red.

Q.3 [1 mark]

Select from the following a process in which a combination reaction is involved:

(a) Black and White photography

(b) Burning of coal <<

(c) Burning of methane

(d) Digestion of food

Explanation:

Burning of coal, $C + O_2 \rightarrow CO_2$, is a combination reaction (two reactants give one product).

Burning of methane, $CH_4 + 2O_2 \rightarrow$

$CO_2 + 2H_2O$, gives two products so it is a combustion/oxidation reaction, not a combination.

Black and white photography and digestion involve decomposition.

Q.4 [1 mark]

The oxide which can react with HCl as well as KOH to give corresponding salt and water is:

(a) CuO

(b) Al_2O_3 <<

(c) Na_2O

(d) K_2O

Explanation:

Al_2O_3 is an amphoteric oxide. It reacts with both acids and bases:

$Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

$Al_2O_3 + 2KOH \rightarrow 2KAlO_2 + H_2O$

CuO, Na_2O, and K_2O are basic oxides that react only with acids.

Q.5 [1 mark]

Consider the following cases:

(a) $CaSO_4 + Al \rightarrow$

(b) $CuSO_4 + Ca \rightarrow$

(c) $FeSO_4 + Cu \rightarrow$

(d) $ZnSO_4 + Mg \rightarrow$

The cases in which new products will form are:

(a) (a) and (b)

(b) (b) and (c)

(c) (c) and (d)

(d) (b) and (d) <<

Explanation:

A more reactive metal displaces a less reactive metal from its salt solution.

Reactivity order: Ca > Mg > Al > Zn > Fe > Cu.

In (b) Ca is more reactive than Cu, so displacement occurs.

In (d) Mg is more reactive than Zn, so displacement occurs.

In (a) Al is less reactive than Ca, so no reaction.

In (c) Cu is less reactive than Fe, so no reaction.

Q.6 [1 mark]

Identify the correct statement about the following reaction:

$2H_2S + SO_2 \rightarrow 2H_2O + S$

(a) H_2S is oxidising agent and SO_2 is reducing agent.

(b) H_2S is reduced to sulphur.

(c) SO_2 is oxidising agent and H_2S is reducing agent. <<

(d) SO_2 is oxidised to sulphur.

Explanation:

In this reaction, H_2S is oxidised (S goes from -2 to 0, losing electrons) — so H_2S is the reducing agent.

SO_2 is reduced (S goes from +4 to 0, gaining electrons) — so SO_2 is the oxidising agent.

Q.7 [1 mark]

Consider the following statements about homologous series of carbon compounds:

(a) All succeeding members differ by $–CH_2$ unit.

(b) Melting point and boiling point increases with increasing molecular mass.

(c) The difference in molecular masses between two successive members is

16 u.

(d) C_2H_2 and C_3H_4 are NOT the successive members of alkyne series.

The correct statements are:

(a) (a) and (b) <<

(b) (b) and (c)

(c) (a) and (c)

(d) (c) and (d)

Explanation:

(a) Correct: successive members differ by a $–CH_2$ unit.

(b) Correct: melting and boiling points increase with molecular mass.

(c) Incorrect: the difference is 14 u (CH_2 = 12 + 2), not 16 u.

(d) Incorrect: C_2H_2 and C_3H_4 ARE successive members of the alkyne series (C_nH_{2n-2}, n = 2 and 3), so the statement that they are not is false.

The correct statements are (a) and (b).

Q.8 [1 mark]

Which of the following statement(s) is (are) true about human heart?

(a) Right atrium receives oxygenated blood from lungs through pulmonary artery.

(b) Left atrium transfers oxygenated blood to left ventricle which sends it to various parts of the body.

(c) Right atrium receives deoxygenated blood through vena cava from upper and lower body.

(d) Left atrium transfers oxygenated blood to aorta which sends it to different parts of the body.

(a) (a)

(b) (a) and (d)

(c) (b) and (c) <<

(d) (b) and (d)

Explanation:

(a) Incorrect: the right atrium receives deoxygenated blood through the vena cava, not oxygenated blood from the lungs through the pulmonary artery.

(b) Correct: the left atrium transfers oxygenated blood to the left ventricle, which pumps it to the body.

(c) Correct: the right atrium receives deoxygenated blood from the upper and lower body through the vena cava.

(d) Incorrect: the left atrium sends blood to the left ventricle, not directly to the aorta.

Correct statements: (b) and (c).

Q.9 [1 mark]

Select out of the following a gland which does NOT occur as a pair in the human body:

(a) Pituitary <<

(b) Ovary

(c) Testis

(d) Adrenal

Explanation:

The pituitary gland is a single gland located at the base of the brain.

Ovaries (2), testes (2), and adrenal glands (2) all occur in pairs.

Q.10 [1 mark]

In human respiratory system, when a person breathes in, the position of ribs and diaphragm will be:

(a) lifted ribs and curvedome shaped diaphragm.

(b) lifted ribs and flattened diaphragm. <<

(c) relaxed ribs and flattened diaphragm.

(d) relaxed ribs and curvedome shaped diaphragm.

Explanation:

During inhalation (breathing in), the ribs are lifted up and outward by intercostal muscles, and the diaphragm contracts and becomes flattened.

This increases the volume of the thoracic cavity, reducing pressure and drawing air

into the lungs.

Q.11 [1 mark]

Identify the mode of asexual reproduction in the following organism (figure: a Hydra with a bud growing out of its body):

(a) Fragmentation
(b) Multiple fission
(c) Budding <<
(d) Binary fission

Explanation:

The figure shows Hydra with a small outgrowth (bud) on its body.
A bud develops from the parent by repeated cell division, grows into a tiny new individual and later detaches.
This is budding.

Q.12 [1 mark]

A cross made between two pea plants produces 50% tall and 50% short pea plants. The gene combination of the parental pea plants must be:

(a) Tt and Tt
(b) TT and Tt
(c) Tt and tt <<
(d) TT and tt

Explanation:

When Tt (heterozygous tall) is crossed with tt (homozygous short): Tt × tt →
Tt, Tt, tt, tt = 50% tall (Tt) and 50% short (tt).
This is a test cross.
TT × Tt gives 100% tall.
Tt × Tt gives 75% tall, 25% short.
TT × tt gives 100% tall.

Q.13 [1 mark]

Consider the following statements in the context of human eye:

(a) The diameter of the eye ball is about 2.3 cm.
(b) Iris is a dark muscular diaphragm that controls the size of the pupil.
(c) Most of the refraction for the light rays entering the eye occurs at the crystalline lens.
(d) While focusing on the objects at different distances the distance between the crystalline lens and the retina is adjusted by ciliary muscles.
The correct statements are:

(a) (a) and (b) <<
(b) (a), (b) and (c)
(c) (b), (c) and (d)
(d) (a), (c) and (d)

Explanation:
(a) Correct — the diameter of the eyeball is approximately 2.3 cm.
(b) Correct — the iris is a dark muscular diaphragm that controls the size of the pupil to regulate light entering the eye.
(c) Incorrect — most refraction occurs at the cornea (outer surface), not at the crystalline lens.
(d) Incorrect — ciliary muscles adjust the focal length (curvature) of the lens, not the distance between lens and retina.

Q.14 [1 mark]

The maximum resistance of a network of five identical resistors of 1/5 Ω each can be:

(a) 1 Ω <<
(b) 0.5 Ω
(c) 0.25 Ω
(d) 0.1 Ω

Explanation:
Maximum resistance is obtained when all resistors are connected in series.
R_total = 5 × (1/5) = 1 Ω.

Q.15 [1 mark]

Study the I-V graph for three resistors of resistances R_1, R_2 and R_3, and select the correct statement from the following (R_1 has the steepest slope, R_3 has the least steep slope):

(a) $R_1 = R_2 = R_3$

(b) $R_1 > R_2 > R_3$

(c) $R_3 > R_2 > R_1$ <<

(d) $R_2 > R_3 > R_1$

Explanation:

In an I-V graph, the slope = I/V = 1/R.

A steeper slope means lower resistance.

Since R_1 has the steepest slope (highest I for given V), R_1 has the least resistance.

R_3 has the least steep slope, so R_3 has the greatest resistance.

Therefore $R_3 > R_2 > R_1$.

Q.16 [1 mark]

Strength of magnetic field produced by a current carrying solenoid DOES NOT depend upon:

(a) number of turns in the solenoid

(b) direction of the current flowing through it

(c) radius of solenoid <<

(d) material of core of the solenoid

Explanation:

The strength of the magnetic field inside a solenoid depends on: (i) number of turns per unit length, (ii) magnitude of current flowing through it, and (iii) material of the core.

The direction of current determines the direction (polarity) of the magnetic field, not its strength.

The radius of the solenoid does not affect the strength of the magnetic field inside an ideal solenoid.

Note: this answer could not be confirmed against an official CBSE marking scheme.

Q.17 [1 mark]

Assertion (A): Different metals have different reactivities with water and dilute acids.

Reason (R): Extraction of a metal from its ore depends on its position in the reactivity series.

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

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

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

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

Explanation:

Both assertion and reason are true.

Different metals do have different reactivities with water and dilute acids, and the extraction method does depend on the metal's position in the reactivity series.

However, the reason does not explain the assertion — the assertion is about reactivity with water/acids, while the reason is about extraction methods.

Q.18 [1 mark]

Assertion (A): Human female has a perfect pair of sex chromosome.

Reason (R): Sex chromosome contributed by the human male in the zygote decides the sex of a child.

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

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

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

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

Explanation:

Both statements are true.

Females have XX chromosomes (a perfect/matched pair), and the sex of the child is determined by the male's contribution (X or Y chromosome).

However, the reason does not explain the assertion — the male's role in sex

determination doesn't explain why females have a perfect pair of sex chromosomes.

Q.19 [1 mark]

Assertion (A): Myopic eye cannot see distant objects distinctly.

Reason (R): For the correction of myopia converging lenses of appropriate power are prescribed by eye-surgeons.

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

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

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

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

Explanation:

Assertion is true — a myopic eye cannot see distant objects clearly as the image forms in front of the retina.

Reason is false — myopia is corrected using diverging (concave) lenses, not converging lenses.

Converging (convex) lenses are used for hypermetropia.

Q.20 [1 mark]

Assertion (A): The deflection of a compass needle placed near a current carrying wire decreases when the magnitude of an electric current in the wire is increased.

Reason (R): Strength of the magnetic field at a point due to a current carrying conductor increases on increasing the current in the conductor.

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

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

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

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

Explanation:

Assertion is false — when current increases, the magnetic field increases, so the deflection of the compass needle also increases (not decreases).

Reason is true — magnetic field strength is directly proportional to the current ($B \propto I$).

Section B

Very Short Answer Questions (2 marks each)

Q.21 [2 marks]

(a) 'No precipitation reaction can occur without exchange of ions between the two reactants.' Justify this statement giving a balanced chemical equation for the reaction.

OR

(b) Giving one example of each, differentiate between a displacement reaction and a double displacement reaction.

Answer: (a) A precipitation reaction occurs when two soluble salts in aqueous solution exchange their ions to form an insoluble salt (precipitate). Without exchange of ions, no new insoluble compound can form. Example: $Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_4\downarrow + 2NaCl(aq)$. Here Na^+ and Ba^{2+} ions exchange their partners (SO_4^{2-} and Cl^-) to form insoluble $BaSO_4$.

OR

(b) Displacement reaction: A more reactive element displaces a less reactive element from its compound. Example: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ (iron displaces copper).

Double displacement reaction: Two compounds exchange their ions to form two new compounds. Example: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$ (exchange of ions between two compounds).

Explanation:

Precipitation reactions are a type of double displacement reaction where ions are exchanged between two reactants forming an insoluble product.

The exchange of ions is essential for the formation of the precipitate.

OR

Q.21 [2 marks]

Giving one example of each, differentiate between a displacement reaction and a double displacement reaction.

Answer: Displacement reaction: A more reactive element displaces a less reactive element from its compound. Example: $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ (iron displaces copper).

Double displacement reaction: Two compounds exchange their ions to form two new compounds. Example: $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$ (exchange of ions between two compounds).

Explanation:

In a displacement reaction, one element takes the place of another in a compound.

In a double displacement reaction, ions from two different compounds exchange places to form two new compounds.

Q.22 [2 marks]

Photosynthesis takes place in the leaves and the food prepared by it reaches other parts of the plants. Name the process involved and explain it.

Answer: The process is called Translocation. It is the transport of soluble food materials (sucrose, amino acids) from the leaves (source) to other parts of the plant (sink) through the phloem. The phloem tissue consists of sieve tubes and companion cells. The transport of food in the phloem requires ATP energy. Sucrose is transported into the sieve tubes using energy from ATP, which increases the osmotic pressure. Water enters the phloem by osmosis, creating a pressure gradient that moves the food to parts with lower pressure (storage organs, growing regions, roots).

Explanation:

Translocation is the process by which food prepared in leaves during photosynthesis is transported to other parts of the plant through phloem.

It utilises ATP energy and occurs via pressure flow mechanism.

Q.23 [2 marks]

'Stability of DNA in a species is ensured during sexual reproduction.' Justify the statement.

Answer: During sexual reproduction, both parents contribute equal amounts of DNA through gametes. Each gamete (sperm and egg) is haploid, containing half the number of chromosomes (n). When fertilisation occurs, the zygote receives one set of chromosomes from each parent, restoring the diploid number (2n). This process of meiosis (to form gametes) followed by fertilisation ensures that the DNA content (chromosome number) remains stable/constant from generation to generation in a species. If the DNA amount were not halved during gamete formation, it would keep doubling with each generation.

Explanation:

DNA stability is maintained because gametes are formed by meiosis (reducing chromosome number to half), and fertilisation restores the original diploid number. This ensures constant DNA content across generations.

Q.24 [2 marks]

(a) State two laws of refraction of light.

OR

(b) Define the term absolute refractive index of a medium. A ray of light enters from vacuum to glass of absolute refractive index 1.5. Find the speed of light in glass. The speed of light in vacuum is 3×10^8 m/s.

Answer: (a) The two laws of refraction of light are:

1. The incident ray, the refracted ray, and the normal to the interface at the point of incidence, all lie in the same plane.

2. The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for a given pair of media (Snell's law): $\sin i / \sin r$ = constant

= n_{21}

OR

(b) Absolute refractive index of a medium is defined as the ratio of the speed of light in vacuum (c) to the speed of light in that medium (v). n = c/v.

Given: n = 1.5, c = 3×10^8 m/s

v = c/n = $(3 \times 10^8) / 1.5 = 2 \times 10^8$ m/s

The speed of light in glass is 2×10^8 m/s.

Explanation:

(a) Laws of refraction: (1) Incident ray, refracted ray, and normal lie in the same plane.

(2) Snell's law: $n_1 \sin i = n_2 \sin r$.

(b) Absolute refractive index n = c/v.

Speed of light in glass = c/n = $3\times10^8/1.5 = 2\times10^8$ m/s.

OR

Q.24 [2 marks]

Define the term absolute refractive index of a medium. A ray of light enters from vacuum to glass of absolute refractive index 1.5. Find the speed of light in glass. The speed of light in vacuum is 3×10^8 m/s.

Answer: Absolute refractive index of a medium is defined as the ratio of the speed of light in vacuum (c) to the speed of light in that medium (v). n = c/v.

Given: n = 1.5, c = 3×10^8 m/s

v = c/n = $(3 \times 10^8) / 1.5 = 2 \times 10^8$ m/s

The speed of light in glass is 2×10^8 m/s.

Explanation:

Absolute refractive index is the ratio of speed of light in vacuum to speed of light in the medium (n = c/v).

For glass: v = c/n = $3\times10^8/1.5 = 2\times10^8$ m/s.

Q.25 [2 marks]

Use Ohm's law to determine the potential difference across the 3 Ω resistor in the circuit shown in the following diagram when key is closed:

The circuit has a 2V battery connected to three resistors: 2Ω and 3Ω in parallel, and this combination in series with a 1Ω resistor.

Answer: The 2 V cell, 1 Ω, 2 Ω and 3 Ω resistors are all in series (single loop, key closed).

R_total = 1 + 2 + 3 = 6 Ω

Current I = V/R = 2/6 = 1/3 A (the same current flows through every resistor).

Potential difference across the 3 Ω resistor: V = I × R = (1/3) × 3 = 1 V

Explanation:

All three resistors are in series with the 2 V cell, so I = 2/(1+2+3) = 1/3 A.

V across 3 Ω = (1/3) × 3 = 1 V.

Q.26 [2 marks]

Name the term used for the materials which cannot be broken down by biological processes. Give two ways by which they harm various components of an ecosystem.

Answer: The term used is Non-biodegradable substances/materials.

Two ways they harm the ecosystem:

1. Biomagnification: Non-biodegradable substances (like pesticides, DDT) enter the food chain and their concentration increases at each trophic level, reaching harmful levels in top consumers.

2. Pollution: They accumulate in the environment (soil, water bodies), contaminating them and making them unfit for living organisms. For example, plastic waste chokes water bodies and harms aquatic life.

Explanation:

Non-biodegradable substances cannot be broken down by biological processes.

They cause harm through biomagnification (accumulation in food chains) and

environmental pollution (contamination of soil, water, and air).

Section C

Short Answer Questions (3 marks each)

Q.27 [3 marks]

It is observed that Calcium on reaction with water floats on its surface. Explain why it happens. Also write a balanced chemical equation for the reaction that occurs. What happens when the aqueous solution of the product of this reaction reacts with Carbon dioxide gas? Write a balanced chemical equation for the reaction.

Answer: When calcium reacts with water, it floats because the hydrogen gas (H_2) produced in the reaction forms bubbles that stick to the surface of the calcium metal, making it float.

$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2(g)\uparrow$

When the aqueous solution of calcium hydroxide (lime water) reacts with carbon dioxide gas, calcium carbonate (white precipitate) is formed:

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s)\downarrow + H_2O(l)$

This is why lime water turns milky when CO_2 is passed through it.

Explanation:

Calcium floats on water because H_2 gas bubbles stick to its surface.

$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$.

When $Ca(OH)_2$ solution reacts with CO_2: $Ca(OH)_2 + CO_2 \rightarrow$ $CaCO_3 + H_2O$ (lime water turns milky).

Q.28 [3 marks]

Draw a labelled diagram to show electrolytic refining of copper. State what

happens when electric current is passed through the electrolyte taken in this case.

Answer: Electrolytic refining of copper:

Setup:
- Anode: Thick block of impure copper
- Cathode: Thin strip of pure copper
- Electrolyte: Acidified copper sulphate solution ($CuSO_4$)

When electric current is passed:
- At the anode: Impure copper dissolves into the electrolyte as Cu^{2+} ions. $Cu \rightarrow Cu^{2+} + 2e^-$
- At the cathode: Cu^{2+} ions from the electrolyte get deposited as pure copper. $Cu^{2+} + 2e^- \rightarrow Cu$
- The soluble impurities go into the solution, while insoluble impurities settle at the bottom of the anode as 'anode mud'.

Thus, pure copper is transferred from the anode to the cathode.

Explanation:
In electrolytic refining, impure copper (anode) dissolves as Cu^{2+} ions and pure copper deposits at the cathode from the acidified $CuSO_4$ electrolyte.
Impurities either dissolve or settle as anode mud.

Q.29 [3 marks]

(a) Give reasons for the following:
(i) Alveoli in lungs are richly supplied with blood capillaries.
(ii) Respiratory pigment in the blood takes up oxygen and not carbon dioxide.
(iii) During anaerobic respiration, a 3-carbon molecule is formed as an end product instead of CO_2 in human beings.

OR

(b) (i) Name the movements that occur all along the gut in human digestive system. How do they help in digestion?
(ii) Where is bile juice stored in human body? List two roles of bile juice.

Answer: (a) (i) Alveoli are richly supplied with blood capillaries to provide a large surface area for the exchange of gases (O_2 and CO_2) between blood and alveolar air. The extensive capillary network ensures maximum absorption of oxygen and release of CO_2.
(ii) The respiratory pigment (haemoglobin) has a high affinity for oxygen. It binds with oxygen to form oxyhaemoglobin. Haemoglobin does not have a strong affinity for CO_2; instead, CO_2 is mostly transported dissolved in blood plasma as bicarbonate ions.
(iii) During anaerobic respiration in humans, glucose (6-carbon) is incompletely broken down. Pyruvate (3-carbon) is converted to lactic acid (3-carbon) in the absence of oxygen. The process does not proceed to complete oxidation, so CO_2 is not the end product; instead, lactic acid (a 3-carbon molecule) accumulates.

OR

(b) (i) Peristaltic movements occur all along the gut. These are rhythmic wave-like contractions of the muscular walls of the alimentary canal. They push the food forward through the digestive tract and help in mixing the food with digestive enzymes/juices, facilitating proper digestion.
(ii) Bile juice is stored in the gall bladder. Two roles: (1) It makes the acidic food from the stomach alkaline for the pancreatic enzymes to act. (2) Bile salts break down large fat globules into smaller globules (emulsification), increasing surface area for enzyme action.

Explanation:

(a)(i) Rich blood supply in alveoli maximises gas exchange.

(ii) Haemoglobin has high affinity for O_2 and forms oxyhaemoglobin.

(iii) Anaerobic respiration in humans produces lactic acid (3-carbon), not CO_2.

(b)(i) Peristalsis pushes food and mixes it with enzymes.

(ii) Bile is stored in gall bladder; it emulsifies fats and makes medium alkaline.

OR

Q.29 [3 marks]

(i) Name the movements that occur all along the gut in human digestive system. How do they help in digestion?

(ii) Where is bile juice stored in human body? List two roles of bile juice.

Answer: (i) Peristaltic movements occur all along the gut. These are rhythmic wave-like contractions of the muscular walls of the alimentary canal. They push the food forward through the digestive tract and help in mixing the food with digestive enzymes/juices, facilitating proper digestion.

(ii) Bile juice is stored in the gall bladder. Two roles: (1) It makes the acidic food from the stomach alkaline for the pancreatic enzymes to act. (2) Bile salts break down large fat globules into smaller globules (emulsification), increasing surface area for enzyme action.

Explanation:

Peristalsis is the rhythmic contraction of gut muscles that pushes food forward and mixes it with enzymes.

Bile is stored in the gall bladder and helps emulsify fats and create alkaline medium.

Q.30 [3 marks]

Explain the events that take place once a sperm reaches the oviduct till it becomes a foetus. Write the role of placenta in pregnancy.

Answer: Events from sperm reaching oviduct to foetus formation:

1. Fertilisation: The sperm fuses with the ovum (egg) in the oviduct (fallopian tube) to form a zygote.

2. Cell division: The zygote begins to divide repeatedly as it moves down the oviduct to form a ball of cells called an embryo.
3. Implantation: The embryo gets implanted (embedded) in the thickened and richly blood-supplied lining of the uterus.
4. Tissue differentiation: The embryo develops body parts and tissue differentiation occurs. After about 8 weeks, the embryo with all major organs and recognisable features is called a foetus.

Role of placenta:
- The placenta is a disc-like structure embedded in the uterine wall, connected to the foetus through the umbilical cord.
- It provides nourishment (glucose, oxygen, nutrients) to the developing foetus from the mother's blood.
- It removes waste products (CO_2, urea) from the foetus to the mother's blood.
- It acts as a barrier and prevents mixing of mother's and foetus's blood.
- It also produces hormones to maintain pregnancy.

Explanation:
Fertilisation occurs in oviduct, zygote divides to form embryo, embryo implants in uterus wall, and develops into foetus.
Placenta provides nutrients and oxygen, removes wastes, and produces hormones for pregnancy maintenance.

Q.31 [3 marks]

(a) Define the term power of accommodation of human eye. Write the name of the part of eye which plays a major role in the process of accommodation and explain what happens when human eye focuses on (i) nearby objects and (ii) distant objects.

OR

(b) Draw a ray diagram to show the formation of a rainbow in the sky. On this

diagram mark A — where dispersion of light occurs, B — where internal reflection of light occurs and C — where refraction of light occurs. List two necessary conditions to observe a rainbow.

Answer: (a) Power of accommodation is the ability of the eye lens to adjust its focal length to form sharp images of objects at varying distances on the retina.

The ciliary muscles play a major role in accommodation.

(i) Nearby objects: Ciliary muscles contract, making the lens thicker (more curved). This decreases the focal length of the lens, allowing the image of nearby objects to form on the retina.

(ii) Distant objects: Ciliary muscles relax, making the lens thinner (less curved). This increases the focal length of the lens, enabling the image of distant objects to form on the retina.

OR

(b) Rainbow formation: Sunlight enters a water droplet, gets refracted (bent) at point C, then undergoes dispersion into component colours at point A. The dispersed light undergoes total internal reflection at point B (back surface of droplet), and then refracts again as it exits the droplet.

Two necessary conditions:

1. The Sun should be behind the observer (sunlight should come from behind).
2. Rain droplets (or water droplets) should be present in the atmosphere in front of the observer.

Explanation:

(a) Power of accommodation is the ability of the eye to change focal length of its lens. Ciliary muscles control this.

For nearby objects, lens thickens (shorter focal length);
for distant objects, lens thins (longer focal length).
(b) Rainbow forms by refraction, dispersion, and total internal reflection in water droplets.
Conditions: Sun behind observer, rain droplets in front.

OR

Q.31 [3 marks]

Draw a ray diagram to show the formation of a rainbow in the sky. On this diagram mark A — where dispersion of light occurs, B — where internal reflection of light occurs and C — where refraction of light occurs. List two necessary conditions to observe a rainbow.

Answer: Rainbow formation: Sunlight enters a water droplet, gets refracted (bent) at point C, then undergoes dispersion into component colours at point A. The dispersed light undergoes total internal reflection at point B (back surface of droplet), and then refracts again as it exits the droplet.

Two necessary conditions:
1. The Sun should be behind the observer (sunlight should come from behind).
2. Rain droplets (or water droplets) should be present in the atmosphere in front of the observer.

Explanation:
A rainbow forms when sunlight undergoes refraction, dispersion, and total internal reflection inside water droplets.
The Sun must be behind the observer and rain/water droplets must be present.

Q.32 [3 marks]

Draw a diagram to show the pattern of magnetic field lines on a horizontal sheet of paper due to a straight conductor passing through its centre and carrying current vertically upwards. Mark on it (i) the direction of current in the conductor and (ii) the corresponding field lines. State right hand thumb

rule and check whether the directions marked by you are in accordance with this rule.

Answer: Diagram description: A straight conductor passes vertically through the centre of a horizontal sheet of paper. The current flows upward (shown by a dot symbol ⊙ at the centre, representing current coming out of the paper). The magnetic field lines form concentric circles around the conductor on the horizontal sheet.

(i) Direction of current: Vertically upward (out of the page, shown as ⊙).
(ii) Field lines: Concentric circles in anticlockwise direction (when viewed from above).

Right Hand Thumb Rule: If you hold the current-carrying straight conductor in your right hand such that the thumb points in the direction of current, then the curl/wrap of the fingers around the conductor gives the direction of the magnetic field lines.

Verification: With the thumb pointing upward (direction of current), the fingers curl in the anticlockwise direction when viewed from above. This confirms the direction of the field lines drawn is correct.

Explanation:
Magnetic field lines around a straight current-carrying conductor are concentric circles. Using the right-hand thumb rule (thumb = current direction, fingers = field direction), with upward current, field lines are anticlockwise when viewed from above.

Q.33 [3 marks]

Use of pesticides to protect our crops affect organisms at various trophic levels and eventually humans. Name the phenomenon involved and explain how does it happen.

Answer: The phenomenon is called Biological Magnification (Biomagnification).

Explanation: When pesticides (like DDT) are sprayed on crops, they enter the food chain. These pesticides are non-biodegradable chemicals that cannot be broken down by biological processes. At each trophic level in the food chain, these chemicals become more concentrated because:

1. Pesticides are absorbed by plants from the soil/spraying.
2. Primary consumers (herbivores like insects) eat many plants, accumulating the pesticide in their bodies.
3. Secondary consumers eat many primary consumers, further concentrating the pesticide.
4. Tertiary consumers (top predators) accumulate the highest concentration.

Since humans are at the top of many food chains, they receive the maximum concentration of these pesticides. This causes severe health problems in humans and can affect reproduction in birds.

Explanation:

Biological magnification is the phenomenon where non-biodegradable pesticides accumulate and their concentration increases at each successive trophic level in a food chain, reaching maximum levels in top consumers including humans.

Section D

Long Answer Questions (5 marks each)

Q.34 [5 marks]

(a) (i) Give reason why carbon can neither form C^{4+} cations nor C^{4-} anions but form covalent compounds.

(ii) What is homologous series of carbon compound? Write the molecular formula of any two consecutive members of homologous series of aldehydes.

(iii) Draw the structure of the molecule of cyclohexane (C_6H_{12}).

OR

(b) (i) Name a commercially important carbon compound having functional group –OH and write its molecular formula.
(ii) Write chemical equation to show its reaction with:
(1) Sodium metal
(2) Excess conc. sulphuric acid
(3) Ethanoic acid in the presence of an acid catalyst
(4) Acidified potassium dichromate
Also write the name of the product formed in each case.

Answer: (a) (i) Carbon has 4 electrons in its outermost shell. To form C^{4+}, it would need to lose 4 electrons, which requires enormous energy. To form C^{4-}, it would need to gain 4 electrons, but it would be difficult for the nucleus with 6 protons to hold 10 electrons. Therefore, carbon shares electrons and forms covalent bonds.

(ii) A homologous series is a series of compounds having the same functional group, similar chemical properties, and the same general formula, with successive members differing by a $–CH_2$ unit.
Two consecutive members of homologous series of aldehydes:
- Methanal (HCHO) — CH_2O
- Ethanal (CH_3CHO) — C_2H_4O

(iii) Cyclohexane (C_6H_{12}) has a hexagonal ring structure with 6 carbon atoms, each bonded to 2 hydrogen atoms, connected by single bonds in a ring.

OR

(b) (i) Ethanol (C_2H_5OH or C_2H_6O)
(ii) Reactions:
(1) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$ — Product: Sodium ethoxide

(2) $C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4,\ 443K} C_2H_4 + H_2O$ — Product: Ethene (dehydration)

(3) $C_2H_5OH + CH_3COOH \xrightarrow{\text{acid catalyst}} CH_3COOC_2H_5 + H_2O$ — Product: Ethyl ethanoate (ester)

(4) $C_2H_5OH \xrightarrow{(K_2Cr_2O_7/H^+)} CH_3COOH$ — Product: Ethanoic acid (acetic acid)

Explanation:

(a) Carbon forms covalent bonds because losing or gaining 4 electrons is energetically unfavourable.

Homologous series members differ by CH_2.

Cyclohexane has a 6-membered ring.

(b) Ethanol (C_2H_5OH) reacts with Na to give sodium ethoxide, with H_2SO_4 to give ethene, with ethanoic acid to give ethyl ethanoate, and with $K_2Cr_2O_7$ to give ethanoic acid.

OR

Q.34 [5 marks]

(i) Name a commercially important carbon compound having functional group –OH and write its molecular formula.

(ii) Write chemical equation to show its reaction with:

(1) Sodium metal

(2) Excess conc. sulphuric acid

(3) Ethanoic acid in the presence of an acid catalyst

(4) Acidified potassium dichromate

Also write the name of the product formed in each case.

Answer: (i) Ethanol (C_2H_5OH or C_2H_6O)

(ii) Reactions:

(1) $2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2\uparrow$ — Product: Sodium ethoxide

(2) $C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4,\ 443K} C_2H_4 + H_2O$ — Product: Ethene (dehydration reaction)

(3) $C_2H_5OH + CH_3COOH \xrightarrow{\text{acid catalyst}} CH_3COOC_2H_5 + H_2O$ — Product: Ethyl ethanoate (esterification)

(4) $C_2H_5OH \xrightarrow{\text{acidified } K_2Cr_2O_7} CH_3COOH$ — Product: Ethanoic acid (oxidation)

Explanation:

Ethanol reacts with: (1) Na → Sodium ethoxide + H_2, (2) conc. H_2SO_4 → Ethene + H_2O (dehydration), (3) CH_3COOH → Ethyl ethanoate + H_2O (esterification), (4) $K_2Cr_2O_7$ → Ethanoic acid (oxidation).

Q.35 [5 marks]

(a) (i) Distinguish between hormonal co-ordination in plants and animals.

(ii) Which part of the brain is responsible for:

(1) intelligence

(2) riding a bicycle

(3) vomiting

(4) controlling hunger

(iii) How is brain and spinal-cord protected against mechanical injuries?

OR

(b) (i) What are tropic movements? Give an example of a plant hormone which (1) inhibits growth and (2) promotes cell division.

(ii) Explain directional movement of a tendril in pea plant in response to touch. Name the hormone responsible for this movement.

Answer: (a) (i) Differences between hormonal coordination in plants and animals:

- Plants: Hormones are produced in various parts (not in specific glands); no nervous system; response is usually slow; hormones include auxin, gibberellin, cytokinin.

- Animals: Hormones are produced in specific endocrine glands; have both nervous and hormonal coordination; response can be fast; hormones include insulin, thyroxine, adrenaline.

(ii) Parts of brain responsible:

(1) Intelligence — Cerebrum (forebrain)
(2) Riding a bicycle — Cerebellum (hindbrain)
(3) Vomiting — Medulla oblongata (hindbrain)
(4) Controlling hunger — Hypothalamus (forebrain)

(iii) Brain is protected by the cranium (skull bone) and cerebrospinal fluid (CSF) which acts as a shock absorber. Spinal cord is protected by the vertebral column (backbone) and also by cerebrospinal fluid.

OR

(b) (i) Tropic movements are directional growth movements in plants in response to external stimuli such as light, gravity, water, or touch.
- Hormone that inhibits growth: Abscisic acid (ABA)
- Hormone that promotes cell division: Cytokinin

(ii) When a tendril of a pea plant comes in contact with a support, the side of the tendril touching the support grows more slowly than the side away from it. The hormone auxin redistributes — its concentration decreases on the side in contact with the support and increases on the opposite side. This causes differential growth (the side away from touch grows faster), making the tendril coil around the support. This is called thigmotropism. The hormone responsible is Auxin.

Explanation:
(a) Plant hormones vs animal hormones differ in source, speed, and type.
Brain parts: cerebrum (intelligence), cerebellum (balance/cycling), medulla (vomiting), hypothalamus (hunger).
Brain and spinal cord protected by skull, vertebral column, and CSF.
(b) Tropic movements are directional growth responses.
ABA inhibits growth, cytokinin promotes cell division.
Tendrils show thigmotropism due to differential auxin distribution.

OR

Q.35 [5 marks]

(i) What are tropic movements? Give an example of a plant hormone which (1) inhibits growth and (2) promotes cell division.

(ii) Explain directional movement of a tendril in pea plant in response to touch. Name the hormone responsible for this movement.

Answer: (i) Tropic movements are directional growth movements in plants in response to external stimuli such as light, gravity, water, or touch.

- Hormone that inhibits growth: Abscisic acid (ABA)
- Hormone that promotes cell division: Cytokinin

(ii) When a tendril of a pea plant comes in contact with a support, the cells on the side of contact grow more slowly while cells on the opposite side grow faster. This differential growth is caused by the redistribution of auxin — auxin concentration decreases on the contact side and increases on the opposite side. This causes the tendril to coil around the support. This movement is called thigmotropism. The hormone responsible is Auxin.

Explanation:

Tropic movements are directional plant growth responses to stimuli.

ABA inhibits growth, cytokinin promotes cell division.

Tendrils coil around supports due to differential auxin distribution (thigmotropism).

Q.36 [5 marks]

(a) Upper half of a convex lens is covered with a black paper. Draw a ray diagram to show the formation of image of an object placed at a distance of 2F from such a lens. Mention the position and nature of the image formed. State the observable difference in the image obtained if the lens is uncovered. Give reason to justify your answer.

OR

(b) An object is placed at a distance of 30 cm from the optical centre of a concave lens of focal length 15 cm. Use lens formula to determine the distance of the image from the optical centre of the lens.

Answer: (a) Covering the upper half of the convex lens does not change where or what kind of image forms. For an object at 2F the image is at 2F on the other side of the lens, real, inverted and the same size as the object. It is only dimmer (less bright) because fewer rays pass through the lens. When the lens is uncovered, the image has the same position, size and nature but is brighter, because every part of the lens forms a complete image and uncovering it lets more light reach the image.

OR

(b) Concave lens: f = −15 cm, u = −30 cm.

Lens formula: $1/v - 1/u = 1/f$

$1/v = 1/f + 1/u = -1/15 - 1/30 = -3/30 = -1/10$

$v = -10$ cm

The image is virtual, 10 cm from the optical centre, on the same side of the lens as the object.

Explanation:

(a) Covering half the lens only dims the image;
position (2F), nature (real, inverted, same size) are unchanged.
(b) $1/v = 1/f + 1/u = -1/10$, so $v = -10$ cm (virtual, same side as object).

OR

Q.36 [5 marks]

An object is placed at a distance of 30 cm from the optical centre of a concave lens of focal length 15 cm. Use lens formula to determine the distance of the image from the optical centre of the lens.

Answer: Concave lens: f = −15 cm, u = −30 cm.

Lens formula: $1/v - 1/u = 1/f$

$1/v = 1/f + 1/u = -1/15 - 1/30 = -3/30 = -1/10$

$v = -10$ cm

The image is virtual, 10 cm from the optical centre, on the same side of the lens as the object.

Explanation:

For a concave lens $f = -15$ cm, $u = -30$ cm: $1/v = 1/f + 1/u = -1/10$, so $v = -10$ cm (virtual image on the object side).

Q.37(a) [4 marks]

Case Study: Salts play a very important role in our daily life. Sodium chloride which is known as common salt is used almost in every kitchen. Baking soda is also a salt used in faster cooking as well as in baking industry. The family of salts is classified on the basis of cations and anions present in them.

Identify the acid and base from which Sodium chloride is formed.

Answer: Sodium chloride (NaCl) is formed from:

- Acid: Hydrochloric acid (HCl)
- Base: Sodium hydroxide (NaOH)

Reaction: $NaOH + HCl \rightarrow NaCl + H_2O$

Explanation:

NaCl is formed by the neutralisation of hydrochloric acid (HCl) and sodium hydroxide (NaOH).

Q.37(b) [4 marks]

Case Study (continued):

Find the cation and the anion present in Calcium sulphate.

Answer: In Calcium sulphate ($CaSO_4$):

- Cation: Ca^{2+} (Calcium ion)
- Anion: SO_4^{2-} (Sulphate ion)

Explanation:

Calcium sulphate ($CaSO_4$) dissociates into Ca^{2+} cation and SO_4^{2-} anion.

Q.37(c) [4 marks]

Case Study (continued):

'Sodium chloride and washing soda both belong to the same family of salts.' Justify this statement.

OR

Define the term pH scale. Name the salt obtained by the reaction of Potassium hydroxide and Sulphuric acid and give the pH value of its aqueous solution.

Answer: Sodium chloride ($NaCl$) and washing soda ($Na_2CO_3.10H_2O$) both belong to the same family of salts because they both contain the same cation — Sodium ion (Na^+). Salts having the same positive ion (cation) belong to the same family.

OR

pH scale: The pH scale is a measurement scale used to determine the hydrogen ion concentration in a solution. It ranges from 0 to 14, where pH < 7 indicates acidic solution, pH = 7 indicates neutral solution, and pH > 7 indicates basic solution.

The salt formed: $2KOH + H_2SO_4 \rightarrow K_2SO_4 + 2H_2O$

Salt: Potassium sulphate (K_2SO_4)

pH value: 7 (neutral), because it is formed from a strong acid (H_2SO_4) and a strong base (KOH).

Explanation:

$NaCl$ and Na_2CO_3 belong to the same family as both have Na^+ cation.

OR: pH scale measures H^+ ion concentration (0-14).
$KOH + H_2SO_4$ gives K_2SO_4 (pH = 7, neutral salt).

Q.38(a) [4 marks]

Case Study: Asexual reproduction involves a single parent to produce offsprings without the formation of gametes. It occurs by the following ways: Fission, Budding, Fragmentation, Spore formation and Regeneration. In one of the methods like regeneration, Planaria A is cut horizontally into three pieces — L, M and N and Planaria B is cut vertically into two equal halves — O and P.

Which of the cut pieces of the two Planaria could regenerate to form a complete organism?

Answer: All the cut pieces of both Planaria can regenerate to form complete organisms. The pieces L, M, N (from Planaria A cut horizontally) and O, P (from Planaria B cut vertically) can all regenerate into complete Planaria. This is because Planaria has specialised cells that can differentiate into various cell types and grow into complete organisms.

Explanation:

All five pieces (L, M, N, O, P) can regenerate into complete organisms because Planaria has specialised cells capable of differentiation and regeneration.

Q.38(b) [4 marks]

Case Study (continued):

Give an example of another organism which follows the same mode of reproduction as Planaria.

Answer: Hydra also shows regeneration as a mode of reproduction. When Hydra is cut into pieces, each piece can regenerate into a complete organism.

Explanation:

Hydra is another organism that reproduces by regeneration, similar to Planaria.

Q.38(c) [4 marks]

Case Study (continued):

What is the meaning of 'development' in regeneration?

Answer: In regeneration, 'development' refers to the process by which the specialised cells of the cut body part proliferate (multiply) and differentiate into various cell types and tissues to form a complete new organism. It is not just the growth of cells but the organised development involving pattern formation and differentiation to recreate the whole body plan of the organism.

Explanation:

Development in regeneration means the organised process where specialised cells multiply and differentiate to form various tissues and organs, recreating the complete organism.

Q.38(d) [4 marks]

Case Study (continued):

Differentiate between regeneration and fragmentation.

OR

What is the meaning of 'development' in regeneration?

Answer: Regeneration vs Fragmentation:

Regeneration:

- It is the process where an organism regrows a new complete organism from a cut body part.
- It occurs due to specialised cells that can differentiate into all cell types.
- Example: Planaria, Hydra.
- The organism does not naturally break; it regenerates if cut.

Fragmentation:

- It is the process where the body of an organism breaks into two or more fragments, each of which grows into a new organism.
- It occurs naturally as part of reproduction when the organism matures.
- Example: Spirogyra, sea anemone.
- The organism naturally breaks into pieces.

OR

Development in regeneration: It refers to the organised sequence of events where specialised cells at the site of the cut multiply, differentiate into various cell types and tissues, and form a complete new organism with proper body organisation.

Explanation:

Regeneration: regrowth from a cut part using specialised cells (Planaria).

Fragmentation: natural breaking of body into pieces that grow independently (Spirogyra).

Both produce new organisms but differ in mechanism.

Q.39(a) [4 marks]

Case Study: When electric current flows in a purely resistive circuit, electrical energy gets fully converted into heat energy. The amount of heat produced (H) in the circuit is found to be directly proportional to (i) the square of current (I^2), (ii) the resistance (R) of the conductor and (iii) the time (t) for which current flows. In other words $H = I^2Rt$. Electrical devices such as electric fuse, electric heater, electric iron etc. are all based on this effect called heating effect of electric current.

List two properties of heating elements.

Answer: Two properties of heating elements (like nichrome):

1. High resistivity — so that they produce sufficient heat even with moderate current.

2. High melting point — so that they can withstand high temperatures without melting and can glow red-hot without damage.

Explanation:

Heating elements should have high resistivity (to produce more heat) and high melting point (to withstand high temperatures without melting).

Q.39(b) [4 marks]

Case Study (continued):

List two properties of electric fuse.

Answer: Two properties of electric fuse wire:

1. Low melting point — so that it melts and breaks the circuit when excessive current flows, protecting the appliances.

2. High resistivity — so that it heats up quickly when current exceeds the rated value.

Explanation:

Fuse wire should have low melting point (melts easily on overloading) and high resistivity (heats up quickly).

It is usually made of an alloy of tin and lead.

Q.39(c) [4 marks]

Case Study (continued):

Name the principle on which an electric fuse works. Explain how a fuse wire is capable of saving electrical appliances from getting damaged due to accidentally produced high current.

OR

The power of an electric heater is 1100 W. If the potential difference between the two terminals of the heater is 220 V, find the current flowing in the circuit. What will happen to an electric fuse of rating 5 A connected in this

circuit?

Answer: Principle: An electric fuse works on the heating effect of electric current (Joule heating).

Explanation: A fuse wire is made of a material with low melting point (alloy of tin and lead) and is connected in series with the electrical circuit. When the current exceeds the safe limit (due to short circuit or overloading), the fuse wire heats up rapidly due to I^2R heating. Since it has a low melting point, it melts and breaks the circuit, disconnecting the electrical supply. This prevents the excessive current from reaching the appliances, protecting them from damage.

OR

Given: P = 1100 W, V = 220 V
Using P = VI:
I = P/V = 1100/220 = 5 A

The current flowing in the circuit is 5 A. Since the fuse rating is also 5 A, the fuse will just sustain the current. However, if there is any slight increase in current (due to fluctuation), the fuse will blow (melt) and break the circuit. The fuse of 5 A rating is at its limit and may blow.

Explanation:
Fuse works on heating effect of current.
Low melting point wire melts when current exceeds safe limit, breaking the circuit.
OR: I = P/V = 1100/220 = 5A.
A 5A fuse is at its exact rating and may blow with any fluctuation.