

CBSE Class X Science Set 1 (31/1/1)

Total Time Allowed : 3 Hours	Maximum Marks : 80	Total Questions : 39	Q.P. Code : 31/1/1
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General Instructions

Read the following instructions very carefully and strictly follow them:

- (i) This question paper comprises 39 questions. All questions are compulsory.
- (ii) This question paper is divided into FIVE sections viz. Section A, B, C, D and E.
- (iii) In Section A question number 1 to 20 are Multiple Choice Questions (MCQs) carrying 1 mark each.
- (iv) In Section B question number 21 to 26 are Very Short Answer (VSA) type questions carrying 2 marks each. Answer to these questions should be in the range of 30 to 50 words.
- (v) In Section C question number 27 to 33 are Short Answer (SA) type questions carrying 3 marks each. Answer to these questions should be in the range of 50 to 80 words.
- (vi) In Section D question number 34 to 36 are Long Answer (LA) type questions carrying 5 marks each. Answer to these questions should be in the range of 80 to 120 words.
- (vii) In Section E question number 37 to 39 are of 3 source-based/case-based units of assessment carrying 4 marks each with sub-parts.
- (viii) There is no overall choice. However, an internal choice has been provided in some Sections. Only one of the alternatives has to be attempted in such questions.

Section - A

Select and write the most appropriate option out of the four options given for each of the questions 1-20. There is no negative mark for the incorrect response.

Question 1: When 2 mL of sodium hydroxide solution is added to a few pieces of granulated zinc in a test tube and then warmed, the reaction that occurs can be written in the form of a balanced chemical equation as:

- (a) $\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2\text{O}$
- (b) $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$

- (c) $2\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2$
(d) $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O}$

Correct Answer: (b) $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$

Solution:

To determine the correct balanced chemical equation, we need to consider the reaction between sodium hydroxide (NaOH) and zinc (Zn). Zinc reacts with sodium hydroxide to form sodium zincate (Na_2ZnO_2) and hydrogen gas (H_2).

Let's analyze the options:

Option (a): $\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2\text{O}$ This equation is not balanced. The number of sodium (Na) and hydrogen (H) atoms are not equal on both sides.

Option (b): $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2$ This equation is balanced. We have 2 Na atoms, 2 O atoms, 2 H atoms, and 1 Zn atom on both sides.

Option (c): $2\text{NaOH} + \text{Zn} \rightarrow \text{NaZnO}_2 + \text{H}_2$ This equation is not balanced. The number of sodium (Na) atoms is not equal on both sides.

Option (d): $2\text{NaOH} + \text{Zn} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2\text{O}$ This equation is not balanced. The number of hydrogen (H) atoms is not equal on both sides.

Therefore, the only balanced chemical equation representing the reaction is option (b).

 Quick Tip

Always check the number of atoms of each element on both sides of the equation to ensure it is balanced. Remember that the total charge must also be balanced in ionic equations.

Question 2: Select from the following a decomposition reaction in which the source of energy for decomposition is light:

- (a) $2\text{FeSO}_4 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2 + \text{SO}_3$
(b) $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
(c) $2\text{AgBr} \rightarrow 2\text{Ag} + \text{Br}_2$
(d) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

Correct Answer: (c) $2\text{AgBr} \rightarrow 2\text{Ag} + \text{Br}_2$

Solution:

A decomposition reaction is a reaction where a single compound breaks down into two or more simpler substances. The question specifies that the source of energy for the decomposition is light. This is characteristic of photochemical reactions.

Let's analyze the options:

Option (a) $2\text{FeSO}_4 \rightarrow \text{Fe}_2\text{O}_3 + \text{SO}_2 + \text{SO}_3$: This is a decomposition reaction, but it's typically thermally driven (requires heat), not light.

Option (b) $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$: This is a decomposition reaction, but it requires a significant amount of energy, usually electrical energy (electrolysis) or heat.

Option (c) $2\text{AgBr} \rightarrow 2\text{Ag} + \text{Br}_2$: This is a decomposition reaction where silver bromide (AgBr) decomposes into silver (Ag) and bromine (Br₂) when exposed to light. This is a classic example of a photochemical decomposition reaction used in photography.

Option (d) $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$: This is a decomposition reaction, but it is typically driven by heat.

Therefore, the decomposition reaction driven by light is option (c).

💡 Quick Tip

Photochemical reactions are chemical reactions initiated by the absorption of light. Remember key examples like the decomposition of silver halides used in photography.

Question 3: A metal and a non-metal that exists in liquid state at the room temperature are respectively:

- (a) Bromine and Mercury
- (b) Mercury and Iodine
- (c) Mercury and Bromine
- (d) Iodine and Mercury

Correct Answer: (c) Mercury and Bromine

Solution:

The question asks for a metal and a non-metal that are liquid at room temperature. Let's examine the properties of the elements listed:

Mercury (Hg): Mercury is a metal and is liquid at room temperature. Its melting point is -38.83°C .

Bromine (Br): Bromine is a non-metal and is liquid at room temperature. Its melting point is -7.2°C .

Iodine (I): Iodine is a non-metal and is a solid at room temperature. Its melting point is 113.7°C .

Therefore, the only combination that correctly identifies a liquid metal and a liquid non-metal at room temperature is Mercury and Bromine.

 Quick Tip

Knowing the physical states (solid, liquid, gas) and properties of common elements at room temperature is crucial for many chemistry problems. Familiarize yourself with the states of elements like mercury, bromine, iodine, and others.

Question 4: Carbon compounds :

- (i) are good conductors of electricity.
- (ii) are bad conductors of electricity.
- (iii) have strong forces of attraction between their molecules.
- (iv) have weak forces of attraction between their molecules.

The correct statements are :

- (a) (i) and (ii)
- (b) (ii) and (iii)
- (c) (ii) and (iv)
- (d) (i) and (iii)

Correct Answer: (c) (ii) and (iv)

Solution:

Carbon compounds, in general, are poor conductors of electricity. This is because they do not have free electrons or ions that can move and carry an electric current. Additionally, the forces of attraction between the molecules in most carbon compounds are relatively weak. These are generally van der Waals forces or London Dispersion Forces. These weak forces contribute to the relatively low melting and boiling points of many organic compounds.

So, statements (ii) “are bad conductors of electricity” and (iv) “have weak forces of attraction between their molecules” are correct.

 Quick Tip

Remember that the electrical conductivity and intermolecular forces of carbon compounds are largely determined by the type of bonding (covalent) and the structure of the molecules. There are exceptions like graphite, which conducts electricity due to its delocalized electrons within its layered structure.

Question 5: Consider the following compounds :

$FeSO_4$; $CuSO_4$; $CaSO_4$; Na_2CO_3

The compound having maximum number of water of crystallisation in its crystalline form in one molecule is :

- (a) $FeSO_4$
- (b) $CuSO_4$
- (c) $CaSO_4$
- (d) Na_2CO_3

Correct Answer: (d) Na_2CO_3

Solution:

The question asks about the water of crystallization, which refers to the water molecules that are present inside crystals. Different hydrated salts have different numbers of water molecules associated with them. Let's examine the common hydrated forms of these compounds:

$FeSO_4$: Commonly exists as $FeSO_4 \cdot 7H_2O$ (heptahydrate)

$CuSO_4$: Commonly exists as $CuSO_4 \cdot 5H_2O$ (pentahydrate)

$CaSO_4$: Commonly exists as $CaSO_4 \cdot 2H_2O$ (dihydrate) or anhydrous $CaSO_4$

Na_2CO_3 : Commonly exists as $Na_2CO_3 \cdot 10H_2O$ (decahydrate)

Comparing the number of water molecules in the common hydrated forms: 7, 5, 2 (or 0), and 10, we find that Sodium Carbonate (Na_2CO_3) has the maximum number of water molecules (10) in its crystalline form.

 Quick Tip

Memorizing the common hydrated forms of salts and their water of crystallization numbers is helpful for many chemistry problems, especially those involving stoichiometry and calculations involving molar mass.

Question 6: Oxides of aluminium and zinc are :

- (a) acidic
- (b) basic
- (c) amphoteric
- (d) neutral

Correct Answer: (c) amphoteric

Solution:

Amphoteric substances can react as both acids and bases. Aluminum oxide (Al_2O_3) and zinc oxide (ZnO) are classic examples of amphoteric oxides. They can react with both acids and bases to form salts and water.

For example, zinc oxide reacts with hydrochloric acid (an acid): $ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

And it also reacts with sodium hydroxide (a base): $ZnO + 2NaOH + H_2O \rightarrow Na_2[Zn(OH)_4]$ (sodium zincate)

Aluminum oxide behaves similarly.

 Quick Tip

Metals that form amphoteric oxides are typically located near the boundary between metals and non-metals in the periodic table. Remember that the amphoteric nature of a substance is related to its ability to donate or accept protons (H^+).

Question 7: $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

The reaction given above is a redox reaction because in this case :

- (a) MnO_2 is oxidised and HCl is reduced.
- (b) HCl is oxidised.

- (c) MnO_2 is reduced.
(d) MnO_2 is reduced and HCl is oxidised.

Correct Answer: (d) MnO_2 is reduced and HCl is oxidised.

Solution:

A redox reaction involves both reduction (gain of electrons) and oxidation (loss of electrons). Let's analyze the given reaction by examining the oxidation states of the elements:

In MnO_2 , Mn has an oxidation state of +4 (oxygen is -2).

In $MnCl_2$, Mn has an oxidation state of +2.

In HCl , Cl has an oxidation state of -1.

In Cl_2 , Cl has an oxidation state of 0.

Manganese's oxidation state changes from +4 to +2, meaning it has gained electrons (reduction). Chlorine's oxidation state changes from -1 to 0, meaning it has lost electrons (oxidation).

Therefore, MnO_2 is reduced and HCl is oxidized.

 Quick Tip

Remember the acronym OIL RIG: Oxidation Is Loss (of electrons), Reduction Is Gain (of electrons). Assigning oxidation states is crucial for identifying which species are oxidized and reduced in a redox reaction.

Question 8: Consider the following statements :

- (i) The sex of a child is determined by what it inherits from the mother.
- (ii) The sex of a child is determined by what it inherits from the father.
- (iii) The probability of having a male child is more than that of a female child.
- (iv) The sex of a child is determined at the time of fertilisation when male and female gametes fuse to form a zygote.

The correct statements are :

- (a) (i) and (iii)
- (b) (ii) and (iv)
- (c) (iii) and (iv)
- (d) (i), (iii) and (iv)

Correct Answer: (b) (ii) and (iv)

Solution:

The sex of a child is determined by the sex chromosomes inherited from the parents. Mothers always contribute an X chromosome. Fathers can contribute either an X or a Y chromosome.

If the child inherits an X chromosome from the father (XX combination), the child will be female.

If the child inherits a Y chromosome from the father (XY combination), the child will be male.

Therefore, statement (ii) “The sex of a child is determined by what it inherits from the father” is correct.

Statement (iv) is also correct. Fertilization is the moment when the sperm (carrying either an X or Y chromosome) fuses with the egg (carrying an X chromosome), determining the sex of the zygote.

Statement (i) is incorrect because the mother always contributes an X chromosome. Statement (iii) is generally considered incorrect; the probability is very close to 50/50, though slightly skewed towards male births in some populations.

💡 Quick Tip

Remember that sex determination in humans is based on the XY chromosome system. The father’s contribution of either an X or a Y chromosome determines the child’s sex.

Question 9: Chromosomes :

- (i) carry hereditary information from parents to the next generation.
- (ii) are thread like structures located inside the nucleus of an animal cell.
- (iii) always exist in pairs in human reproductive cells.
- (iv) are involved in the process of cell division.

The correct statements are :

- (a) (i) and (ii)
- (b) (iii) and (iv)
- (c) (i), (ii) and (iv)
- (d) (i) and (iv)

Correct Answer: (d) (i) and (iv)

Solution:

Let's examine each statement:

- (i) Chromosomes carry genes, which are made of DNA, the molecule that carries hereditary information. This statement is **correct**.
- (ii) Chromosomes are thread-like structures located within the nucleus of eukaryotic cells. This statement is **incorrect**.
- (iii) Human reproductive cells (gametes – sperm and egg) are haploid, meaning they contain only one set of chromosomes (23 chromosomes, not pairs). So, this statement is **incorrect**.
- (iv) Chromosomes are crucial for cell division. They are replicated and then separated into daughter cells during mitosis and meiosis. This statement is **correct**.

Therefore, the correct statements are (i) and (iv).

 Quick Tip

Chromosomes are essential for carrying genetic information and for cell division. Remember the difference between diploid cells (with paired chromosomes) and haploid cells (with single sets of chromosomes).

Question 10: In a nerve cell, the site where the electrical impulse is converted into a chemical signal is known as :

- (a) Axon
- (b) Dendrites
- (c) Neuromuscular junction
- (d) Cell body

Correct Answer: (c) Neuromuscular junction

Solution:

The question describes the point where a nerve cell communicates with a muscle cell. Let's consider the structure and function of a neuron:

Dendrites: These are the branched extensions of a neuron that receive signals from other neurons.

Cell Body (Soma): This contains the nucleus and other organelles essential for the neuron's function. It integrates incoming signals from the dendrites.

Axon: This is the long, slender projection of a neuron that transmits the electrical impulse away from the cell body.

Neuromuscular Junction: This is the specialized synapse (connection) between a motor neuron's axon terminal and a muscle fiber. It is at this junction that the electrical impulse traveling along the axon is converted into a chemical signal. This chemical sig-

nal, a neurotransmitter (typically acetylcholine), diffuses across the synapse and triggers a response in the muscle fiber, leading to muscle contraction.

Therefore, the correct answer is the neuromuscular junction.

 Quick Tip

The neuromuscular junction is a critical component of the nervous system, allowing for voluntary muscle control. Understanding the sequence of signal transmission (electrical to chemical) at this junction is essential.

Question 11: A stomata closes when :

- (i) it needs carbon dioxide for photosynthesis.
- (ii) it does not need carbon dioxide for photosynthesis.
- (iii) water flows out of the guard cells.
- (iv) water flows into the guard cells.

The correct reason(s) in this process is/are :

- (a) (i) only
- (b) (i) and (iii)
- (c) (ii) and (iii)
- (d) (ii) and (iv)

Correct Answer: (c) (ii) and (iii)

Solution:

Stomata are tiny pores on the surface of leaves, primarily responsible for gas exchange (taking in carbon dioxide for photosynthesis and releasing oxygen). They are surrounded by guard cells that regulate their opening and closing.

Stomata open when the guard cells become turgid (swollen) due to an influx of water. This turgidity is caused by increased potassium ion concentration within the guard cells, which leads to water entering via osmosis.

Conversely, stomata close when the guard cells lose water and become flaccid. This happens when potassium ions leave the guard cells, causing water to flow out by osmosis.

Therefore, a stomata closes when:

(ii) It does not need carbon dioxide for photosynthesis: When photosynthesis is not active (e.g., at night or during water stress), the stomata tend to close to conserve water.

(iii) Water flows out of the guard cells: This loss of water makes the guard cells flaccid, causing the stomatal pore to close.

💡 Quick Tip

Remember that the opening and closing of stomata are regulated by the turgor pressure of the guard cells, which is controlled by the movement of water in and out of these cells. This movement is influenced by factors like light, carbon dioxide concentration, and water availability.

Question 12: At what distance from a convex lens should an object be placed to get an image of the same size as that of the object on a screen?

- (a) Beyond twice the focal length of the lens.
- (b) At the principal focus of the lens.
- (c) At twice the focal length of the lens.
- (d) Between the optical centre of the lens and its principal focus.

Correct Answer: (c) At twice the focal length of the lens.

Solution:

The question asks about the object distance for a convex lens that produces a real image (formed on a screen) of the same size as the object. We can use the lens formula and magnification formula to determine this:

Lens Formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, where f is the focal length, v is the image distance, and u is the object distance (sign conventions apply: u is negative for real objects).

Magnification Formula: $m = \frac{v}{u}$ (or $m = \frac{h_i}{h_o}$, where h_i is the image height and h_o is the object height).

We are given that the image size is the same as the object size, so the magnification $m = 1$ (or -1 for a real, inverted image). Since the image is formed on a screen, it's a real image, so $m = -1$.

Therefore, $-1 = \frac{v}{u}$, which means $v = -u$.

Substituting $v = -u$ into the lens formula: $\frac{1}{f} = \frac{1}{-u} - \frac{1}{u} \Rightarrow \frac{1}{f} = -\frac{2}{u} \Rightarrow u = -2f$

The object distance is $-2f$. The negative sign indicates that the object is placed on the left side of the lens (as per standard convention), and $2f$ means it's placed at twice the focal length.

💡 Quick Tip

For a convex lens, an object placed at twice the focal length produces a real, inverted image of the same size at twice the focal length on the other side of the lens.

Question 13: The lens system of human eye forms an image on a light sensitive screen, which is called as :

- (a) Cornea
- (b) Ciliary muscles
- (c) Optic nerves
- (d) Retina

Correct Answer: (d) Retina

Solution:

Let's break down the components of the human eye involved in image formation:

Cornea: The transparent front part of the eye that refracts light.

Lens: Focuses the light onto the retina.

Ciliary Muscles: Control the shape of the lens to adjust focus for different distances.

Retina: The light-sensitive layer at the back of the eye. It contains photoreceptor cells (rods and cones) that convert light into electrical signals.

Optic Nerves: Transmit the electrical signals from the retina to the brain.

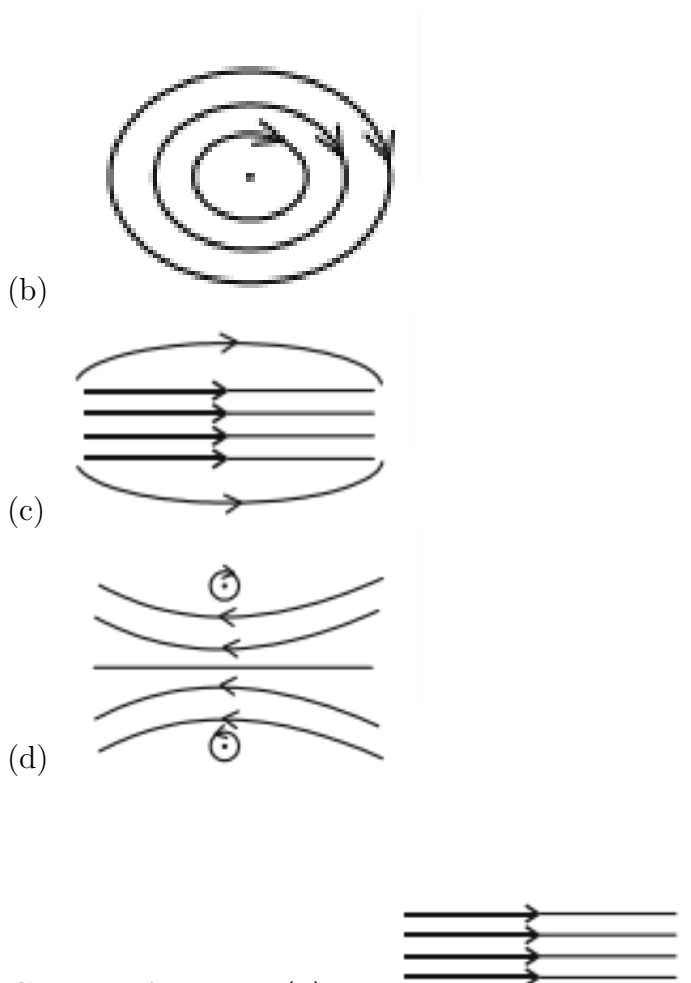
The retina acts as the “screen” where the lens forms the image. The photoreceptor cells in the retina convert the light image into electrical signals that are sent to the brain via the optic nerve, allowing us to see.

💡 Quick Tip

The retina is the key structure responsible for light detection in the eye. Damage to the retina can lead to vision impairment or blindness.

Question 14: The pattern of the magnetic field produced inside a current carrying solenoid is :





Correct Answer: (a)

Solution:

A solenoid is a coil of wire wrapped around a cylindrical core. When a current flows through the solenoid, it creates a magnetic field. Inside the solenoid, the magnetic field lines are nearly parallel and uniform, resembling the field of a bar magnet. The field lines are close together inside the solenoid, indicating a strong magnetic field, and they loop around outside the solenoid, returning to the opposite end.

Option (a) correctly depicts this pattern. The parallel lines inside the solenoid represent the uniform magnetic field.

Option (b) shows concentric circles, which is the magnetic field pattern around a straight current-carrying wire.

Option (c) shows curved field lines inside, which is not representative of the uniform field inside a solenoid.

Option (d) depicts a field pattern that's more characteristic of two opposite magnetic poles facing each other.

 Quick Tip

The magnetic field inside a solenoid is strong and uniform, while it is weaker outside. The direction of the magnetic field inside can be determined using the right-hand rule: if you curl your fingers in the direction of the current flow, your thumb points in the direction of the magnetic field lines inside the solenoid.

Question 15: Identify the food chain in which the organisms of the second trophic level are missing :

- (a) Grass, goat, lion
- (b) Zooplankton, Phytoplankton, small fish, large fish
- (c) Tiger, grass, snake, frog
- (d) Grasshopper, grass, snake, frog, eagle

Correct Answer: (c) Tiger, grass, snake, frog

Solution:

Trophic levels represent the different levels in a food chain or food web.

First Trophic Level: Producers (plants) – These organisms produce their own food through photosynthesis.

Second Trophic Level: Primary Consumers (herbivores) – These organisms consume producers.

Third Trophic Level: Secondary Consumers (carnivores) – These organisms consume primary consumers.

Fourth Trophic Level (and higher): Tertiary Consumers (top carnivores) – These organisms consume secondary consumers.

 Quick Tip

Food chains depict the flow of energy from producers to consumers. Each organism occupies a specific trophic level based on its feeding habits.

Question 16: In which of the following organisms, multiple fission is a means of asexual reproduction?

- (a) Yeast
- (b) Leishmania
- (c) Paramecium
- (d) Plasmodium

Correct Answer: (d) Plasmodium

Solution:

Multiple fission is a type of asexual reproduction where a single parent organism divides into multiple daughter cells simultaneously.

Yeast: Reproduces primarily through budding, a form of asexual reproduction where a small outgrowth (bud) develops and eventually separates from the parent cell.

Leishmania: Reproduces asexually through binary fission (splitting into two).

Paramecium: Also reproduces asexually through binary fission.

Plasmodium: The parasite that causes malaria exhibits multiple fission, especially during its life cycle stage in the liver (schizogony). The nucleus of the Plasmodium undergoes repeated divisions, followed by the cytoplasm dividing into numerous merozoites (daughter cells).

 Quick Tip

Multiple fission is an efficient method of asexual reproduction, allowing for rapid population growth, especially in parasitic organisms like Plasmodium.

For Q. Nos. 17 to 20, two statements are given – One labelled as Assertion (A) and the other labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below :

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

Question 17: Assertion (A) : Hydrogen gas is not evolved when zinc reacts with nitric acid.

Reason (R) : Nitric acid oxidises the hydrogen gas produced to water and itself gets reduced.

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

Solution:

Assertion (A): True. Zinc reacts with nitric acid, but hydrogen gas is typically not

evolved (except under very dilute conditions).

Reason (R): True. Nitric acid is a strong oxidizing agent. When zinc reacts with nitric acid, the nascent hydrogen (hydrogen produced in the reaction) is immediately oxidized to water by the nitric acid. The nitric acid itself gets reduced to various nitrogen oxides (like NO_2 , NO , N_2O) depending on the concentration of the acid.

The overall reaction (simplified, and for moderately concentrated nitric acid) can be represented as: $\text{Zn} + 4\text{HNO}_3 \rightarrow \text{Zn}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$

Because the reason correctly explains why hydrogen is not evolved (nitric acid oxidizes it), the correct answer is (a).

 Quick Tip

Nitric acid's strong oxidizing nature makes it different from other acids like hydrochloric acid or sulfuric acid, where hydrogen gas is typically produced when they react with metals like zinc.

Question 18: Assertion (A) : Accumulation of harmful chemicals is maximum in the organisms at the highest trophic level of a food chain.

Reason (R) : Harmful chemicals are sprayed on the crops to protect them from diseases and pests.

Correct Answer: (b) Both Assertion (A) and Reason (R) are true, but Reason not the correct explanation of the Assertion (A)

Solution:

Assertion (A): True. This phenomenon is known as biomagnification or bioaccumulation. Non-biodegradable harmful chemicals (like DDT, PCBs) enter the food chain at the producer level. As these chemicals move up the trophic levels, their concentration increases in the tissues of organisms at each successive level. Organisms at higher trophic levels consume larger quantities of organisms from lower levels, thus accumulating more of these chemicals.

Reason (R): True. Harmful chemicals such as pesticides and insecticides are commonly used in agriculture to protect crops. This is one of the ways these chemicals can enter the food chain.

However, while both statements are true, the reason is not the *primary* explanation for the assertion. The key reason for biomagnification is the non-biodegradable nature of the chemicals and their tendency to accumulate in organisms' tissues, amplified as you move

up the food chain. The reason just describes one way these chemicals can get introduced into the environment and the food chain.

 Quick Tip

Biomagnification is a significant environmental concern because it can lead to high concentrations of harmful substances in top predators, including humans. This can have serious health consequences.

Question 19: Assertion (A) : The rate of breathing in aquatic organisms is much faster than in terrestrial organisms.

Reason (R) : The amount of oxygen dissolved in water is very high as compared to the amount of oxygen in air.

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

Solution:

Assertion (A): True. Aquatic organisms generally have a faster breathing rate than terrestrial organisms. This is because the amount of dissolved oxygen available in water is considerably less than the amount of oxygen available in the air. Aquatic animals, therefore, have to breathe more rapidly to extract sufficient oxygen from the water.

Reason (R): False. The amount of dissolved oxygen in water is significantly *lower* than the amount of oxygen in the air. Air is composed of approximately 21% oxygen, while dissolved oxygen in water is much less and can vary depending on temperature, pollution, etc.

 Quick Tip

The lower oxygen availability in water is a key challenge for aquatic organisms, requiring adaptations like gills and a faster breathing rate.

Question 20: Assertion (A) : The rainbow is a natural spectrum of sunlight in the sky.

Reason (R) : Rainbow is formed in the sky when the sun is overhead and water droplets are also present in air.

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

Solution:

Assertion (A): True. A rainbow is indeed a natural spectrum of sunlight. It is formed

by the dispersion of sunlight by water droplets in the atmosphere. Sunlight is composed of different wavelengths (colors), and when it passes through a water droplet, these wavelengths are refracted (bent) at different angles, causing them to separate and form a spectrum.

Reason (R): False. Rainbows are *not* formed when the sun is directly overhead. They are formed when the sun is behind the observer and sunlight is refracted, reflected, and dispersed by water droplets in the air. The angle between the sunlight, the water droplets, and the observer's eye is crucial for rainbow formation (around 42 degrees).

 Quick Tip

Rainbows are formed by refraction, reflection, and dispersion of sunlight by water droplets. The position of the sun relative to the observer is key to seeing a rainbow.

Section - B

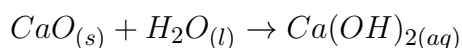
Question 21: Name the type of chemical reaction in which calcium oxide reacts with water. Justify your answer by giving a balanced chemical equation for the chemical reaction.

Solution:

When calcium oxide (CaO), also known as quicklime, reacts with water (H₂O), it forms calcium hydroxide (Ca(OH)₂), also known as slaked lime.

This reaction is a **combination reaction** because two reactants (calcium oxide and water) combine to form a single product (calcium hydroxide).

The balanced chemical equation is:



This reaction is also highly **exothermic**, meaning it releases a significant amount of heat. The heat generated can be intense enough to boil the water.

 Quick Tip

The reaction of calcium oxide with water is a classic example of a combination reaction and an exothermic reaction. The product, calcium hydroxide, is an alkali and has many industrial applications.

Question 22: State one role of each of the following in the human digestive system:

- (i) Hydrochloric acid
- (ii) Villi
- (iii) Anal Sphincter
- (iv) Lipase

Solution:

(i) **Hydrochloric acid (HCl):** Hydrochloric acid is produced by the stomach lining. Its primary role is to create an acidic environment in the stomach (pH 1-3). This acidic environment is essential for activating the enzyme pepsin, which begins protein digestion. It also helps to kill harmful bacteria that may be ingested with food.

(ii) **Villi:** Villi are small, finger-like projections that line the inner wall of the small intestine. They significantly increase the surface area of the small intestine, which is the primary site for nutrient absorption. The increased surface area provided by villi enhances the efficient absorption of digested food molecules into the bloodstream.

(iii) **Anal Sphincter:** The anal sphincter is a muscle that controls the opening of the anus. Its role is to regulate the expulsion of feces (undigested waste) from the body.

(iv) **Lipase:** Lipase is an enzyme that plays a crucial role in the digestion of fats (lipids). It breaks down fats into fatty acids and glycerol, which can then be absorbed by the body. Lipase is produced in the pancreas and secreted into the small intestine.

 Quick Tip

The human digestive system is a complex system with specialized organs and enzymes working together to break down food and absorb nutrients. Understanding the function of each component is essential for comprehending the overall process of digestion.

Question 23: (A) How is the movement of leaves of a sensitive plant different from the downward movement of the roots?

OR

(B) There is a hormone which regulates carbohydrate, protein and fat metabolism

in our body. Name the hormone and the gland which secretes it. Why is it important for us to have iodised salt in our diet?

Solution (A):

The movement of leaves in a sensitive plant (e.g., *Mimosa pudica*) is a rapid, reversible response to touch or other stimuli. This movement is called **nastic movement**. It is caused by changes in turgor pressure in specialized cells at the base of the leaves and leaflets called pulvini. When stimulated, these cells lose water, causing the leaflets to fold and the leaf to droop. This response is independent of the direction of the stimulus.

The downward movement of roots, on the other hand, is a growth response called **geotropism** or **gravitropism**. Roots grow downwards in response to gravity. This is a much slower process than the nastic movement of sensitive plant leaves and is directional (towards the gravitational pull). It's driven by plant hormones like auxin that influence cell elongation in the root.

 Quick Tip

Nastic movements are rapid, reversible, and non-directional, while tropic movements (like geotropism) are slower, growth-related, and directional.

Solution (B):

The hormone that regulates carbohydrate, protein, and fat metabolism in our body is **thyroxine**. Thyroxine is secreted by the **thyroid gland**, located in the neck.

Thyroxine plays a vital role in controlling the body's basal metabolic rate (BMR), which influences energy expenditure, growth, and development. It affects the metabolism of carbohydrates, proteins, and fats, ensuring the body efficiently utilizes these nutrients.

Iodine is essential for the synthesis of thyroxine. A deficiency of iodine in the diet can lead to hypothyroidism, a condition characterized by low levels of thyroxine, resulting in symptoms like fatigue, weight gain, and impaired cognitive function.

Iodized salt is a simple and effective way to ensure adequate iodine intake. By adding iodine to salt, a commonly used ingredient, the risk of iodine deficiency and associated health problems is significantly reduced.

 Quick Tip

Iodine is crucial for thyroid hormone production. Consuming iodized salt is an effective way to prevent iodine deficiency and maintain proper metabolic function.

Question 24: An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position of the image formed by the mirror.

Solution:

We can use the mirror formula to determine the image position:

Mirror Formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$, where f is the focal length, v is the image distance, and u is the object distance.

For convex mirrors, the focal length (f) is positive, and the object distance (u) is negative (since the object is placed in front of the mirror).

Given:

Object distance, $u = -10$ cm

Focal length, $f = 15$ cm

Substituting these values into the mirror formula:

$$\frac{1}{15} = \frac{1}{v} + \frac{1}{-10}$$

$$\frac{1}{15} = \frac{1}{v} - \frac{1}{10}$$

$$\frac{1}{v} = \frac{1}{15} + \frac{1}{10}$$

$$\frac{1}{v} = \frac{2+3}{30}$$

$$\frac{1}{v} = \frac{5}{30}$$

$$\frac{1}{v} = \frac{1}{6}$$

$$v = 6 \text{ cm}$$

The image distance is positive, which means the image is formed **behind** the mirror (virtual image). Therefore, the image is formed 6 cm behind the mirror.

 Quick Tip

Convex mirrors always form virtual, erect, and diminished images. Remember the sign conventions for mirrors: the object distance is negative, the focal length is positive for convex mirrors, and the image distance is positive for virtual images.

Question 25 (A): Show how you would connect three resistors each of resistance $6\ \Omega$, so that the combination has a resistance of $9\ \Omega$. Also justify your answer.

Solution:

To obtain a combined resistance of $9\ \Omega$ using three $6\ \Omega$ resistors, we should connect two resistors in parallel, and then connect this parallel combination in series with the third resistor.

Justification:

1. **Parallel Combination:** When two $6\ \Omega$ resistors are connected in parallel, their equivalent resistance (R_p) is calculated as follows:

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{6} = \frac{2}{6} = \frac{1}{3} \quad R_p = 3\ \Omega$$

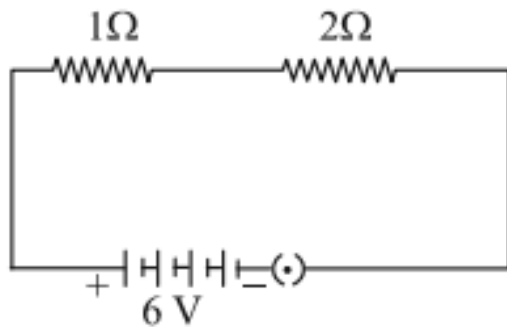
2. **Series Combination:** Now, this $3\ \Omega$ equivalent resistance (of the parallel combination) is connected in series with the third $6\ \Omega$ resistor. The total equivalent resistance (R_T) is the sum of the resistances in series:

$$R_T = R_p + 6 = 3 + 6 = 9\ \Omega$$

Therefore, connecting two resistors in parallel and then in series with the third resistor gives the desired total resistance of $9\ \Omega$.

OR

Question 25 (B): In the given circuit calculate the power consumed in watts in the resistor of $2\ \Omega$:

**Solution:**

1. Calculate Total Resistance:** The two resistors are connected in series, so the total resistance (R_T) is the sum of their individual resistances:

$$R_T = 1\ \Omega + 2\ \Omega = 3\ \Omega$$

2. Calculate Current: Using Ohm's Law ($V = IR$), we can calculate the current (I) flowing through the circuit:

$$I = \frac{V}{R_T} = \frac{6\ \text{V}}{3\ \Omega} = 2\ \text{A}$$

Since the resistors are in series, the same current (2 A) flows through both resistors.

3. Calculate Power Consumed by the 2 Ω Resistor:** The power (P) consumed by a resistor can be calculated using the formula $P = I^2 R$:

$$P = (2\ \text{A})^2 \times 2\ \Omega = 4\ \text{A}^2 \times 2\ \Omega = 8\ \text{W}$$

Therefore, the power consumed by the 2 Ω resistor is 8 Watts.

💡 Quick Tip
For resistors in series, the current is the same through each resistor, and the total voltage is the sum of the voltage drops across each resistor. Power can be calculated using $P = I^2 R$, $P = IV$, or $P = V^2/R$.

Question 26: (i) Two magnetic field lines do not intersect each other. Why?
(ii) How is a uniform magnetic field in a given region represented? Draw a diagram in support of your answer.

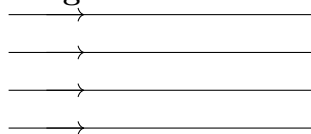
Solution (i):

Magnetic field lines represent the direction of the magnetic force that a small north

magnetic pole would experience if placed at that point. If two magnetic field lines were to intersect, it would mean that at the point of intersection, the magnetic force would have two different directions. This is not possible, as a magnetic field can only have one direction at any given point. Thus, magnetic field lines never intersect.

Solution (ii): A uniform magnetic field is represented by parallel and equally spaced magnetic field lines. This indicates that the magnetic field strength and direction are the same at all points in that region.

Diagram:



💡 Quick Tip

The density of magnetic field lines represents the strength of the field. Closer lines indicate a stronger field, while further apart lines represent a weaker field.

Section - C

Question 27: Write one chemical equation each for the chemical reaction in which the following have taken place :

- (i) Change in colour
- (ii) Change in temperature
- (iii) Formation of precipitate

Mention colour change/temperature change (rise/fall)/compound precipitated along with equation.

Solution:

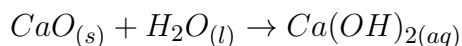
(i) **Change in colour:**

Reaction between copper sulfate (blue) and iron: $Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_{4(aq)} + Cu_{(s)}$

Colour change: The blue colour of copper sulfate solution fades, and a reddish-brown deposit of copper forms on the iron.

(ii) **Change in temperature:**

Reaction between calcium oxide (quicklime) and water (exothermic reaction):



Temperature change: The temperature rises significantly, as this is an exothermic

reaction (heat is released).

(iii) **Formation of precipitate:**

Reaction between silver nitrate and sodium chloride: $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} \downarrow + NaNO_{3(aq)}$ **Precipitate formed:** A white precipitate of silver chloride (AgCl) is formed.

 Quick Tip

Chemical reactions often involve observable changes like color change, temperature change, gas evolution, or precipitate formation. These changes are indicators that a chemical reaction has taken place.

Question 28: (i) The pH of a sample of tomato juice is 4.6. How is this juice likely to be in taste? Give reason to justify your answer.

(ii) How do we differentiate between a strong acid and a weak base in terms of ion-formation in aqueous solutions?

(iii) The acid rain can make the survival of aquatic animals difficult. How?

Solution (i):

Tomato juice with a pH of 4.6 is likely to be **acidic** in taste. A pH below 7 indicates an acidic solution. The lower the pH, the higher the concentration of hydrogen ions (H^+) and the more acidic the substance. The sour taste of tomato juice is due to the presence of these hydrogen ions.

Solution (ii):

Strong acids and weak bases can be differentiated based on their extent of ionization in aqueous solutions:

Strong Acids: Strong acids almost completely ionize in water, releasing a high concentration of H^+ ions. For example, hydrochloric acid (HCl) dissociates completely: $HCl_{(aq)} \rightarrow H^+_{(aq)} + Cl^-_{(aq)}$.

Weak Bases: Weak bases only partially ionize in water, releasing a low concentration of hydroxide ions (OH^-). For example, ammonia (NH_3) partially reacts with water: $NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH^+_{4(aq)} + OH^-_{(aq)}$. The double arrow indicates a reversible reaction and partial ionization.

Solution (iii):

Acid rain has a pH lower than normal rainwater (which is slightly acidic due to dissolved carbon dioxide, around pH 5.6). Acid rain can have a pH as low as 4. This increased acidity can make the survival of aquatic animals difficult for several reasons:

Interference with enzyme activity: The low pH can disrupt the function of enzymes essential for metabolic processes in aquatic organisms.

Damage to gills and skin: Acidic water can irritate and damage the sensitive tissues of fish and other aquatic animals.

Aluminum toxicity: Acid rain can leach aluminum from the soil into water bodies. Aluminum is toxic to many aquatic organisms, particularly fish, affecting their respiration and osmoregulation.

Disruption of food chains: Acid rain can negatively impact the populations of plankton and other organisms at the base of the food chain, affecting the entire aquatic ecosystem.

💡 Quick Tip

pH is a logarithmic scale. A difference of one pH unit represents a tenfold difference in hydrogen ion concentration. So, a pH of 4 is ten times more acidic than a pH of 5.

Question 29: (i) Why is respiratory pigment needed in multicellular organisms with large body size?

(ii) Give reasons for the following : (a) Rings of cartilage are present in the throat.

(b) Lungs always contain a residual volume of air.

(c) The diaphragm flattens and ribs are lifted up when we breathe in.

(d) Walls of alveoli contain an extensive network of blood vessels.

Solution (i): Respiratory pigments, like hemoglobin in vertebrates, are crucial for multicellular organisms with large body sizes because they greatly increase the oxygen-carrying capacity of blood. Simple diffusion alone is not sufficient to transport enough oxygen to meet the metabolic demands of larger organisms, where cells may be far from the external environment. Respiratory pigments bind reversibly with oxygen, allowing them to pick up oxygen at the respiratory surface (lungs or gills) and release it to the body tissues.

Solution (ii):

- (a) **Rings of cartilage in the throat:** The rings of cartilage in the trachea (windpipe) provide structural support, preventing it from collapsing and ensuring a clear airway for the passage of air to and from the lungs.
- (b) **Residual volume of air in lungs:** The lungs always contain a residual volume of air to prevent the alveoli (tiny air sacs in the lungs) from collapsing during exhalation. This ensures that gas exchange can continue even between breaths.
- (c) **Diaphragm flattens and ribs lift during inhalation:** During inhalation, the diaphragm muscle contracts and flattens, while the intercostal muscles between the ribs contract, causing the ribs to lift upward and outward. These actions increase the volume of the thoracic cavity (chest cavity), which in turn decreases the pressure inside the lungs, drawing air into the lungs.
- (d) **Extensive network of blood vessels in alveoli walls:** The walls of the alveoli have an extensive network of capillaries (tiny blood vessels) to facilitate efficient gas exchange. The thin walls of the alveoli and capillaries allow oxygen to diffuse from the air in the lungs into the blood, and carbon dioxide to diffuse from the blood into the air.

 Quick Tip

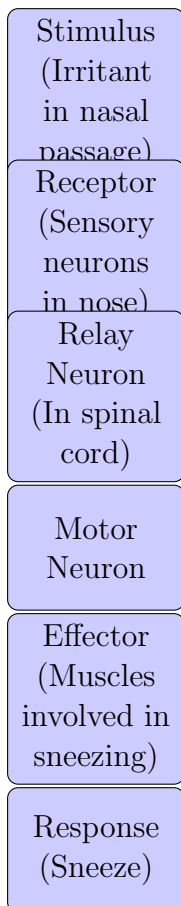
Efficient gas exchange is crucial for delivering oxygen to cells and removing carbon dioxide. The respiratory system has several adaptations to maximize surface area and minimize diffusion distances for effective gas exchange.

Question 30: Define reflex action. With the help of a flow chart show the path of a reflex action such as sneezing.

Solution:

Definition of Reflex Action: A reflex action is an involuntary and nearly instantaneous movement in response to a stimulus. It occurs without conscious thought or decision-making by the brain. Reflex actions are rapid, automatic responses that protect the body from harm.

Flowchart for Sneezing Reflex:

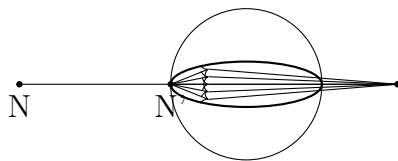
**Explanation of the Sneezing Reflex Pathway:**

1. **Stimulus:** An irritant, such as dust, pollen, or a virus, enters the nasal passage.
2. **Receptor:** Sensory neurons in the lining of the nose detect the irritant.
3. **Relay Neuron:** The sensory neurons send a signal to the spinal cord, where a relay neuron connects the sensory neuron to a motor neuron. (This bypasses the brain for a faster response.)
4. **Motor Neuron:** The relay neuron transmits the signal to a motor neuron.
5. **Effector:** The motor neuron sends a signal to the effector muscles, which are the muscles involved in the act of sneezing (abdominal muscles, diaphragm, chest muscles).
6. **Response:** The effector muscles contract forcefully, expelling air and the irritant from the nasal passage, resulting in a sneeze.

💡 Quick Tip

Reflex actions are essential for survival as they provide rapid responses to potentially harmful stimuli, minimizing injury.

Question 31: Study the diagram given below and answer the questions that follow :



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

Solution (i):

The defect of vision represented in the diagram is **hypermetropia** (also known as far-sightedness or long-sightedness). The diagram shows that light rays from a nearby object are focusing *behind* the retina instead of on the retina. This is characteristic of hypermetropia. A person with hypermetropia can see distant objects clearly but has difficulty focusing on near objects.

Solution (ii):

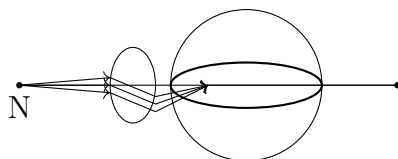
Two causes of hypermetropia are:

Shorter eyeball: If the eyeball is shorter than normal, the light rays focus behind the retina.

Weak lens: If the ciliary muscles are unable to make the lens sufficiently thick or if the lens has lost some of its refractive power (with age), the light rays from near objects are not adequately refracted and focus behind the retina.

Solution (iii):

Hypermetropia can be corrected using a **convex lens**. The convex lens converges the light rays before they enter the eye, so that they focus correctly on the retina.



Quick Tip

Remember that in hypermetropia, the image of a nearby object forms *behind* the retina, and a convex lens is used for correction.

Question 32: Name and state the rule to determine the direction of a :

- (i) magnetic field produced around a current carrying straight conductor.
 (ii) force experienced by a current carrying straight conductor placed in a magnetic field which is perpendicular to it.

Solution (i):

The rule to determine the direction of the magnetic field around a current-carrying straight conductor is the **right-hand thumb rule** (also known as the right-hand grip rule).

Right-Hand Thumb Rule: Imagine holding the straight conductor in your right hand with your thumb pointing in the direction of the conventional current flow (from positive to negative). Then, the direction in which your fingers curl around the conductor represents the direction of the magnetic field lines.

Solution (ii): The rule to determine the direction of the force experienced by a current-carrying straight conductor placed in a perpendicular magnetic field is **Fleming's left-hand rule**.

Fleming's Left-Hand Rule: Hold your left hand with the thumb, forefinger (index finger), and middle finger mutually perpendicular to each other (at right angles).

Forefinger (First finger): Points in the direction of the magnetic field (from North to South).

Middle finger (seCond finger): Points in the direction of the conventional current flow (from positive to negative).

Thumb: Points in the direction of the force (motion) acting on the conductor.

💡 Quick Tip

Remember the mnemonic "FBI" for Fleming's Left-Hand Rule: Forefinger (Field), seCond finger/Middle finger (Current), Thumb (Force/Motion).

Question 33: (A) Plants → Deer → Lion

In the given food chain, what will be the impact of removing all the organisms of second trophic level on the first and third trophic level? Will the impact be the same for the organisms of the third trophic level in the above food chain if they were present in a food web? Justify.

OR

(B) A gas 'X' which is a deadly poison is found at the higher levels of atmosphere and performs an essential function. Name the gas and write the function performed by this gas in the atmosphere. Which chemical is linked to the decrease in the level of this gas? What measures have been taken by an international organization to check the depletion of the layer containing this gas?

Solution (A):

In the food chain Plants → Deer → Lion:

Impact on the first trophic level (Plants): Removing all the deer (second trophic level) would lead to an *increase* in the population of plants (first trophic level) because their primary consumer is absent. The plants would face less grazing pressure and their numbers would grow.

Impact on the third trophic level (Lions): Removing all the deer would have a *negative* impact on the lions (third trophic level). Deer are the lions' primary food source, so their removal would lead to a food shortage for the lions. The lion population would likely decrease or even become locally extinct.

Impact on Lions if Present in a Food Web: If lions were part of a food web (rather than a simple food chain), the impact of removing deer might be less severe. In a food web, organisms have multiple food sources. If deer were removed, lions might be able to switch to other prey. The impact on the lions would depend on the availability and abundance of alternative prey in the food web. They might face some decline, but complete extinction would be less likely.

💡 Quick Tip

Food webs provide greater stability to ecosystems compared to simple food chains because they offer alternative pathways for energy flow.

Solution (B):

The gas 'X' described in the question is **ozone** (O₃).

Function of Ozone: Ozone is found in the stratosphere (upper atmosphere) and forms the ozone layer. The essential function of the ozone layer is to absorb most of the harmful ultraviolet (UV) radiation from the sun. This protects living organisms on Earth from the damaging effects of UV radiation, which can cause skin cancer, cataracts, and damage to the immune system.

Chemical linked to ozone depletion:

Chlorofluorocarbons (CFCs) are the primary chemicals linked to the depletion of the ozone layer. CFCs were widely used in refrigerants, aerosols, and other industrial applications. When released into the atmosphere, CFCs break down in the stratosphere, releasing chlorine atoms that catalytically destroy ozone molecules.

International measures to check ozone depletion: The **Montreal Protocol**, an international treaty adopted in 1987, is the main measure taken by the international community to protect the ozone layer. The Montreal Protocol phased out the production

and consumption of ozone-depleting substances like CFCs.

 Quick Tip

The ozone layer is vital for protecting life on Earth from harmful UV radiation. The Montreal Protocol has been highly successful in reducing CFC emissions and helping the ozone layer recover.

Section - D

- Question 34: (A)** (i) Define a homologous series of carbon compounds. 5
(ii) Why is the melting and boiling points of C_4H_8 higher than that of C_3H_6 or C_2H_4 ?
(iii) Why do we NOT see any gradation in chemical properties of a homologous series compounds?
(iv) Write the name and structures of (i) aldehyde and (ii) ketone with molecular formula C_3H_6O .

OR

- (B) (i) Write the name and structure of an organic compound 'X' having two carbon atoms in its molecule and its name is suffixed with '-ol'. 5
(ii) What happens when 'X' is heated with excess concentrated sulphuric acid at 443 K? Write chemical equation for the reaction stating the conditions for the reaction. Also state the role played by concentrated sulphuric acid in the reaction.
(iii) Name and draw the electron dot structure of hydrocarbon produced in the above reaction.

Solution (A):

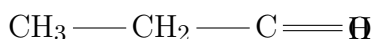
(i) **Homologous series:** A homologous series is a sequence of organic compounds with the same functional group and similar chemical properties, where each successive member differs by a CH_2 unit.

(ii) **Melting and boiling points:** The melting and boiling points of alkenes (like C_4H_8 , C_3H_6 , and C_2H_4) increase with increasing molecular mass (or increasing number of carbon atoms). This is because larger molecules have stronger van der Waals forces of attraction between them, which require more energy to overcome during melting or boiling. C_4H_8 has a larger molecular mass than C_3H_6 or C_2H_4 , hence the higher melting and boiling points.

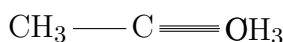
(iii) **Gradation in chemical properties:** We do *see* gradation in *physical* properties (like melting and boiling points) in a homologous series. However, the *chemical* properties remain similar because the members of a homologous series have the same functional group, which determines the chemical reactivity of the molecule.

(iv) **Aldehyde and Ketone (C₃H₆O):**

(i) **Aldehyde:** Propanal (or propionaldehyde)



(ii) **Ketone:** Propanone (or acetone)



 Quick Tip

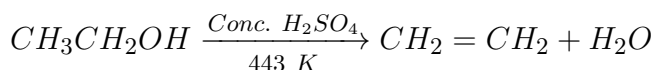
Homologous series provide a systematic way to study organic chemistry due to the predictable trends in physical properties and similar chemical properties of the members.

Solution (B):

(i) **Organic compound 'X' (-ol suffix):** The organic compound 'X' with two carbon atoms and an '-ol' suffix is **ethanol** (ethyl alcohol).

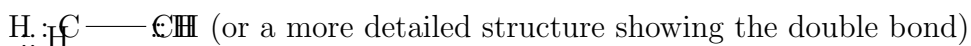


(ii) **Reaction with concentrated sulfuric acid:** When ethanol is heated with excess concentrated sulfuric acid at 443 K (170°C), it undergoes dehydration to produce **ethene** (ethylene), a hydrocarbon.



Role of concentrated sulfuric acid: Concentrated sulfuric acid acts as a **dehydrating agent** in this reaction. It removes a water molecule from the ethanol molecule.

(iii) **Electron dot structure of ethene:**



💡 Quick Tip

Concentrated sulfuric acid is a common dehydrating agent in organic chemistry, used to eliminate water molecules from alcohols to form alkenes.

5

Question 35: (A) (i) Name three techniques/devices used by human females to avoid pregnancy. Mention the side effects caused by each.

(ii) What will happen if in a human female (a) fertilisation takes place, (b) an egg is not fertilised ?

OR

5

(B) (i) Draw a diagram showing spore formation in *Rhizopus* and label the (a) reproductive and (b) non-reproductive parts. Why does *Rhizopus* not multiply on a dry slice of bread ?

(ii) Name and explain the process by which reproduction takes place in *Hydra*.

Solution (A):

(i) **Techniques/devices to avoid pregnancy:**

Oral Contraceptive Pills (“The Pill”): These pills contain synthetic hormones (estrogen and/or progesterone) that prevent ovulation (release of an egg). **Side effects:** Nausea, weight gain, mood swings, headaches, irregular bleeding.

Intrauterine Device (IUD): A small, T-shaped device inserted into the uterus to prevent implantation of a fertilized egg. **Side effects:** Cramping, heavier periods, pelvic inflammatory disease (PID) (rare).

Condoms (Female Condoms): A barrier method that prevents sperm from entering the vagina.

Side effects: Rarely, allergic reactions to the material (latex or polyurethane).

(ii) **Fertilization vs. No Fertilization:**

(a) **If fertilization takes place:** The fertilized egg (zygote) implants in the lining of the uterus and begins to develop into an embryo, leading to pregnancy.

(b) **If an egg is not fertilized:** The egg disintegrates, and the uterine lining is shed during menstruation.

💡 Quick Tip

It is important to consult with a healthcare professional to discuss the most suitable and effective methods of contraception and to understand the potential risks and benefits of each method.

Solution (B):**(i) Spore formation in Rhizopus:**

Rhizopus on dry bread: Rhizopus requires moisture for growth and reproduction. Spores need water to germinate, and the hyphae need a moist environment to grow. A dry slice of bread does not provide the necessary moisture for Rhizopus to multiply.

(ii) Reproduction in Hydra: Hydra can reproduce both asexually and sexually. The primary method of asexual reproduction in Hydra is **budding**.

Budding: A small outgrowth, or bud, develops on the body of the parent Hydra. This bud grows and develops into a miniature Hydra. Eventually, the bud detaches from the parent and becomes an independent individual.

💡 Quick Tip

Rhizopus reproduces by spore formation, while Hydra primarily reproduces asexually by budding. Environmental conditions, such as moisture availability, play a crucial role in the growth and reproduction of these organisms.

5

Question 36: (A) (i) Define electric power. Express it in terms of potential difference (V) and resistance (R).

(ii) An electric oven is designed to work on the mains voltage of 220 V. This oven consumes 11 units of electrical energy in 5 hours. Calculate :

- (a) power rating of the oven**
- (b) current drawn by the oven**
- (c) resistance of the oven when it is red hot**

OR

5

(B) (i) Write the relation between resistance R and electrical resistivity ρ of the material of a conductor in the shape of cylinder of length l and area of cross-section A. Hence derive the SI unit of electrical resistivity.

(ii) The resistance of a metal wire of length 3 m is $60\ \Omega$. If the area of cross-section of the wire is $4 \times 10^{-7}\ \text{m}^2$, calculate the electrical resistivity of the wire.

(iii) State how would electrical resistivity be affected if the wire (of part 'ii') is stretched so that its length is doubled. Justify your answer.

Solution (A):

(i) **Electric Power:** Electric power is the rate at which electrical energy is consumed or dissipated. It is defined as the amount of electrical energy consumed per unit time.

Power in terms of potential difference and resistance: $P = \frac{V^2}{R}$, where P is the power, V is the potential difference, and R is the resistance. Alternatively, using Ohm's law ($V = IR$), power can also be expressed as $P = I^2R$ or $P = VI$, where I is the current.

(ii) **Electric Oven Calculations:**

Given:

Voltage, $V = 220\ \text{V}$

Energy consumed, $E = 11\ \text{units} = 11\ \text{kWh} = 11 \times 1000\ \text{Wh} = 11000\ \text{Wh}$

Time, $t = 5\ \text{hours}$

(a) **Power Rating:** Power is energy consumed per unit time:

$$P = \frac{E}{t} = \frac{11000\ \text{Wh}}{5\ \text{h}} = 2200\ \text{W} = 2.2\ \text{kW}$$

(b) **Current Drawn:** Using $P = VI$:

$$I = \frac{P}{V} = \frac{2200\ \text{W}}{220\ \text{V}} = 10\ \text{A}$$

(c) **Resistance:** Using $P = \frac{V^2}{R}$:

$$R = \frac{V^2}{P} = \frac{(220\ \text{V})^2}{2200\ \text{W}} = \frac{48400}{2200} = 22\ \Omega$$

 Quick Tip

1 unit of electrical energy is equivalent to 1 kilowatt-hour (kWh).

Solution (B):

(i) **Relation between R and ρ :** The resistance (R) of a cylindrical conductor is related to its resistivity (ρ), length (l), and cross-sectional area (A) by the following formula:

$$R = \rho \frac{l}{A}$$

SI unit of resistivity: Rearranging the formula: $\rho = \frac{RA}{l}$.

The SI units of resistance (R), area (A), and length (l) are ohms (Ω), square meters (m^2), and meters (m) respectively.

Therefore, the SI unit of resistivity (ρ) is $\Omega \cdot \text{m}$ (ohm-meter).

(ii) **Resistivity Calculation:**

Given:

Length, $l = 3 \text{ m}$

Resistance, $R = 60 \Omega$

Area, $A = 4 \times 10^{-7} \text{ m}^2$

Using the formula $\rho = \frac{RA}{l}$:

$$\rho = \frac{60 \Omega \times 4 \times 10^{-7} \text{ m}^2}{3 \text{ m}} = 8 \times 10^{-6} \Omega \cdot \text{m}$$

(iii) **Effect of stretching on resistivity:** The **resistivity** of the wire will *not be affected* if the wire is stretched to double its length. Resistivity is a material property and is independent of the dimensions of the wire. While the resistance will change (it will increase by a factor of 4, because doubling the length quarters the area assuming constant volume), the resistivity will remain the same.

💡 Quick Tip

Resistivity is an intrinsic property of a material, while resistance depends on both the material and its dimensions (length and cross-sectional area).

Section - E

Q. Nos. 37-39 are source-based/case-based questions with 2 to 3 short sub-parts. Internal choice is provided in one of these sub-parts :

Question 37: The metals produced by various reduction processes are not very pure. They contain impurities, which must be removed to obtain pure metals. The most widely used method for refining impure metals is elec-

trolytic refining.

4

- (i) What is the cathode and anode made of in the refining of copper by this process ?
(ii) Name the solution used in the above process and write its formula.
(iii) (A) How copper gets refined when electric current is passed in the electrolytic cell ?

OR

- (iii) (B) You have two beakers 'A' and 'B' containing copper sulphate solution. What would you observe after about 2 hours if you dip a strip of zinc in beaker 'A' and a strip of silver in beaker 'B'? Give reason for your observations in each case.

Solution (i):

In the electrolytic refining of copper:

Cathode: A thin strip of *pure* copper is used as the cathode.

Anode: A thick slab of *impure* copper is used as the anode.

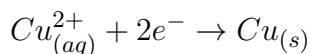
Solution (ii):

The solution used in the electrolytic refining of copper is an **acidified copper sulfate** solution. Its chemical formula is **CuSO₄** (with a small amount of sulfuric acid added).

Solution (iii) (A):

During electrolytic refining of copper:

1. When an electric current is passed through the electrolytic cell, copper ions (Cu²⁺) from the anode (impure copper) dissolve into the copper sulfate solution.
2. These Cu²⁺ ions then migrate towards the cathode (pure copper strip).
3. At the cathode, the Cu²⁺ ions gain electrons and are reduced to copper atoms (Cu), which deposit on the cathode, making it thicker.

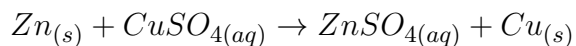


Impurities from the anode either settle at the bottom of the cell as "anode mud" or remain in the solution. The pure copper deposits on the cathode.

Solution (iii) (B):

Beaker A (Zinc in Copper Sulfate): After about 2 hours, you would observe that the zinc strip has become coated with a reddish-brown deposit, and the blue color of the

copper sulfate solution starts to fade. This is because zinc is more reactive than copper, so it displaces copper from the copper sulfate solution.



Beaker B (Silver in Copper Sulfate): After about 2 hours, you would observe no significant change. This is because silver is less reactive than copper and cannot displace it from the copper sulfate solution. No reaction occurs.

 Quick Tip

Electrolytic refining is based on the principle of electrolysis and is used to purify metals. The reactivity series of metals helps predict displacement reactions.

Question 38: Mendel worked out the rules of heredity by working on garden pea using a number of visible contrasting characters. He conducted several experiments by making a cross with one or two pairs of contrasting characters of pea plant. On the basis of his observations he gave some interpretations which helped to study the mechanism of inheritance. 4

- (i) When Mendel crossed pea plants with pure tall and pure short characteristics to produce F_1 progeny, which two observations were made by him in F_1 plants?
- (ii) Write one difference between dominant and recessive trait.
- (iii) (A) In a cross with two pairs of contrasting characters

$\text{RRYY} \times \text{rryy}$

(Round Yellow) (Wrinkled Green)

Mendel observed 4 types of combinations in F_2 generation. By which method did he obtain F_2 generation? Write the ratio of the parental combinations obtained and what conclusions were drawn from this experiment.

OR

- (iii) (B) Justify the statement :

“It is possible that a trait is inherited but may not be expressed.”

Solution (i):

When Mendel crossed pure tall pea plants (TT) with pure short pea plants (tt), he made the following two observations in the F_1 generation:

1. **All F_1 plants were tall:** There were no short plants, even though one parent was

short.

2. **Uniformity in F₁ generation:** All the F₁ plants had a similar height (tall), indicating uniformity in the trait.

Solution (ii):

Dominant vs. Recessive Trait: A dominant trait is expressed even when only one copy of the allele is present (e.g., Tt results in a tall plant). A recessive trait is expressed only when two copies of the allele are present (e.g., tt results in a short plant). In other words, a dominant trait masks the expression of a recessive trait in a heterozygous condition (Tt).

Solution (iii) (A):

Mendel obtained the F₂ generation by **self-pollinating** the F₁ generation plants.

In the dihybrid cross RRYy × rryy, the F₁ generation would all be RrYy (Round Yellow). Upon self-pollination of the F₁ plants, he observed four types of combinations in the F₂ generation in a 9:3:3:1 phenotypic ratio (Round Yellow : Round Green : Wrinkled Yellow : Wrinkled Green).

Ratio of Parental Combinations: The parental combinations (Round Yellow and Wrinkled Green) appear in a 9:1 ratio out of the 16 possible combinations in the F₂ generation. Or, within each individual trait (shape and color), the parental types reappear in a 3:1 ratio (round to wrinkled and yellow to green), as seen in a monohybrid cross.

Conclusions: This experiment led Mendel to formulate the **Law of Independent Assortment**, which states that during gamete formation, the alleles for different traits segregate independently of each other. This means the inheritance of one trait (e.g., seed shape) doesn't influence the inheritance of another trait (e.g., seed color).

Solution (iii) (B):

The statement "It is possible that a trait is inherited but may not be expressed" is justified because of the concept of **recessive traits**. A recessive trait is inherited from both parents (carriers) but is only expressed when an individual has two copies of the recessive allele. If an individual inherits one dominant allele and one recessive allele (heterozygous), the dominant allele masks the expression of the recessive allele. The recessive trait is present in the genotype but not expressed in the phenotype. For example, a person might inherit the allele for cystic fibrosis (a recessive disorder) from both parents but only show symptoms if they have two copies of the allele. If they have one normal allele and one cystic fibrosis allele, they will be a carrier but not have the disease.

💡 Quick Tip

Mendel's work laid the foundation for modern genetics. His laws of inheritance explain how traits are passed from one generation to the next.

Question 39: Study the data given below showing the focal length of three concave mirrors A, B and C and the respective distances of objects placed in front of the mirrors : 4

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

- (i) In which one of the above cases the mirror will form a diminished image of the object? Justify your answer.
 (ii) List two properties of the image formed in case 2.
 (iii) (A) What is the nature and size of the image formed by mirror C ? Draw ray diagram to justify your answer.

OR

- (iii) (B) An object is placed at a distance of 18 cm from the pole of a concave mirror of focal length 12 cm. Find the position of the image formed in this case.

Solution (i):

A concave mirror forms a diminished image when the object is placed *beyond* the center of curvature (C), which is located at twice the focal length ($2f$).

Case 1 (Mirror A): Object distance (45 cm) $> 2 \times$ focal length (40 cm). Therefore, Mirror A will form a diminished image.

Case 2 (Mirror B): Object distance (30 cm) $= 2 \times$ focal length (30 cm). Mirror B will form an image of the same size as the object.

Case 3 (Mirror C): Object distance (20 cm) $<$ focal length (30 cm). Mirror C will form an enlarged image.

Therefore, the mirror in **Case 1** will form a diminished image.

Solution (ii):

In Case 2, the object is placed at the center of curvature (C) of the concave mirror. The image formed will have the following properties:

Real and inverted: The image is formed on the same side of the mirror as the object.

Same size as the object: The image size is equal to the object size.

Located at the center of curvature: The image is formed at the same location as the object.

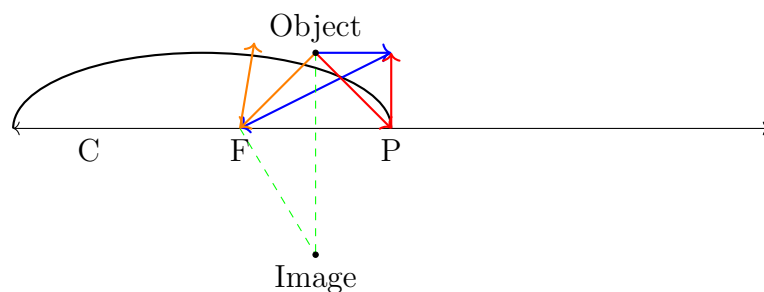
Solution (iii) (A):

In Case 3, the object is placed between the pole (P) and the principal focus (F) of the concave mirror. The image formed will be:

Virtual and erect: The image is formed behind the mirror.

Enlarged: The image is larger than the object.

Ray Diagram (Case 3 - Mirror C):



Solution (iii) (B):

Given:

Object distance, $u = -18$ cm (negative for real object)

Focal length, $f = -12$ cm (negative for concave mirror)

Using the mirror formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$$\frac{1}{-12} = \frac{1}{v} + \frac{1}{-18}$$

$$\frac{1}{v} = \frac{1}{18} - \frac{1}{12}$$

$$\frac{1}{v} = \frac{2-3}{36}$$

$$\frac{1}{v} = \frac{-1}{36}$$

$$v = -36 \text{ cm}$$

The image distance is negative, which means the image is formed 36 cm in front of the mirror (real image).

 Quick Tip

For concave mirrors, remember the sign conventions: u and f are negative. v is negative for real images and positive for virtual images.
