

UP Board Class 10 Science - 824(CK) - 2025 Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :70	Total Questions :11
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. First 15 minutes are allotted for the candidates to read the question paper.
2. The question paper is divided into two Parts – Part 'A' and Part 'B'.
3. Part 'A' and Part 'B' are divided into three Sub-sections I, II, and III.
4. In Part 'A' of the question paper, there are Multiple Choice Type Questions. Select the correct alternative and then by a blue or black ballpoint pen, fill completely in the circle in OMR Answer-Sheet. Do not erase, cut, or use whitener on the OMR Answer-Sheet after answering.
5. 1 mark is allotted for each question in the Multiple Choice Type Questions of Part 'A'.
6. Part 'B' has descriptive questions.
7. The allotted marks are given in each question.
8. All the questions of Sub-Sections of Part 'B' are to be attempted all at a time. Start each Sub-Section from a new page.
9. All the questions are compulsory.

Part - A

1. A ray of white light passes through the triangular prism made of glass. The maximum dispersion will be for the colour

- (A) Red
- (B) Green
- (C) Violet
- (D) Yellow

Correct Answer: (C) Violet

Solution:

Step 1: Understanding the Concept:

Dispersion of light is the phenomenon of splitting of a beam of white light into its constituent

colours when it passes through a prism. The band of colours obtained is called a spectrum (VIBGYOR - Violet, Indigo, Blue, Green, Yellow, Orange, Red).

Step 2: Detailed Explanation:

The cause of dispersion is that the refractive index of the prism material (glass) is different for different wavelengths (colours) of light.

According to Cauchy's relation, the refractive index (μ) is inversely related to the wavelength (λ) of light.

$$\mu \propto \frac{1}{\lambda}$$

Violet light has the shortest wavelength (λ_V) and red light has the longest wavelength (λ_R). Therefore, the refractive index of glass is maximum for violet light (μ_V) and minimum for red light (μ_R).

The angle of deviation (δ) for a prism is directly related to the refractive index (μ). Since $\mu_V > \mu_R$, the deviation for violet light (δ_V) is maximum, and the deviation for red light (δ_R) is minimum.

Maximum dispersion means the maximum deviation from the original path. Hence, violet light shows the maximum dispersion.

Step 3: Final Answer:

The colour that deviates the most and hence shows maximum dispersion is Violet.

Quick Tip

Remember the acronym VIBGYOR in the order of increasing wavelength and decreasing deviation/dispersion. Violet (V) has the shortest wavelength and deviates the most, while Red (R) has the longest wavelength and deviates the least.

2. At sunrise and sunset the sky around the horizon looks –

- (A) Whitish
- (B) Reddish
- (C) Bluish
- (D) Blackish

Correct Answer: (B) Reddish

Solution:

Step 1: Understanding the Concept:

The colour of the sky is determined by the scattering of sunlight by the particles in the Earth's atmosphere. This phenomenon is called Rayleigh scattering.

Step 2: Detailed Explanation:

According to Rayleigh's law of scattering, the intensity of scattered light is inversely proportional to the fourth power of its wavelength ($\text{Intensity} \propto \frac{1}{\lambda^4}$). This means shorter wavelengths (like blue and violet) are scattered much more strongly than longer wavelengths (like red and orange).

At sunrise and sunset, the sun is near the horizon. The sunlight has to travel through a much thicker layer of the atmosphere to reach our eyes compared to when the sun is overhead.

As the light travels this long distance, most of the shorter wavelengths (blue and violet) are scattered away from our line of sight by the atmospheric particles.

The longer wavelengths (red, orange, yellow) are scattered less and are able to pass through the atmosphere to reach our eyes.

This is why the sun and the sky surrounding it appear reddish during sunrise and sunset.

Step 3: Final Answer:

Due to the scattering of light over a long distance through the atmosphere, the sky around the horizon appears reddish at sunrise and sunset.

Quick Tip

Remember this simple rule: Short path (midday) = Blue sky (shorter wavelengths scattered towards you). Long path (sunrise/sunset) = Red sky (longer wavelengths reach you as blue is scattered away).

3. Every ray of light passing through a point in front of the concave mirror, reflects back to pass through the same point. The point is

- (A) Pole of the mirror
- (B) Focus of the mirror
- (C) Centre of curvature of the mirror
- (D) None of the above

Correct Answer: (C) Centre of curvature of the mirror

Solution:

Step 1: Understanding the Concept:

This question relates to the laws of reflection for spherical mirrors, specifically for a concave mirror. A ray of light reflects from a surface such that the angle of incidence is equal to the angle of reflection.

Step 2: Detailed Explanation:

For a ray of light to reflect back along its original path, it must strike the mirror surface at a right angle (90°), which means its angle of incidence is 0° . This is called normal incidence.

For any spherical mirror, a line drawn from the centre of curvature to any point on the mirror's

surface is normal (perpendicular) to the surface at that point.

Therefore, any ray of light that passes through the centre of curvature (C) of a concave mirror will strike the mirror surface along the normal.

When the incident ray is normal to the surface, the angle of incidence is 0° . According to the law of reflection, the angle of reflection must also be 0° . This means the ray will reflect back along the same path.

Step 3: Final Answer:

The point from which an incident ray passes to be reflected back along the same path is the centre of curvature of the mirror.

Quick Tip

Memorize the three principal ray rules for concave mirrors: 1. Ray parallel to the principal axis passes through the focus (F) after reflection. 2. Ray passing through the focus (F) becomes parallel to the principal axis after reflection. 3. Ray passing through the centre of curvature (C) retraces its path after reflection.

4. Which of the following lens is used to see an erect, virtual and smaller in size image of an object ?

- (A) Convex
- (B) Concave
- (C) Plane
- (D) None of the above

Correct Answer: (B) Concave

Solution:

Step 1: Understanding the Concept:

This question requires knowledge of the types of images formed by different types of lenses. The key characteristics mentioned are erect, virtual, and smaller (diminished).

Step 2: Detailed Explanation:

Let's analyze the image formation by each type of lens:

- **Convex Lens:** A convex lens is a converging lens. It can form both real and virtual images. It forms a real, inverted image when the object is placed beyond the focal point. It forms a virtual, erect, and **magnified** image when the object is placed between the optical centre and the focal point. It does not form a smaller virtual image.

- **Concave Lens:** A concave lens is a diverging lens. It always diverges the rays of light. For any position of a real object, a concave lens always forms a **virtual, erect, and diminished** (smaller in size) image. The image is formed between the optical centre and the focus on the same side as the object.

- **Plane Lens (or mirror):** A plane mirror forms a virtual, erect image that is of the **same size** as the object.

Step 3: Final Answer:

The lens that forms an erect, virtual, and smaller image is the concave lens.

Quick Tip

Concave lenses are used in eyeglasses to correct myopia (nearsightedness) and as peep-holes in doors because they provide a wider field of view with an erect, smaller image. This application helps remember its properties.

5. The unit of current flowing in an electrical circuit is –

- (A) Volt
- (B) Ampere
- (C) Ohm
- (D) Watt

Correct Answer: (B) Ampere

Solution:

Step 1: Understanding the Concept:

This is a question about the standard (SI) units for fundamental electrical quantities.

Step 2: Detailed Explanation:

- **Volt (V):** The SI unit of electric potential difference (voltage). It measures the potential energy per unit charge.
- **Ampere (A):** The SI unit of electric current. It measures the rate of flow of electric charge (one coulomb per second).
- **Ohm (Ω):** The SI unit of electrical resistance. It measures the opposition to the flow of electric current.
- **Watt (W):** The SI unit of power. It measures the rate at which energy is transferred or consumed (one joule per second).

Step 3: Final Answer:

The unit of electric current is the Ampere.

Quick Tip

Remember the relationship given by Ohm's Law: Voltage (V) = Current (I) $\times$ Resistance (R). This helps associate Volts with voltage, Amperes with current (I), and Ohms with resistance (R).

6. Three resistances of equal value, are connected in series combination. The resultant resistance of the combination as compared with each resistance will be

- (A) one-third
- (B) half
- (C) double
- (D) triple

Correct Answer: (D) triple

Solution:

Step 1: Understanding the Concept:

The question asks for the equivalent (resultant) resistance of three equal resistors connected in series.

Step 2: Key Formula or Approach:

The formula for the equivalent resistance (R_{eq}) of resistors connected in series is the sum of the individual resistances:

$$R_{eq} = R_1 + R_2 + R_3 + \dots$$

Step 3: Detailed Explanation:

Let the value of each of the three equal resistances be R .

So, $R_1 = R$, $R_2 = R$, and $R_3 = R$.

Since they are connected in series, we use the series combination formula:

$$R_{eq} = R_1 + R_2 + R_3$$

Substituting the values:

$$R_{eq} = R + R + R$$

$$R_{eq} = 3R$$

The resultant resistance ($3R$) is three times, or triple, the value of each individual resistance (R).

Step 4: Final Answer:

The resultant resistance of the combination will be triple the value of each resistance.

Quick Tip

For series connections, the total resistance is always greater than the largest individual resistance. For 'n' equal resistors 'R' in series, $R_{eq} = nR$. For parallel connections, the total resistance is always less than the smallest individual resistance. For 'n' equal resistors 'R' in parallel, $R_{eq} = R/n$.

7. The magnetic field caused due to current carrying linear conductor will exhibit along

- (A) Straight line
- (B) Triangular
- (C) Quadrilateral
- (D) Circular

Correct Answer: (D) Circular

Solution:

Step 1: Understanding the Concept:

This question is about the shape and pattern of magnetic field lines produced by a current flowing through a straight (linear) conductor.

Step 2: Detailed Explanation:

When an electric current flows through a straight conductor, it generates a magnetic field around it. The properties of this magnetic field are:

- The magnetic field lines are concentric circles centred on the wire.
- The plane of these circles is perpendicular to the conductor.
- The direction of the magnetic field lines can be determined using the **Right-Hand Thumb Rule**. If you imagine holding the conductor in your right hand with your thumb pointing in the direction of the current, the direction in which your fingers curl gives the direction of the magnetic field lines.
- The strength of the magnetic field decreases as the distance from the conductor increases.

Step 3: Final Answer:

The magnetic field lines around a straight current-carrying conductor are circular.

Quick Tip

Remember the patterns for different conductor shapes: - **Straight Wire:** Concentric circles. - **Circular Loop:** Field lines are circles near the wire, becoming straight at the center of the loop. - **Solenoid:** Field lines are parallel straight lines inside (like a bar magnet) and loops outside.

8. Chemical formula of baking soda is :

- (A) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$
- (B) NaHCO_3
- (C) $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$
- (D) NaCl

Correct Answer: (B) NaHCO_3

Solution:

Step 1: Understanding the Concept:

This question asks for the chemical formula of a common chemical compound, baking soda.

Step 2: Detailed Explanation:

Let's identify each of the chemical formulas given in the options:

- (A) $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$: This is Sodium Carbonate Decahydrate, commonly known as **Washing Soda**.
- (B) NaHCO_3 : This is Sodium Hydrogen Carbonate or Sodium Bicarbonate, commonly known as **Baking Soda**. It is used in baking as a leavening agent.
- (C) $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$: This is Sodium Sulfate Decahydrate, also known as **Glauber's salt**.
- (D) NaCl : This is Sodium Chloride, commonly known as **Table Salt** or Common Salt.

Step 3: Final Answer:

The correct chemical formula for baking soda is NaHCO_3 .

Quick Tip

It's important to memorize the common names and chemical formulas of a few key compounds like Baking Soda (NaHCO_3), Washing Soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$), Caustic Soda (NaOH), Bleaching Powder (CaOCl_2), and Plaster of Paris ($\text{CaSO}_4 \cdot 1/2 \text{H}_2\text{O}$).

9. Functional group in Butanone is :

- (A) CHO
- (B) C=O
- (C) OH
- (D) C-OH

Correct Answer: (B) $\begin{array}{c} \text{C=O} \\ \text{[] []} \end{array}$

Solution:

Step 1: Understanding the Concept:

The question asks to identify the functional group present in the organic compound "Butanone". We need to deduce the functional group from the IUPAC name.

Step 2: Detailed Explanation:

The name **Butanone** can be broken down into two parts:

- **Butan-**: This prefix indicates that the main carbon chain contains 4 carbon atoms.
- **-one**: This suffix is characteristic of the **Ketone** functional group.

A ketone is a compound containing a carbonyl group (C=O) where the carbonyl carbon atom is bonded to two other carbon atoms. The general structure is R-CO-R' .

Now let's look at the functional groups given in the options:

- (A) **-CHO**: This is the **Aldehyde** group.
- (B) **C=O**: This represents the **Carbonyl** group, which is the functional group for **Ketones** (when bonded to two carbons).
- (C) **-OH**: This is the **Hydroxyl** group, characteristic of **Alcohols**.
- (D) **-COOH**: This is the **Carboxyl** group, characteristic of **Carboxylic Acids**.

Step 3: Final Answer:

Since Butanone is a ketone, its functional group is the carbonyl group, correctly represented by option (B). The structure of butanone is $\text{CH}_3\text{-CO-CH}_2\text{-CH}_3$.

Quick Tip

Memorize the suffixes for common functional groups in IUPAC nomenclature: - **-ol** for Alcohols (-OH) - **-al** for Aldehydes (-CHO) - **-one** for Ketones (C=O) - **-oic acid** for Carboxylic Acids (-COOH)

10. Which of the following gas is released on reacting zinc metal with dilute HCl ?

- (A) Ozone
- (B) Oxygen
- (C) Hydrogen
- (D) Nitrogen

Correct Answer: (C) Hydrogen

Solution:

Step 1: Understanding the Concept:

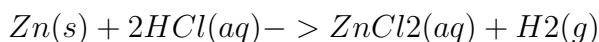
This question is about the chemical reaction between a metal and a dilute acid. Generally, when a reactive metal reacts with a dilute acid, it displaces hydrogen from the acid to form a metal salt and hydrogen gas.

Step 2: Key Formula or Approach:

The general word equation for this type of reaction is:



The specific chemical equation for the reaction between zinc (Zn) and dilute hydrochloric acid (HCl) is:

**Step 3: Detailed Explanation:**

In this reaction, zinc metal reacts with dilute hydrochloric acid. Zinc is more reactive than hydrogen, so it displaces hydrogen from HCl.

The products formed are zinc chloride ZnCl_2 , which is a salt, and hydrogen gas H_2 .

The gas released is therefore Hydrogen.

Step 4: Final Answer:

Based on the chemical reaction, the gas released is Hydrogen.

Quick Tip

Remember the reactivity series of metals. Metals above hydrogen in the series (like Zn, Fe, Mg) will displace hydrogen from dilute acids, while metals below hydrogen (like Cu, Ag, Au) will not.

11. pH value of pure water is :

- (A) 0
- (B) 1
- (C) 7
- (D) 14

Correct Answer: (C) 7

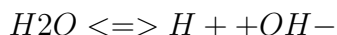
Solution:

Step 1: Understanding the Concept:

The pH scale measures how acidic or basic a substance is. The scale ranges from 0 to 14. A pH of 7 is neutral, a pH less than 7 is acidic, and a pH greater than 7 is basic (alkaline).

Step 2: Detailed Explanation:

Pure water undergoes auto-ionization, where a small fraction of water molecules dissociate into hydrogen ions (H^+) and hydroxide ions (OH^-).



In pure water at 25°C , the concentration of H^+ ions is equal to the concentration of OH^- ions, which is 10^{-7} moles per liter.

The pH is calculated as the negative logarithm of the hydrogen ion concentration:

$$\begin{aligned} \text{pH} &= -\log_{10}[H^+] \\ \text{pH} &= -\log_{10}[10^{-7}] = -(-7) = 7 \end{aligned}$$

A pH of 7 signifies that the solution is neutral, which is the case for pure water.

Step 3: Final Answer:

The pH value of pure water is 7, indicating it is neutral.

Quick Tip

Memorize these key pH values: - pH $<$ 7 = Acidic (e.g., Lemon Juice, Vinegar) - pH = 7 = Neutral (e.g., Pure Water) - pH $>$ 7 = Basic/Alkaline (e.g., Soap, Bleach)

12. Amalgam is :

- (A) Sub-metal
- (B) Alloy
- (C) Compound
- (D) Heterogeneous mixture

Correct Answer: (B) Alloy

Solution:

Step 1: Understanding the Concept:

The question asks for the definition or classification of an amalgam.

Step 2: Detailed Explanation:

An **alloy** is a mixture of metals, or a metal combined with one or more other elements. Examples include brass (copper and zinc) and bronze (copper and tin).

An **amalgam** is a special type of alloy where one of the constituent metals is **mercury** (Hg). For example, dental amalgam is an alloy of mercury with silver, tin, and copper. Sodium amalgam is an alloy of sodium and mercury.

Since an amalgam is a mixture of mercury with other metals, it is classified as an alloy.

Step 3: Final Answer:

An amalgam is an alloy of mercury.

Quick Tip

Whenever you see the term "amalgam," immediately associate it with "mercury." It's the defining component of this specific type of alloy.

13. Which of the following hydrocarbon is alkene ?

- (A) Methane
- (B) Ethane
- (C) Ethylene
- (D) Acetylene

Correct Answer: (C) Ethylene

Solution:**Step 1: Understanding the Concept:**

Hydrocarbons are organic compounds consisting entirely of hydrogen and carbon atoms. They are classified based on the type of bonds between carbon atoms.

- **Alkanes:** Contain only single carbon-carbon bonds (C-C). Suffix '-ane'. General formula C_nH_{2n+2} .
- **Alkenes:** Contain at least one carbon-carbon double bond (C=C). Suffix '-ene'. General formula C_nH_{2n} .
- **Alkynes:** Contain at least one carbon-carbon triple bond (C-C). Suffix '-yne'. General formula C_nH_{2n-2} .

Step 2: Detailed Explanation:

Let's analyze the options:

- (A) **Methane** (CH_4): The simplest alkane with one carbon atom.
- (B) **Ethane** (C_2H_6): An alkane with two carbon atoms.
- (C) **Ethylene** (C_2H_4): This is the common name for **ethene**. It has a carbon-carbon double bond and fits the general formula for alkenes ($C_2H_{2 \times 2}$). It is an alkene.
- (D) **Acetylene** (C_2H_2): This is the common name for **ethyne**. It has a carbon-carbon triple bond and is an alkyne.

Step 3: Final Answer:

Ethylene (ethene) is the alkene among the given options.

Quick Tip

Remember the common names for the simplest alkene and alkyne: Ethylene = Ethene (C_2H_4) and Acetylene = Ethyne (C_2H_2). These names are frequently used in exams.

14. Reproduction by binary fission is found in –

- (A) Paramoecium
- (B) Amoeba
- (C) Euglena
- (D) All of the above

Correct Answer: (D) All of the above

Solution:

Step 1: Understanding the Concept:

Binary fission is a method of asexual reproduction where a parent cell divides into two genetically identical daughter cells. It is the most common form of reproduction in prokaryotes and also occurs in some single-celled eukaryotes (protists).

Step 2: Detailed Explanation:

Let's examine the options, which are all unicellular protists:

- **Paramoecium:** Reproduces asexually by **transverse binary fission**, where the cell divides across its shorter axis.
- **Amoeba:** Reproduces asexually by **simple or irregular binary fission**, where the plane of division is hard to observe.
- **Euglena:** Reproduces asexually by **longitudinal binary fission**, where the cell divides along its longer axis.

Since all three organisms listed reproduce by binary fission (albeit with different planes of division), the correct option is "All of the above."

Step 3: Final Answer:

Paramoecium, Amoeba, and Euglena all reproduce by binary fission.

Quick Tip

While all three reproduce by binary fission, remember the specific type for each: Amoeba (simple), Paramoecium (transverse), and Euglena (longitudinal). This extra detail can be useful for more specific questions.

15. Atrium and Ventricle are the part of which human organ ?

- (A) Heart
- (B) Liver
- (C) Kidney
- (D) Brain

Correct Answer: (A) Heart

Solution:

Step 1: Understanding the Concept:

This question asks to identify the organ that contains structures called atria and ventricles. This is a basic question about human organ systems.

Step 2: Detailed Explanation:

The human heart is a four-chambered muscular organ responsible for pumping blood throughout the body. The four chambers are:

- **Right Atrium:** Receives deoxygenated blood from the body.
- **Left Atrium:** Receives oxygenated blood from the lungs.
- **Right Ventricle:** Pumps deoxygenated blood to the lungs.
- **Left Ventricle:** Pumps oxygenated blood to the rest of the body.

The atria (plural of atrium) are the upper receiving chambers, and the ventricles are the lower pumping chambers. The other organs listed have different structures: the liver has lobes, the kidney has the cortex and medulla, and the brain has cerebrum, cerebellum, etc.

Step 3: Final Answer:

The atria and ventricles are the chambers of the heart.

Quick Tip

Remember the flow of blood: Body → Right Atrium → Right Ventricle → Lungs → Left Atrium → Left Ventricle → Body. The atria are the "arrival" chambers, and the ventricles are the "departure" chambers.

16. Which one of the following is not a plant hormone ?

- (A) Auxin
- (B) Gibberellin
- (C) Insulin
- (D) Cytokinin

Correct Answer: (C) Insulin

Solution:

Step 1: Understanding the Concept:

Plant hormones, also known as phytohormones, are chemicals that regulate a plant's growth, development, and responses to stimuli. The question asks to identify which of the given options is not a plant hormone.

Step 2: Detailed Explanation:

Let's analyze the options:

- **Auxin:** A major class of plant hormones that regulates cell elongation, phototropism, and apical dominance.
- **Gibberellin:** A class of plant hormones that promotes stem elongation, seed germination, and flowering.
- **Insulin:** This is an **animal hormone** produced by the pancreas in humans and other vertebrates. It regulates the metabolism of carbohydrates, fats, and protein by promoting the absorption of glucose from the blood into liver, fat, and skeletal muscle cells. It is not found in plants.
- **Cytokinin:** A class of plant hormones that promotes cell division (cytokinesis) and growth.

Step 3: Final Answer:

Auxin, Gibberellin, and Cytokinin are plant hormones. Insulin is an animal hormone. Therefore, insulin is not a plant hormone.

Quick Tip

The five major classes of plant hormones are Auxins, Gibberellins, Cytokinins, Abscissic Acid (ABA), and Ethylene. Familiarize yourself with these five to easily spot an outlier like Insulin.

17. Reproductive organs of flower are –

- (A) Calyx and Stamens
- (B) Corolla and Gynoecium
- (C) Stamens and Gynoecium
- (D) Gynoecium and Corolla

Correct Answer: (C) Stamens and Gynoecium

Solution:

Step 1: Understanding the Concept:

A flower has four main whorls of parts. Some are directly involved in reproduction (essential whorls), while others are supportive or attract pollinators (accessory whorls).

Step 2: Detailed Explanation:

The parts of a flower are:

- **Calyx:** The outermost whorl, composed of sepals. It is an accessory part, primarily for protection.
- **Corolla:** The whorl inside the calyx, composed of petals. It is an accessory part, primarily for attracting pollinators.
- **Androecium:** The whorl inside the corolla, composed of **stamens** (anther and filament). This is the **male reproductive organ** of the flower.
- **Gynoecium** (or Pistil): The innermost whorl, composed of one or more carpels (stigma, style, and ovary). This is the **female reproductive organ** of the flower.

The question asks for the reproductive organs. These are the stamens (male) and the gynoecium (female).

- Option (A) includes Calyx (accessory). - Option (B) includes Corolla (accessory). - Option (C) includes both Stamens and Gynoecium (both reproductive). - Option (D) includes Corolla (accessory).

Step 3: Final Answer:

The essential reproductive organs of a flower are the stamens and the gynoecium.

Quick Tip

Remember that the reproductive parts are "essential" for making seeds. The accessory parts (calyx and corolla) are "helpful" but not directly involved in fertilization. Stamen sounds like "stay-men" (male part), which can help you remember it.

18. Mendel studied maths and science from which university ?

- (A) Oxford University
- (B) Madras University
- (C) Vienna University
- (D) Paris University

Correct Answer: (C) Vienna University

Solution:

Step 1: Understanding the Concept:

This is a factual question about the educational history of Gregor Mendel, the "Father of Genetics."

Step 2: Detailed Explanation:

Gregor Johann Mendel was an Augustinian friar and scientist. Although much of his groundbreaking work on pea plants was conducted at the St. Thomas's Abbey in Brno (now in the Czech Republic), he sought formal scientific training. From 1851 to 1853, he was sent to study at the **University of Vienna** at the expense of the monastery. There, he studied physics under

Christian Doppler and botany under Franz Unger. This training in physics and mathematics, particularly statistics and probability, was crucial for his later experimental design and analysis of genetic inheritance.

Step 3: Final Answer:

Gregor Mendel studied maths and science at the University of Vienna.

Quick Tip

Associate Mendel's scientific rigor and statistical approach to genetics with his formal training in physics and mathematics at the prestigious University of Vienna.

19. Which one of the following pairs are dominant characters as per Mendel ?

- (A) Long stem and Wrinkled seeds
- (B) Long stem and rounded seeds
- (C) Long stem and Green cotyledones
- (D) None of the above

Correct Answer: (B) Long stem and rounded seeds

Solution:

Step 1: Understanding the Concept:

This question tests the knowledge of the seven contrasting traits in pea plants studied by Gregor Mendel and which of those traits are dominant. A dominant trait is one that is expressed in an organism's phenotype, masking the effect of a recessive trait when present.

Step 2: Detailed Explanation:

Let's list the dominant and recessive forms of the traits mentioned in the options:

- **Stem Height:** Long/Tall (Dominant) vs. Short/Dwarf (Recessive)
- **Seed Shape:** Round (Dominant) vs. Wrinkled (Recessive)
- **Seed Color (Cotyledon):** Yellow (Dominant) vs. Green (Recessive)

Now let's evaluate the pairs in the options:

- (A) Long stem (**Dominant**) and Wrinkled seeds (**Recessive**). This is a mix of dominant and recessive.
- (B) Long stem (**Dominant**) and rounded seeds (**Dominant**). This pair consists of two dominant characters.
- (C) Long stem (**Dominant**) and Green cotyledones (**Recessive**). This is a mix of dominant and recessive.

Step 3: Final Answer:

The pair that contains only dominant characters as per Mendel's studies is "Long stem and

rounded seeds.”

Quick Tip

It's helpful to memorize the key dominant traits Mendel studied: Tall plants, Round seeds, Yellow seeds, Purple flowers, Inflated pods, Green pods, and Axial flower position.

20. Which forms the first trophic level in food chain ?

- (A) Producers
- (B) Secondary consumers
- (C) Primary consumers
- (D) Tertiary consumers

Correct Answer: (A) Producers

Solution:

Step 1: Understanding the Concept:

A trophic level refers to the position an organism occupies in a food chain. It describes how far the organism is from the original source of energy, which is typically the sun.

Step 2: Detailed Explanation:

The trophic levels are organized as follows:

- **First Trophic Level (T1):** This level is occupied by **Producers** (or autotrophs). These are organisms that produce their own food, usually through photosynthesis (e.g., plants, algae). They form the base of the food chain.
- **Second Trophic Level (T2):** This level is occupied by **Primary Consumers**. These are herbivores that feed on the producers.
- **Third Trophic Level (T3):** This level is occupied by **Secondary Consumers**. These are carnivores or omnivores that feed on primary consumers.
- **Fourth Trophic Level (T4):** This level is occupied by **Tertiary Consumers**. These are carnivores or omnivores that feed on secondary consumers.

Step 3: Final Answer:

The first trophic level in any food chain is formed by the producers.

Quick Tip

Think of trophic levels as a pyramid. The base is the largest and most fundamental level, which is always the producers. Every level above depends on the one below it. "Producers" produce the energy for everyone else, so they must come first.

Part - B

1. (i) Why the stars twinkle in sky ? Explain.
- (ii) Write down the laws of refraction.

Solution:

- (i) Why the stars twinkle in sky ? Explain.

Step 1: Understanding the Concept:

The twinkling of stars is caused by a phenomenon called **atmospheric refraction**. It is the refraction (bending) of light from a star as it passes through the Earth's atmosphere.

Step 2: Detailed Explanation:

1. **Stars as Point Sources:** Stars are extremely far away from the Earth. Because of this vast distance, they appear as point-sized sources of light.
2. **Earth's Atmosphere:** The Earth's atmosphere is not uniform. It consists of many layers of air with continuously changing physical conditions like temperature and density. This causes the optical density (refractive index) of the air to vary at different altitudes and even at the same altitude at different times.
3. **Path of Starlight:** When the starlight enters the Earth's atmosphere, it has to pass through these layers of varying refractive indices. As light passes from a rarer medium to a denser medium, it bends towards the normal. The path of the light from the star continuously bends as it travels through the atmosphere.
4. **Apparent Position:** Due to this continuous refraction, the apparent position of the star seems to be slightly different from its actual position. This apparent position is not stationary but keeps changing because the physical conditions of the atmosphere are not static (e.g., due to wind and convection currents).
5. **Twinkling Effect:** As the path of the starlight fluctuates, the amount of light entering our eye from the star also varies. Sometimes more light enters the eye, making the star appear bright, and sometimes less light enters, making it appear dim. This continuous change in brightness and apparent position results in the twinkling effect.

- (ii) Write down the laws of refraction.

Step 1: Understanding the Concept:

Refraction is the bending of light as it passes from one transparent medium to another. The

laws of refraction govern how the light ray changes its path.

Step 2: The Laws of Refraction:

There are two laws of refraction, also known as Snell's laws of refraction:

1. **First Law:** The incident ray, the refracted ray, and the normal to the interface of the two transparent media at the point of incidence, all lie in the same plane.
2. **Second Law (Snell's Law):** The ratio of the sine of the angle of incidence (i) to the sine of the angle of refraction (r) is a constant for a given pair of media and for light of a given wavelength. This constant is called the refractive index of the second medium with respect to the first medium (n_{21}).

Mathematically, the second law is expressed as:

$$\frac{\sin i}{\sin r} = \text{constant} = n_{21} = \frac{n_2}{n_1}$$

Where n_1 is the refractive index of the first medium and n_2 is the refractive index of the second medium.

Quick Tip

For twinkling, remember the key phrase "atmospheric refraction" and the fact that stars are "point sources." For the laws of refraction, don't forget to mention that the constant in Snell's law (the refractive index) depends on the pair of media and the colour/wavelength of light.

-
2. (i) What is meant by power of accommodation of eye ?
(ii) Calculate the power of a convex lens of focal length 50 cm.

Solution:

- (i) What is meant by power of accommodation of eye ?

Step 1: Understanding the Concept:

The power of accommodation of the eye is the ability of the eye lens to adjust its focal length to form a clear and sharp image of objects at different distances on the retina.

Step 2: Detailed Explanation:

The human eye lens is a flexible, living structure held in place by ciliary muscles.

- **Viewing Distant Objects:** When the eye needs to focus on a distant object, the ciliary muscles are in a relaxed state. This pulls the suspensory ligaments taut, which in turn

flattens the eye lens. The lens becomes thinner, its focal length increases, and its converging power decreases, allowing a sharp image of the distant object to be formed on the retina.

- **Viewing Nearby Objects:** When the eye needs to focus on a nearby object, the ciliary muscles contract. This loosens the suspensory ligaments, allowing the eye lens to bulge and become thicker due to its natural elasticity. The focal length decreases, and the converging power of the lens increases, focusing the light from the nearby object onto the retina.

(ii) Calculate the power of a convex lens of focal length 50 cm.

Step 1: Understanding the Concept:

The power of a lens (P) is a measure of its ability to converge or diverge light rays. It is defined as the reciprocal of its focal length (f) when the focal length is expressed in meters. The SI unit of power is the dioptre (D).

Step 2: Key Formula or Approach:

The formula for the power of a lens is:

$$P = \frac{1}{f(\text{in meters})}$$

Step 3: Detailed Explanation:

Given:

- Type of lens: Convex lens
- Focal length, $f = 50$ cm

Sign Convention: The focal length of a convex lens is positive.

So, $f = +50$ cm.

Conversion to Meters: The formula requires the focal length to be in meters.

$$f = 50 \text{ cm} = \frac{50}{100} \text{ m} = 0.5 \text{ m}$$

So, $f = +0.5$ m.

Calculation of Power:

$$P = \frac{1}{f} = \frac{1}{+0.5}$$
$$P = +2.0 \text{ D}$$

Step 4: Final Answer:

The power of the convex lens is **+2.0 dioptres**. The positive sign indicates that it is a converging lens.

Quick Tip

When calculating the power of a lens, the most common mistake is forgetting to convert the focal length from centimeters to meters. Always perform this conversion first. Also, remember the sign convention: focal length is positive for convex lenses and negative for concave lenses.

3. (i) What is Ohm's law ? Explain clearly with it's formula.
(ii) What is the series combination of resistances ? Explain with it's formula.

Solution:

- (i) What is Ohm's law ? Explain clearly with it's formula.

Step 1: Understanding the Concept:

Ohm's law gives the relationship between the potential difference (voltage) across a conductor, the current flowing through it, and its resistance.

Step 2: Detailed Explanation:

Statement of Ohm's Law: Ohm's law states that, provided the physical conditions (like temperature) remain constant, the electric current (I) flowing through a conductor is directly proportional to the potential difference (V) across its ends.

Formula and Explanation:

According to the statement, we can write the proportionality as:

$$I \propto V$$

or, equivalently,

$$V \propto I$$

To convert this proportionality into an equation, we introduce a constant of proportionality, which is the resistance (R) of the conductor.

$$V = R \times I$$

This is the mathematical formula for Ohm's law, where:

- V is the **potential difference** (voltage) across the conductor, measured in Volts (V).
- I is the **electric current** flowing through the conductor, measured in Amperes (A).
- R is the **resistance** of the conductor, which is a constant for a given conductor at a given temperature, measured in Ohms (Ω).

Resistance (R) is the property of a conductor to resist the flow of charge through it.

- (ii) What is the series combination of resistances ? Explain with it's formula.

Step 1: Understanding the Concept:

A series combination is a way of connecting electrical components (in this case, resistors) in a

circuit.

Step 2: Detailed Explanation:

Definition: When two or more resistors are connected end-to-end consecutively, they are said to be connected in **series**. In this arrangement, there is only a single path for the current to flow through all the resistors.

Characteristics of a Series Circuit:

1. **Current:** The electric current flowing through each resistor in the series combination is the same. $I = I_1 = I_2 = I_3 = \dots$
2. **Voltage:** The total potential difference (voltage) across the entire combination is equal to the sum of the potential differences across the individual resistors. $V = V_1 + V_2 + V_3 + \dots$

Formula for Equivalent Resistance:

The equivalent resistance (R_s) of a series combination is the single resistance that could replace the entire combination without changing the total current and voltage in the circuit.

Let's consider three resistors R_1, R_2, R_3 connected in series to a voltage source V .

The total voltage is $V = V_1 + V_2 + V_3$.

Using Ohm's law for each resistor, we have $V_1 = IR_1$, $V_2 = IR_2$, and $V_3 = IR_3$.

For the entire circuit, $V = IR_s$.

Substituting these into the voltage equation:

$$IR_s = IR_1 + IR_2 + IR_3$$

Since the current I is the same throughout the circuit, we can divide the entire equation by I :

$$R_s = R_1 + R_2 + R_3$$

For 'n' resistors in series, the formula is:

$$R_s = R_1 + R_2 + R_3 + \dots + R_n$$

This means the equivalent resistance in a series circuit is the sum of the individual resistances.

Quick Tip

For Ohm's law, always remember to mention the condition "at constant temperature and other physical conditions." For series combination, the key takeaways are: same current, voltage divides, and the total resistance is the sum of individual resistances ($R_s = R_1 + R_2 + \dots$). The equivalent resistance in series is always larger than the largest resistor in the combination.

4. (i) What is Fleming's Left hand rule ? Explain.
(ii) What is the Right-hand thumb rule ? Explain.
(iii) 100 Joule/sec heat is produced in a resistor of resistance of $2\ \Omega$. Calculate the current flowing in the resistor.

Solution:

(i) What is Fleming's Left hand rule ? Explain.

Step 1: Understanding the Concept:

Fleming's Left-Hand Rule is used to determine the direction of the force experienced by a current-carrying conductor placed in a magnetic field. It relates the direction of the magnetic field, the current, and the resulting force (motion).

Step 2: Detailed Explanation:

The Rule: Stretch the thumb, the forefinger (index finger), and the middle finger of your left hand so that they are mutually perpendicular to each other.

- The **Forefinger** points in the direction of the **Magnetic Field (B)**.
- The **Middle finger** points in the direction of the **Current (I)**.
- Then, the **Thumb** will point in the direction of the **Force (F)** or motion experienced by the conductor.

Application: This rule is fundamental to understanding the working principle of electric motors, where an electrical current in a magnetic field produces a mechanical force.

(ii) What is the Right-hand thumb rule ? Explain.

Step 1: Understanding the Concept:

The Right-Hand Thumb Rule (also known as Maxwell's Corkscrew Rule) is used to find the direction of the magnetic field produced around a current-carrying conductor.

Step 2: Detailed Explanation:

The Rule: Imagine you are holding a straight current-carrying conductor in your right hand such that your thumb points in the direction of the electric current. Then, the direction in which your fingers curl around the conductor gives the direction of the magnetic field lines.

- The **Thumb** points in the direction of the **Current (I)**.
- The **Curled Fingers** show the direction of the circular **Magnetic Field (B)** lines.

Application: This rule helps visualize the magnetic field pattern around simple conductors like straight wires and can be extended to determine the polarity of solenoids.

(iii) 100 Joule/sec heat is produced in a resistor of resistance of $2\ \Omega$. Calculate the current flowing in the resistor.

Step 1: Understanding the Concept:

This problem involves Joule's law of heating, which relates the heat produced in a resistor to the current flowing through it and its resistance.

Step 2: Key Formula or Approach:

Heat produced per unit time is Power (P). The formula relating power, current (I), and resistance (R) is:

$$P = I^2 R$$

Step 3: Detailed Explanation:

Given:

- Heat produced per second (Power), $P = 100\text{ Joule/sec} = 100\text{ Watts (W)}$.
- Resistance, $R = 2\ \Omega$.

To find:

- Current, I .

Calculation:

Using the formula $P = I^2 R$:

$$100 = I^2 \times 2$$

Rearranging to solve for I^2 :

$$I^2 = \frac{100}{2}$$

$$I^2 = 50$$

Now, take the square root to find I :

$$I = \sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2}$$

Numerically, $I \approx 5 \times 1.414 = 7.07\text{ Amperes}$.

Step 4: Final Answer:

The current flowing in the resistor is $5\sqrt{2}\text{ A}$ or approximately **7.07 A**.

Quick Tip

Remember the mnemonics: For Fleming's Left-Hand Rule, associate it with the Motor principle (Force). Use F-B-I: **F**ather (Force/Thumb), **M**other (Magnetic Field/Forefinger), **C**hild (Current/Middle finger). For the power formula, remember $P = VI$, $P = I^2R$, and $P = V^2/R$. Use the one that fits the given variables.

4. (OR) (i) What are the factors on which force on a current carrying conductor placed in a magnetic field depends ?

(ii) Draw a distribution diagram of general domestic electric circuit.

Solution:

(i) What are the factors on which force on a current carrying conductor placed in a magnetic field depends ?

Step 1: Understanding the Concept:

The force experienced by a current-carrying conductor in a magnetic field is known as the Lorentz force. Its magnitude is described by a specific formula.

Step 2: Key Formula and Factors:

The magnitude of the force (F) is given by the formula:

$$F = BIL \sin \theta$$

Based on this formula, the force depends on the following four factors:

1. **Magnetic Field Strength (B):** The force is directly proportional to the strength of the magnetic field. A stronger magnetic field results in a greater force.
2. **Electric Current (I):** The force is directly proportional to the magnitude of the current flowing through the conductor. A larger current results in a greater force.
3. **Length of the Conductor (L):** The force is directly proportional to the length of the conductor that is inside the magnetic field. A longer conductor experiences a greater force.
4. **Angle (θ):** The force depends on the sine of the angle (θ) between the direction of the current (conductor) and the direction of the magnetic field.

(ii) Draw a distribution diagram of general domestic electric circuit.

Step 1: Understanding the Concept:

A domestic electric circuit diagram shows how electricity from the main supply is distributed to various appliances in a house safely and efficiently.

Step 2: Description of the Circuit Diagram:

1. **Main Supply:** The circuit begins with the main power supply from the electric pole, which provides three wires:
 - **Live Wire (Red insulation):** Carries the high potential (e.g., 220 V).
 - **Neutral Wire (Black insulation):** Is at or near zero potential.
 - **Earth Wire (Green insulation):** A safety wire connected to a metal plate buried deep in the earth.
2. **Main Fuse/MCB:** The live and neutral wires first pass through a main fuse or a Miniature Circuit Breaker (MCB) of high rating (e.g., 50 A). This is a safety device that cuts off the supply in case of an overload or short circuit.
3. **Electricity Meter:** After the main fuse, the wires connect to the electricity meter, which records the amount of electrical energy consumed by the household.
4. **Distribution Box (Consumer Unit):** From the meter, the wires go to a distribution box. This box contains separate fuses or MCBs for different circuits within the house (e.g., a lighting circuit with a 5 A fuse, and a power circuit for heavy appliances with a 15 A fuse).
5. **Parallel Connection:** From the distribution box, the circuits run to different rooms and appliances. **All appliances are connected in parallel** across the live and neutral wires. This ensures that:
 - Each appliance receives the full supply voltage (e.g., 220 V).
 - Each appliance can be switched on or off independently without affecting others.
 - If one appliance fails, the others continue to work.

Quick Tip

For the factors affecting force, remember the formula $F = BIL \sin \theta$; the factors are the variables in the formula. For domestic circuits, the key concept is the ****parallel connection**** of appliances and the role of the three wires (Live, Neutral, Earth) for functionality and safety.

5. Write the balanced chemical equation for the following reactions :

(i) Calcium hydroxide + Carbon dioxide $\rightarrow$ Calcium carbonate + Water

(ii) Zinc + Silver nitrate $\rightarrow$ Zinc nitrate + Silver

(iii) Nitrogen + Hydrogen $\rightarrow$ Ammonia

(iv) Barium chloride + Sodium sulphate $\rightarrow$ Barium sulphate + Sodium chloride

Solution:

Step 1: Understanding the Concept:

This task requires converting word equations into balanced chemical equations. This involves writing the correct chemical formulas for all reactants and products and then adjusting stoichiometric coefficients to ensure the law of conservation of mass is obeyed (i.e., the number of atoms of each element is the same on both sides of the equation).

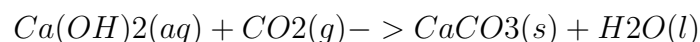
Step 2: Balanced Chemical Equations:

(i) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water

- Formulas: $\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}$

- Balancing: - Left side: 1 Ca, 4 O, 2 H, 1 C - Right side: 1 Ca, 4 O, 2 H, 1 C - The equation is already balanced.

Balanced Equation:

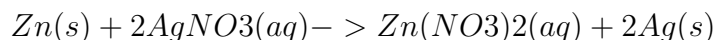


(ii) Zinc + Silver nitrate → Zinc nitrate + Silver

- Formulas: $\text{Zn} + \text{AgNO}_3 \rightarrow \text{Zn(NO}_3)_2 + \text{Ag}$

- Balancing: - The nitrate group (NO_3) is 1 on the left and 2 on the right. Place a '2' before AgNO_3 . - $\text{Zn} + 2\text{AgNO}_3 \rightarrow \text{Zn(NO}_3)_2 + \text{Ag}$ - Now, Ag is 2 on the left and 1 on the right. Place a '2' before Ag. - The equation is now balanced.

Balanced Equation:

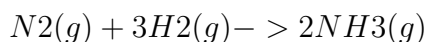


(iii) Nitrogen + Hydrogen → Ammonia

- Formulas: $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$

- Balancing (Haber Process): - N is 2 on the left and 1 on the right. Place a '2' before NH_3 . - $\text{N}_2 + \text{H}_2 \rightarrow 2\text{NH}_3$ - Now, H is 2 on the left and $2 \times 3 = 6$ on the right. Place a '3' before H_2 . - The equation is now balanced.

Balanced Equation:

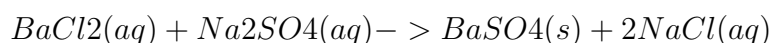


(iv) Barium chloride + Sodium sulphate → Barium sulphate + Sodium chloride

- Formulas: $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{NaCl}$

- Balancing (Double Displacement): - Na is 2 on the left and 1 on the right. Place a '2' before NaCl . - $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$ - Now, check other atoms: Ba (1 on both), Cl (2 on both), S (1 on both), O (4 on both). - The equation is now balanced.

Balanced Equation:



Quick Tip

When balancing, start with the most complex formula or polyatomic ions that appear on both sides (like SO_4 or NO_3). Leave individual elements like O_2 or H_2 for last as they are easiest to adjust.

6. (i) Explain with reason by chemical equation : When copper rod is dipped in silver nitrate solution, it turns blue. Why ?

(ii) Write IUPAC name of the following :

(a) $\text{CH}_3\text{-C(=O)-OH}$

(b) HCHO

Solution:

(i) Explain with reason by chemical equation : When copper rod is dipped in silver nitrate solution, it turns blue. Why ?

Step 1: Understanding the Concept:

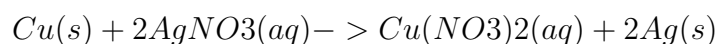
This phenomenon is explained by a single displacement reaction, which is governed by the relative reactivities of the metals involved. The reactivity series of metals determines which metal can displace another from its salt solution.

Step 2: Detailed Explanation:

Reason: Copper (Cu) is more reactive than silver (Ag). According to the reactivity series, a more reactive metal can displace a less reactive metal from its salt solution. When a copper rod is dipped into a colorless solution of silver nitrate (AgNO_3), the more reactive copper displaces the less reactive silver.

Chemical Reaction: Copper atoms from the rod lose two electrons each to become copper(II) ions (Cu^{2+}) and go into the solution. These electrons are gained by the silver ions (Ag^+) from the solution, which become solid silver atoms (Ag) and get deposited on the copper rod.

Chemical Equation:



- **Reactants:** Solid copper (rod) and aqueous silver nitrate (colorless solution).

- **Products:** Aqueous copper(II) nitrate and solid silver (a shiny grey deposit on the rod).

Why the solution turns blue?

The solution turns blue because of the formation of aqueous copper(II) nitrate, $\text{Cu}(\text{NO}_3)_2(aq)$. Hydrated copper(II) ions (Cu^{2+}) in an aqueous solution have a characteristic blue color.

(ii) Write IUPAC name of the following :

Step 1: Understanding the Concept:

The IUPAC (International Union of Pure and Applied Chemistry) nomenclature is a systematic method of naming organic chemical compounds. The name is based on the number of carbon atoms in the parent chain and the type of functional group present.

Step 2: Detailed Explanation:

(a) $\text{CH}_3\text{-C(=O)-OH}$ or CH_3COOH

1. **Identify the parent chain:** There are two carbon atoms in the chain. The root word for two carbons is **eth-**.
2. **Identify the bonds:** The carbon atoms are connected by a single bond, so the infix is **-an-**.
3. **Identify the functional group:** The functional group is **-COOH** (carboxyl group). The suffix for a carboxylic acid is **-oic acid**.
4. **Combine the parts:** Eth + an + oic acid = **Ethanoic acid**. (The terminal 'e' of 'ane' is dropped before adding 'oic acid').

IUPAC Name: Ethanoic acid. (Common name: Acetic acid)

(b) HCHO or H-C(=O)-H

1. **Identify the parent chain:** There is only one carbon atom. The root word for one carbon is **meth-**.
2. **Identify the bonds:** Since there's only one carbon, we use the infix **-an-**.
3. **Identify the functional group:** The functional group is **-CHO** (aldehyde group). The suffix for an aldehyde is **-al**.
4. **Combine the parts:** Meth + an + al = **Methanal**.

IUPAC Name: Methanal. (Common name: Formaldehyde)

Quick Tip

For reactivity series questions, remember the mnemonic: "Please Stop Calling Me A Cute Zebra, I Like Her Call, Smart Guy" (K, Na, Ca, Mg, Al, C, Zn, Fe, Sn, Pb, H, Cu, Ag, Au). For IUPAC names, always identify the longest carbon chain first, then the functional group to determine the suffix.

7. What happens when ? (Write chemical equation only.)

- (i) Sodium reacts with water.
- (ii) Calcium oxide reacts with water.
- (iii) Water vapours are passed through red hot iron.

- (iv) Ethanol is heated with excess of concentrated H_2SO_4 at 443 K.
- (v) Ethyl alcohol reacts with sodium.
- (vi) Methane is combusted.

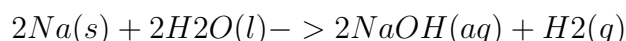
Solution:

Step 1: Understanding the Concept:

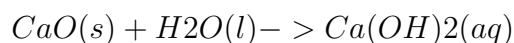
This question requires writing the balanced chemical equations for six different chemical reactions.

Step 2: Chemical Equations:

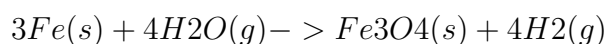
(i) Sodium reacts with water.



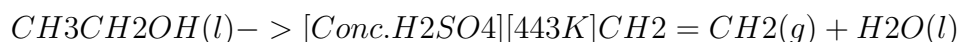
(ii) Calcium oxide reacts with water.



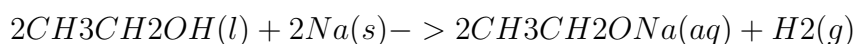
(iii) Water vapours are passed through red hot iron.



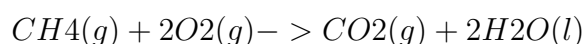
(iv) Ethanol is heated with excess of concentrated H_2SO_4 at 443 K.



(v) Ethyl alcohol reacts with sodium.



(vi) Methane is combusted.



Quick Tip

Always ensure your chemical equations are balanced, meaning there is an equal number of atoms of each element on both the reactant and product sides. Also, remember to include state symbols (s, l, g, aq) where appropriate.

7. (OR) Write short notes on the following :

- (i) Saponification
- (ii) Hydrogenation reaction
- (iii) Rancidity

Solution:

(i) Saponification

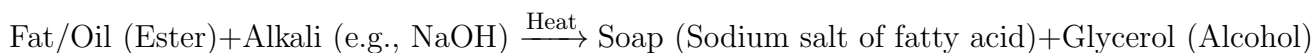
Step 1: Understanding the Concept:

Saponification is the chemical reaction that produces soap. It is the hydrolysis of an ester, specifically a fat or oil (which are triglycerides, i.e., esters of fatty acids and glycerol), in the presence of a strong alkali (like sodium hydroxide or potassium hydroxide).

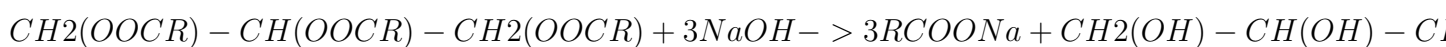
Step 2: Detailed Explanation:

The process involves heating a fat or oil with a concentrated solution of an alkali. This breaks down the ester into its constituent alcohol (glycerol) and the sodium or potassium salt of the fatty acid, which is called soap.

General Equation:



For example:



Where R represents a long hydrocarbon chain.

(ii) Hydrogenation reaction

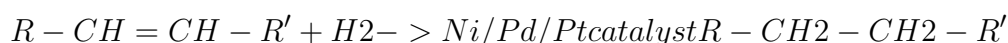
Step 1: Understanding the Concept:

Hydrogenation is an addition reaction in which hydrogen (H₂) is added across a carbon-carbon double bond or triple bond in an unsaturated organic compound. This reaction converts an unsaturated compound into a saturated compound.

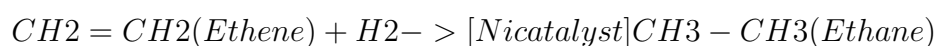
Step 2: Detailed Explanation:

This reaction is typically carried out in the presence of a metal catalyst, such as nickel (Ni), palladium (Pd), or platinum (Pt). A common industrial application is the conversion of unsaturated vegetable oils (liquids at room temperature) into saturated vegetable fats or 'vanaspati ghee' (solids or semi-solids at room temperature).

General Equation (for an alkene):



Example: The hydrogenation of ethene to form ethane.



(iii) Rancidity

Step 1: Understanding the Concept:

Rancidity is the process of aerial oxidation of fats and oils present in food materials, resulting in an unpleasant smell and taste. It makes the food unfit for consumption.

Step 2: Detailed Explanation:

When food containing fats and oils is exposed to air for a long time, the fats and oils get oxidized. The products of this oxidation have a foul odour and taste. This process can be prevented or slowed down by the following methods:

- **Adding Antioxidants:** Substances that prevent oxidation, like BHA (Butylated Hydroxyanisole) and BHT (Butylated Hydroxytoluene), are often added to foods.
- **Vacuum Packing:** Removing air from the packaging prevents contact with oxygen.
- **Flushing with Nitrogen:** Packets of foods like potato chips are flushed with an inert gas like nitrogen to displace oxygen and prevent oxidation.
- **Refrigeration:** Keeping food at low temperatures slows down the rate of oxidation.
- **Storing in Air-tight Containers:** This limits the food's exposure to oxygen in the air.

Quick Tip

Saponification = Soap-making. Hydrogenation = Adding Hydrogen to make saturated fats. Rancidity = Oxidation of fats causing food to go bad.

8. Explain the flow of energy in food chain and food-web with example.

Solution:

Step 1: Understanding the Concept:

The flow of energy in an ecosystem is the transfer of energy from one trophic (feeding) level to another. This flow is unidirectional and follows specific principles, primarily the 10% law of energy transfer.

Step 2: Energy Flow in a Food Chain:

A food chain illustrates a single pathway of energy flow in an ecosystem.

1. **The Ultimate Source:** The ultimate source of energy for almost all food chains is the Sun.
2. **Producers:** Producers (green plants, algae) are at the first trophic level. They capture a small fraction of solar energy and convert it into chemical energy (food) through photosynthesis.
3. **Consumers:** Energy is then transferred to primary consumers (herbivores) when they eat the producers. Then to secondary consumers (carnivores) when they eat the herbivores, and so on.
4. **Unidirectional Flow:** The flow of energy is unidirectional. It flows from the sun to producers, then to consumers, and is not recycled. Energy that is captured by an organism is either used for its life processes or passed on to the next trophic level; it does not flow backward.
5. **The 10% Law:** During the transfer of energy from one trophic level to the next, only about **10%** of the energy is stored in the body of the organism and becomes available

to the next trophic level. The remaining 90% is lost to the environment as heat during metabolic activities (like respiration), used for life processes, or is uneaten. Due to this progressive loss of energy, food chains typically have only 3 to 4 trophic levels.

Step 3: Energy Flow in a Food Web:

A food web is a more realistic representation of feeding relationships in an ecosystem, consisting of multiple interconnected food chains.

- In a food web, an organism can have multiple food sources and can be eaten by multiple other organisms. This creates a complex web of energy pathways.
- The principles of energy flow remain the same as in a food chain: the flow is still unidirectional, and energy is lost at each transfer according to the 10% law.
- A food web provides more stability to the ecosystem. If one species in the web is removed, the consumers that feed on it have alternative food sources, reducing the risk of the ecosystem's collapse.

Example of a Food Web:

- **Producers:** Plants - **Primary Consumers:** Grasshopper, Rabbit, Mouse - **Secondary Consumers:** Frog (eats Grasshopper), Fox (eats Rabbit and Mouse), Snake (eats Frog and Mouse)

Quick Tip

The two most important concepts for energy flow are: 1) It is **unidirectional** (one-way street, not a cycle). 2) The **10% Law** explains why energy decreases significantly at each higher trophic level.

9. Write short notes on any two of the following :

- (i) Importance of sun light in food chain
- (ii) Waste Management
- (iii) Ozone layer is beneficial or harmful ? Explain.

Solution:

(i) Importance of sun light in food chain

Sunlight is the ultimate and primary source of energy for nearly all life on Earth and is the foundation of every food chain. Its importance is paramount for the following reasons:

- **Photosynthesis:** Producers, such as plants and algae, which form the first trophic level, use sunlight to perform photosynthesis. In this process, they convert light energy into chemical energy, storing it in organic molecules like glucose.
- **Base of the Food Chain:** This stored chemical energy is the only form of energy available to all other organisms in the ecosystem. Herbivores (primary consumers) obtain this energy by eating plants, and carnivores (secondary and tertiary consumers) obtain it by eating other animals.

- **Sustaining Life:** Without sunlight, photosynthesis would cease. This would lead to the death of producers, and consequently, the entire food chain would collapse due to the lack of an energy source, eventually leading to the extinction of most life forms.

(ii) Waste Management

Waste management refers to the systematic collection, transportation, processing, recycling, and disposal of waste materials produced by human activities. Its goal is to minimize the adverse effects of waste on human health, the environment, and aesthetics. Key strategies in waste management are often summarized as the "3 R's":

- **Reduce:** This is the most effective strategy. It involves minimizing the amount of waste generated in the first place by consuming less and choosing products with minimal packaging.
- **Reuse:** This involves using items multiple times for their original purpose or a new purpose before they are discarded. Examples include using reusable shopping bags and refilling water bottles.
- **Recycle:** This is the process of converting waste materials into new materials and objects. For example, recycling paper, plastic, glass, and metals conserves natural resources, saves energy, and reduces landfill waste.

(iii) Ozone layer is beneficial or harmful ? Explain.

Whether the ozone (O₃) is beneficial or harmful depends entirely on its location in the atmosphere.

- **Beneficial Ozone (Stratospheric Ozone):** The "ozone layer" is a region in the stratosphere (about 15-35 km above Earth's surface) with a high concentration of ozone. This layer is extremely beneficial and vital for life. It acts as a protective shield, absorbing about 97-99% of the Sun's harmful ultraviolet (UV-B) radiation. By blocking this radiation, the ozone layer protects humans, animals, and plants from damaging effects like skin cancer, cataracts, and genetic damage.
- **Harmful Ozone (Tropospheric or Ground-Level Ozone):** Ozone found in the troposphere (the lowest layer of the atmosphere where we live) is a harmful air pollutant. It is a key component of smog. Ground-level ozone is not emitted directly but is formed by chemical reactions between pollutants like nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight. Inhaling this ozone is harmful to the respiratory system, can trigger asthma, and can damage lung tissue. It is also toxic to plants, damaging crops and forests.

Quick Tip

A simple way to remember the dual role of ozone is: "Good up high, bad nearby." This refers to the protective ozone layer in the stratosphere and the harmful pollutant ozone at ground level.

10. Write an essay on importance of variations in reproduction.

Solution:

Introduction

Variation refers to the differences in characteristics and traits among individuals of the same species. These variations are the cornerstone of evolution and are crucial for the long-term survival of a species.

Sources of Variation

Variations primarily arise from two sources. Firstly, minor inaccuracies in the process of DNA copying (mutations) can create new traits. This is the main source of variation in asexually reproducing organisms. Secondly, and more significantly, sexual reproduction generates immense variation through processes like the crossing over of genes between homologous chromosomes during meiosis, the random assortment of chromosomes into gametes, and the random fusion of these gametes during fertilization. This reshuffling of existing genes creates a vast number of new combinations in every generation.

Importance of Variation for Survival and Adaptation

The primary importance of variation lies in its role in ensuring the survival of a species in a constantly changing environment. An ecosystem is subject to changes in climate, availability of food, emergence of new predators, or the introduction of new diseases. A population that is genetically identical is extremely vulnerable; a single change, like a new disease, could wipe out the entire population.

However, if a population has a wide range of variations, it is more likely that some individuals will possess traits that make them better suited to survive the new conditions. For instance, in a bacterial population, a random mutation may confer resistance to a particular antibiotic. When that antibiotic is introduced, the non-resistant bacteria perish, but the resistant variant survives, reproduces, and thrives. This variation was the key to the population's survival. Similarly, variations in heat tolerance, camouflage, or food-digesting ability can become advantageous under specific environmental pressures.

Quick Tip

When writing about the importance of variation, always link it to the two key concepts: **Survival** in a changing environment and **Evolution** through natural selection. Use the example of antibiotic resistance in bacteria as a classic illustration.

11. What is digestion ? Describe in detail the digestive process in humans with suitable diagram.

Solution:

Definition of Digestion

Digestion is the complex process of breaking down large, insoluble food molecules into small, water-soluble molecules that can be absorbed into the body's tissues and used for energy, growth, and repair. This breakdown is achieved through both mechanical means (like chewing and churning) and chemical means (by enzymes).

The Digestive Process in Humans

The process of digestion occurs in a sequential manner as food passes through the alimentary canal:

1. **Mouth (Buccal Cavity):** Digestion begins here.
 - **Mechanical Digestion:** The teeth cut, tear, and grind the food (mastication).
 - **Chemical Digestion:** The salivary glands secrete saliva, which contains the enzyme **salivary amylase**. This enzyme begins the breakdown of complex carbohydrates (starch) into simpler sugars. The tongue mixes the food with saliva to form a soft ball called a bolus.
2. **Oesophagus (Food Pipe):** The bolus is swallowed and moves down the oesophagus through wave-like muscular contractions called **peristalsis**. No digestion takes place here.
3. **Stomach:** The stomach is a muscular organ that stores food and continues digestion.
 - **Mechanical Digestion:** The muscular walls of the stomach churn the food, mixing it thoroughly with gastric juices.
 - **Chemical Digestion:** The gastric glands secrete gastric juice, which contains:
 - **Hydrochloric Acid (HCl):** Creates a highly acidic environment that kills most harmful bacteria and activates the enzyme pepsin.
 - **Pepsin:** An enzyme that begins the chemical digestion of proteins into smaller polypeptides.
 - **Mucus:** A thick layer that protects the inner lining of the stomach from being damaged by the acid.
4. **Small Intestine:** This is the longest part of the alimentary canal and the primary site for the complete digestion and absorption of nutrients.
 - It receives secretions from two glands:
 - **Liver:** Secretes **bile**, which is stored in the gall bladder. Bile emulsifies fats, breaking large fat globules into smaller droplets, which increases the surface area for enzymes to act upon.
 - **Pancreas:** Secretes **pancreatic juice**, which contains powerful enzymes like **trypsin** (for protein digestion), **pancreatic amylase** (for carbohydrate digestion), and **lipase** (for fat digestion).
 - The walls of the small intestine itself secrete intestinal juice, which contains enzymes that complete the breakdown process: carbohydrates into glucose, proteins into amino acids, and fats into fatty acids and glycerol.
 - **Absorption:** The inner lining of the small intestine is covered with millions of tiny, finger-like projections called **villi**. These villi vastly increase the surface area for the efficient absorption of digested nutrients into the bloodstream.
5. **Large Intestine:** The undigested and unabsorbed food passes into the large intestine. Its main function is to absorb water and electrolytes from the remaining material, solidifying it into feces.

6. **Rectum and Anus:** The feces are stored in the rectum and eliminated from the body through the anus in a process called egestion.

Quick Tip

For each part of the digestive system, remember to mention both the **mechanical** and **chemical** processes occurring there. Associating specific enzymes (Amylase, Pepsin, Lipase, Trypsin) with their respective locations and functions is key.

11. (OR) Write an essay on role of hormones for co-ordination and control in human body.

Solution:

Introduction: The Endocrine System

In the human body, coordination and control are managed by two intricate systems: the nervous system and the endocrine system. While the nervous system provides rapid, short-term coordination through electrical impulses, the endocrine system provides slower, long-term regulation through chemical messengers called **hormones**.

Major Endocrine Glands and Their Hormonal Roles

Several key endocrine glands work in concert to maintain the body's internal balance (homeostasis).

- **Pituitary Gland:** Often called the "master gland," it is located at the base of the brain and controls the functions of many other endocrine glands. It secretes **Growth Hormone (GH)**, which is essential for the normal growth of the body. Deficiency in childhood leads to dwarfism, while excess leads to gigantism.
- **Thyroid Gland:** Located in the neck, it secretes **thyroxine**, a hormone crucial for regulating the body's overall metabolic rate. It controls how quickly the body uses energy from food. Iodine is essential for the synthesis of thyroxine, and its deficiency can lead to a condition called goitre.
- **Adrenal Glands:** Situated on top of the kidneys, these glands are vital for the body's stress response. They secrete **adrenaline** (epinephrine), often known as the "fight or flight" hormone. In emergency situations, adrenaline is rapidly released, increasing heart rate, blood pressure, breathing rate, and blood glucose levels to prepare the body for immediate action.
- **Pancreas:** This organ has both digestive and endocrine functions. Its endocrine part, the islets of Langerhans, secretes **insulin** and **glucagon**, which work antagonistically to control blood sugar levels. Insulin lowers blood glucose by helping cells absorb it, while glucagon raises it. The failure of the pancreas to produce sufficient insulin results in diabetes mellitus.

- **Gonads (Testes and Ovaries):** These are the reproductive glands. The testes in males produce **testosterone**, which is responsible for the development of male secondary sexual characteristics (e.g., deep voice, body hair) and sperm production. The ovaries in females produce **estrogen** and **progesterone**, which control the development of female secondary sexual characteristics, regulate the menstrual cycle, and maintain pregnancy.

The Feedback Mechanism: Maintaining Balance

The secretion of hormones is not constant but is tightly regulated by a **feedback mechanism**. This mechanism ensures that hormones are released only when needed and in the right amounts. For example, when blood sugar levels rise after a meal, the pancreas is stimulated to release insulin. Insulin lowers the blood sugar, and this drop in sugar level, in turn, signals the pancreas to stop secreting insulin. This is a negative feedback loop, which is the primary mechanism for regulating most hormones.

Quick Tip

When discussing hormones, it's effective to structure your essay by gland. For each gland, name the primary hormone, its main function, and a disorder associated with its imbalance (e.g., Pituitary -> Growth Hormone -> Dwarfism/Gigantism).