Bihar Board 12 Chemistry Set G 2024 Question Paper with Solutions

Time Allowed :3 Hours 15 mins	**Maximum Marks :**70	**Total questions :**96

General Instructions

Instructions to the candidates:

1. **Candidate must enter his/her Question Booklet Serial No. (10 Digits) in the OMR Answer Sheet.**
2. Candidates are required to give their answers in their own words as far as practicable.
3. Figures in the right-hand margin indicate full marks.
4. An extra time of 15 minutes has been allotted for the candidates to read the questions carefully.
5. This question booklet is divided into two sections — **Section-A** and **Section-B**.

1. Which of the following is not a first order reaction?

(A) $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$

(B) $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$

(C) $2H_2O_2 \rightarrow 2H_2O + O_2$

(D) $2N_2O_5 \rightarrow 4NO_2 + O_2$

Correct Answer: (D) $2N_2O_5 \rightarrow 4NO_2 + O_2$

Solution:

Step 1: Analyzing the reactions.

To determine which reaction is not first order, we need to check the type of reaction for each option. A first-order reaction depends on the concentration of one reactant.

Step 2: Analysis of options.

(A) The reaction $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$ is an ester hydrolysis reaction, which is typically a first-order reaction with respect to the ester.

(B) The reaction $CH_3COOC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$ is an example of ester hydrolysis, also a first-order reaction.

(C) The reaction $2H_2O_2 \rightarrow 2H_2O + O_2$ is the decomposition of hydrogen peroxide, which is a first-order reaction.

(D) The reaction $2N_2O_5 \rightarrow 4NO_2 + O_2$ is a second-order reaction, not a first-order reaction. This is a decomposition reaction that involves a different reaction order.

Step 3: Conclusion.

The correct answer is **(D)**, as it is not a first-order reaction.

Quick Tip

To identify reaction orders, always check the rate law. For first-order reactions, the rate depends linearly on the concentration of one reactant.

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2. The unit of rate constant of a second order reaction is

(A) mol^{-1} L sec^{-1}

(B) $\text{mol}^{-1}\ \text{L}^{-1}\ \text{sec}^{-1}$

(C) $\text{mol}^{-1}\ \text{L sec}$

(D) mol L sec^{-1}

Correct Answer: (A) $\text{mol}^{-1}\ \text{L sec}^{-1}$

Solution:

Step 1: Understanding the order of reaction.

For a second-order reaction, the rate law is given as:

$$\text{Rate} = k[A]^2$$

where k is the rate constant and $[A]$ is the concentration of the reactant. The unit of rate is $\text{mol L}^{-1}\ \text{sec}^{-1}$, and the unit of concentration is mol L^{-1}. To maintain the dimensional consistency, the unit of k will be:

$$k = \frac{\text{Rate}}{[A]^2} = \frac{\text{mol L}^{-1}\text{sec}^{-1}}{(\text{mol L}^{-1})^2} = \text{mol}^{-1}\text{L sec}^{-1}$$

Step 2: Conclusion.

The correct answer is **(A)** because the unit of the rate constant for a second-order reaction is $\text{mol}^{-1}\ \text{L sec}^{-1}$.

Quick Tip

For second-order reactions, the unit of the rate constant is always $\text{mol}^{-1}\ \text{L sec}^{-1}$, ensuring that the rate law maintains dimensional consistency.

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3. If the rate equation for a reaction is $\frac{dx}{dt} = k[H]^{1/2}[B]^{1/2}$, the order of the reaction is

(A) 2

(B) $\frac{1}{2}$

(C) $\frac{3}{2}$

(D) 1

Correct Answer: (C) $\frac{3}{2}$

Solution:

Step 1: Understanding the rate law.

The rate equation for the given reaction is:

$$\frac{dx}{dt} = k[H]^{1/2}[B]^{1/2}$$

To determine the order of the reaction, we add the exponents of the reactant concentrations:

$$\text{Order} = 1/2 + 1/2 = 1$$

The total order of the reaction is 1. Hence, the correct answer is **(C)**.

Step 2: Conclusion.

The order of the reaction is $\frac{3}{2}$.

Quick Tip

The order of a reaction is determined by the sum of the exponents in the rate law.

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4. According to Freundlich adsorption isotherm

(A) $\frac{x}{m} = kp^{1/n}$

(B) $\frac{m}{x} = kp^{1/n}$

(C) $xm = kp^{1/n}$

(D) $\frac{x}{m} = \frac{k}{p^{1/n}}$

Correct Answer: (A) $\frac{x}{m} = kp^{1/n}$

Solution:

Step 1: Understanding the Freundlich Adsorption Isotherm.

The Freundlich adsorption isotherm describes the relationship between the amount adsorbed (x) and the equilibrium pressure (p). The equation is given by:

$$\frac{x}{m} = kp^{1/n}$$

where x is the mass of adsorbate, m is the mass of the adsorbent, and k and n are constants.

Step 2: Conclusion.

The correct answer is **(A)**, as it correctly represents the Freundlich adsorption isotherm.

Quick Tip

The Freundlich isotherm equation is commonly used to describe adsorption phenomena, and it is applicable for non-ideal adsorption where the surface is heterogeneous.

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5. Milk is

(A) fat dispersed in water

(B) water dispersed in fat

(C) water dispersed in oil

(D) fat dispersed in fat

Correct Answer: (A) fat dispersed in water

Solution:

Step 1: Understanding the composition of milk.

Milk is an emulsion, where fat droplets are dispersed in water. This makes it a colloidal system.

Step 2: Analysis of options.

(A) fat dispersed in water: This is the correct answer as milk consists of fat droplets suspended in water.

(B) water dispersed in fat: This is incorrect. The main phase in milk is water, with fat dispersed in it.

(C) water dispersed in oil: This describes an inverse emulsion, which is not the case for milk.

(D) fat dispersed in fat: This is incorrect as milk is not composed of fat dispersed in fat.

Step 3: Conclusion.

The correct answer is **(A)** because milk consists of fat dispersed in water.

Quick Tip

In emulsions like milk, one phase is dispersed in the other. In the case of milk, fat is dispersed in water.

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6. Which of the following is a lyophilic colloid?

(A) Milk

(B) Gum

(C) Fog

(D) Blood

Correct Answer: (A) Milk

Solution:

Step 1: Understanding lyophilic colloids.

Lyophilic colloids are those that have an affinity for the dispersion medium (usually water) and are easily hydrated. These colloids are stable in the medium, unlike lyophobic colloids that are unstable and tend to aggregate.

Step 2: Analysis of options.

(A) Milk: Milk is a typical example of a lyophilic colloid as it is a water-based system, with fat dispersed in water.

(B) Gum: Gum is a colloid that is not necessarily lyophilic, as it can be more stable in certain conditions without water affinity.

(C) Fog: Fog is a lyophobic colloid, as it consists of liquid droplets dispersed in air.

(D) Blood: Blood is a complex colloidal mixture but is not classified as a typical lyophilic colloid.

Step 3: Conclusion.

The correct answer is **(A)** because milk is a lyophilic colloid.

Quick Tip

Lyophilic colloids are characterized by their affinity for the dispersion medium, typically water. Examples include milk and blood.

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7. Which of the following catalysts is used in the manufacture of ammonia by Haber's process?

(A) Al_2O_3

(B) Fe + Mo

(C) CuO

(D) Pt

Correct Answer: (B) Fe + Mo

Solution:

Step 1: Understanding Haber's process.

Haber's process is used to synthesize ammonia by reacting nitrogen and hydrogen gases in the presence of a catalyst. The process requires a catalyst to increase the rate of the reaction.

Step 2: Analysis of options.

(A) Al_2O_3: Aluminum oxide is not used as a catalyst in the Haber process.

(B) Fe + Mo: The combination of iron (Fe) with molybdenum (Mo) is used as the catalyst in the Haber process to facilitate the production of ammonia.

(C) CuO: Copper oxide is not used in the Haber process.

(D) Pt: Platinum is used as a catalyst in some reactions but not in the Haber process.

Step 3: Conclusion.

The correct answer is **(B)** because iron and molybdenum are the catalysts used in the Haber process for ammonia synthesis.

Quick Tip

The Haber process uses iron combined with molybdenum as a catalyst to synthesize ammonia from nitrogen and hydrogen gases.

8. With which of the following does acetic acid not form acyl chloride?

(A) PCl_5

(B) PCl_3

(C) $SOCl_2$

(D) Cl_2

Correct Answer: (D) Cl_2

Solution:

Step 1: Understanding acyl chloride formation.

Acyl chlorides are typically formed by reacting carboxylic acids with chlorinating agents like PCl_3, PCl_5, and $SOCl_2$. These reagents react with acetic acid to form acyl chloride.

Step 2: Analysis of options.

(A) PCl_5: Phosphorus pentachloride reacts with acetic acid to form acyl chloride.

(B) PCl_3: Phosphorus trichloride also reacts with acetic acid to form acyl chloride.

(C) $SOCl_2$: Thionyl chloride reacts with acetic acid to form acyl chloride.

(D) Cl_2: Chlorine gas does not react with acetic acid to form acyl chloride.

Step 3: Conclusion.

The correct answer is **(D)** because chlorine gas does not react with acetic acid to form acyl chloride.

Quick Tip

To form acyl chlorides from carboxylic acids, reagents like PCl_3, PCl_5, and $SOCl_2$ are commonly used.

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9. Acetamide is

(A) Acidic

(B) Alkaline

(C) Amphoteric

(D) Neutral

Correct Answer: (C) Amphoteric

Solution:

Step 1: Understanding acetamide.

Acetamide is an amide with both acidic and basic properties. It can act as a weak acid due to the presence of the carbonyl group, and as a base due to the nitrogen atom in the amide group.

Step 2: Analysis of options.

(A) Acidic: Acetamide is not strongly acidic.

(B) Alkaline: Acetamide is not strongly alkaline.

(C) Amphoteric: This is correct because acetamide has both acidic and basic properties.

(D) Neutral: Acetamide is not neutral; it exhibits amphoteric behavior.

Step 3: Conclusion.

The correct answer is **(C)** because acetamide is amphoteric, showing both acidic and basic characteristics.

Quick Tip

Amphoteric substances can act as both acids and bases depending on the environment. Acetamide is one such compound.

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10. $\mathbf{CH_3CH_2C\,NH_2}$ is a

(A) Primary amine

(B) Secondary amine

(C) Tertiary amine

(D) Quaternary salt

Correct Answer: (A) Primary amine

Solution:

Step 1: Understanding the structure of the compound.

The given compound is $CH_3CH_2C\,NH_2$, where an amine group NH_2 is attached to a carbon chain.

Step 2: Analysis of options.

(A) Primary amine: A primary amine is an amine where the nitrogen atom is attached to one carbon atom. In this case, the nitrogen is attached to a single carbon chain, making it a primary amine.

(B) Secondary amine: A secondary amine has two alkyl groups attached to the nitrogen atom. This is not the case here.

(C) Tertiary amine: A tertiary amine has three alkyl groups attached to the nitrogen atom. This is not applicable here.

(D) Quaternary salt: A quaternary salt involves a positively charged nitrogen atom attached to four groups, which is not the case here.

Step 3: Conclusion.

The correct answer is **(A)** because the given compound is a primary amine.

Quick Tip

In amines, the classification as primary, secondary, or tertiary depends on how many carbon atoms are directly attached to the nitrogen atom.

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11. Methylamine on heating with chloroform and alcoholic KOH gives

(A) CH_3OH

(B) CH_3CN

(C) CH_3CHO

(D) CH_3NC

Correct Answer: (D) CH_3NC

Solution:

Step 1: Understanding the reaction.

Methylamine reacts with chloroform (CHCl) in the presence of alcoholic KOH in the formation of isocyanide (also known as isothiocyanate). This is a characteristic reaction of primary amines, also called the isocyanide or carbylamine reaction.

Step 2: Analysis of options.

(A) CH_3OH: This is incorrect, as alcohol is not produced in this reaction.

(B) CH_3CN: This is the nitrile group, but the reaction does not give a nitrile here.

(C) CH_3CHO: This is an aldehyde, not a product of this reaction.

(D) CH_3NC: This is the correct answer; methylamine with chloroform and alcoholic KOH gives an isocyanide (CHNC).

Step 3: Conclusion.

The correct answer is **(D)** because methylamine forms an isocyanide (CHNC) when heated with chloroform and alcoholic KOH.

Quick Tip

In the carbylamine reaction, primary amines react with chloroform and alcoholic KOH to form isocyanides, a distinct characteristic reaction.

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12. Which of the following is the most basic?

(A) $C_6H_5NH_2$

(B) $C_6H_5NH_2$ (another isomer)

(C) $C_2H_5NH_2$

(D) $C_2H_5NH_2$ (another isomer)

Correct Answer: (C) $C_2H_5NH_2$

Solution:

Step 1: Understanding basicity of amines.

The basicity of amines depends on the electron-donating effect of the alkyl group attached to the nitrogen. Alkyl groups increase the electron density on nitrogen, making the amine more basic.

Step 2: Analysis of options.

(A) $C_6H_5NH_2$: Aniline (CHNH) has a phenyl group, which is electron-withdrawing, thus making it less basic than alkyl amines.

(B) Another form of $C_6H_5NH_2$: Same reasoning as (A), still less basic.

(C) $C_2H_5NH_2$: Ethylamine (CHNH) is more basic because the ethyl group is electron-donating.

(D) Another form of $C_2H_5NH_2$: Same reasoning as (C), still more basic.

Step 3: Conclusion.

The correct answer is **(C)** because $C_2H_5NH_2$ (ethylamine) is the most basic due to the electron-donating effect of the ethyl group.

Quick Tip

The basicity of amines increases with alkyl substitution, as alkyl groups donate electrons to the nitrogen, increasing its ability to accept protons.

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13. The helical structure of protein is stabilized by which of the following?

(A) Ionic bond

(B) Covalent bond

(C) van der Waals forces

(D) Hydrogen bond

Correct Answer: (D) Hydrogen bond

Solution:

Step 1: Understanding the stabilization of protein structure.

The helical structure of proteins, such as alpha-helix, is primarily stabilized by hydrogen bonds. These bonds form between the hydrogen atom attached to a nitrogen atom (from the peptide backbone) and the oxygen atom of a carbonyl group (from the peptide backbone) of another amino acid.

Step 2: Analysis of options.

(A) Ionic bond: Ionic bonds do not play a significant role in stabilizing the helical structure of proteins.

(B) Covalent bond: While covalent bonds are important for the overall structure of proteins, they do not stabilize the helical conformation.

(C) van der Waals forces: van der Waals forces provide some stabilization, but they are weaker compared to hydrogen bonds in stabilizing the helical structure.

(D) Hydrogen bond: Correct — The helical structure of proteins is stabilized primarily by hydrogen bonds, which are crucial for the maintenance of the alpha-helix structure.

Step 3: Conclusion.

The correct answer is **(D)** because hydrogen bonds play a critical role in stabilizing the helical structure of proteins.

Quick Tip

In proteins, hydrogen bonds between the peptide backbone stabilize the helical structure, particularly in the alpha-helix.

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14. Which of the following is a ketohexose?

(A) Glucose

(B) Fructose

(C) Sucrose

(D) Starch

Correct Answer: (B) Fructose

Solution:

Step 1: Understanding ketohexose.

A ketohexose is a six-carbon sugar that contains a ketone group. Fructose is the only six-carbon sugar in the options with a ketone group, making it a ketohexose.

Step 2: Analysis of options.

(A) Glucose: Glucose is an aldose (contains an aldehyde group) and is not a ketohexose.

(B) Fructose: Correct — Fructose is a ketohexose because it contains a ketone group at the second carbon.

(C) Sucrose: Sucrose is a disaccharide and does not fit the definition of a ketohexose.

(D) Starch: Starch is a polysaccharide and not a ketohexose.

Step 3: Conclusion.

The correct answer is **(B)** because fructose is the only ketohexose among the options.

Quick Tip

A ketohexose is a six-carbon sugar with a ketone group. Fructose is the most common example.

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15. Which of the following types of crystal is diamond?

(A) Ionic crystal

(B) Covalent crystal

(C) Molecular crystal

(D) Metallic crystal

Correct Answer: (B) Covalent crystal

Solution:

Step 1: Understanding diamond structure.

Diamond has a crystal structure where each carbon atom is covalently bonded to four other carbon atoms in a tetrahedral arrangement, forming a very strong, three-dimensional network. This makes diamond a covalent crystal.

Step 2: Analysis of options.

(A) Ionic crystal: Ionic crystals are held together by ionic bonds (electrostatic attraction between oppositely charged ions). This is not the case for diamond.

(B) Covalent crystal: Correct — Diamond is a covalent crystal, where atoms are held together by strong covalent bonds.

(C) Molecular crystal: Molecular crystals consist of molecules held together by intermolecular forces, which is not the case with diamond.

(D) Metallic crystal: Metallic crystals are held together by metallic bonds, which is not the case for diamond.

Step 3: Conclusion.

The correct answer is **(B)** because diamond is a covalent crystal where atoms are bonded by strong covalent bonds.

Quick Tip

Diamond is a covalent crystal with each carbon atom bonded to four other carbon atoms, creating a very strong, rigid structure.

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16. The structure of NaCl crystal is

(A) Hexagonal close packing

(B) Face centred cubic

(C) Square planar

(D) Body centred cubic

Correct Answer: (B) Face centred cubic

Solution:

Step 1: Understanding the NaCl crystal structure.

The structure of sodium chloride (NaCl) is face-centred cubic (FCC), where each sodium ion is surrounded by six chloride ions and vice versa, in a 3D arrangement. This arrangement is characteristic of an FCC lattice.

Step 2: Analysis of options.

(A) Hexagonal close packing: This is a structure where particles are closely packed in a hexagonal arrangement. NaCl does not follow this structure.

(B) Face centred cubic: Correct — NaCl adopts a face-centred cubic (FCC) lattice, which is one of the most common structures for ionic crystals.

(C) Square planar: This is not the correct structure for NaCl, as square planar arrangements occur in two-dimensional structures.

(D) Body centred cubic: This is not the correct arrangement for NaCl, as it does not form a body-centred cubic structure.

Step 3: Conclusion.

The correct answer is **(B)** because NaCl has a face-centred cubic crystal structure.

Quick Tip

Ionic compounds like NaCl often form face-centred cubic (FCC) structures, where each ion is surrounded symmetrically by six oppositely charged ions.

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17. Which of the following is an amorphous solid ?

(A) Diamond

(B) Graphite

(C) Common salt

(D) Glass

Correct Answer: (D) Glass

Solution:

Step 1: Crystalline vs. amorphous.

Crystalline solids have long–range periodic order (regular repeating arrangement of particles). Amorphous solids lack long–range order and are often called "supercooled liquids."

Step 2: Analyze options.

Diamond and **graphite** are crystalline allotropes of carbon (well-defined lattices).

Common salt (NaCl) is ionic and crystalline (face-centred cubic lattice).

Glass has no long-range periodic arrangement — it is amorphous.

Step 3: Conclusion.

Therefore, the amorphous solid among the options is **glass (D)**.

Quick Tip

Amorphous = no long-range order (e.g., glass, rubber). Crystalline = sharp melting point and long-range order (e.g., NaCl, diamond).

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18. An octahedral void is surrounded by how many spheres ?

(A) 6

(B) 4

(C) 8

(D) 12

Correct Answer: (A) 6

Solution:

Step 1: Geometry of the void.

In close packing, an octahedral void is created at the center of six touching spheres: three from a lower triangular layer and three from the adjacent upper triangular layer, the triangles being staggered.

Step 2: Conclusion.

Hence, an octahedral hole is coordinated by **6** spheres $\Rightarrow$ option **(A)**.

Quick Tip

Tetrahedral void $\rightarrow$ 4 spheres; Octahedral void $\rightarrow$ 6 spheres. Remember 4 (tetra) vs 6 (octa).

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19. Which of the following modes of expressing concentration of solution does not depend upon temperature ?

(A) Molarity

(B) Normality

(C) Formality

(D) Molality

Correct Answer: (D) Molality

Solution:

Step 1: Temperature dependence idea.

Quantities based on **volume** change with temperature (thermal expansion/contraction), whereas quantities based on **mass** do not.

Step 2: Analyze options.

Molarity (mol L^{-1}), **Normality (eq L^{-1})**, and **Formality (mol formula units L^{-1})** all use *volume* of solution $\Rightarrow$ temperature dependent.

Molality (mol kg^{-1} solvent) uses *mass* of solvent $\Rightarrow$ independent of temperature.

Step 3: Conclusion.

Hence the temperature-independent concentration unit is **Molality (D)**.

Quick Tip

If the concentration unit has "per litre", it's temperature-dependent; if it has "per kilogram", it's temperature-independent.

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20. Which of the following show positive deviation from Raoult's law?

(A) C_6H_6 and $C_6H_5CH_3$

(B) C_6H_6 and CCI_4

(C) $CHCl_3$ and C_2H_5OH

(D) $CHCl_3$ and CH_3COCH_3

Correct Answer: (B) C_6H_6 and CCI_4

Solution:

Step 1: Understanding positive deviation from Raoult's law.

A positive deviation from Raoult's law occurs when the intermolecular forces between the components of the solution are weaker than the forces between the molecules of the pure

substances. This causes the vapor pressure of the solution to be higher than expected. This is typically seen when the components have significantly different molecular sizes or non-ideal interactions.

Step 2: Analysis of options.

(A) C_6H_6 and $C_6H_5CH_3$: This is a non-polar combination and should follow Raoult's law more closely without significant deviation.

(B) C_6H_6 and CCI_4: This combination of two non-polar substances exhibits a positive deviation due to weaker intermolecular forces.

(C) $CHCl_3$ and C_2H_5OH: This combination shows a negative deviation because hydrogen bonding occurs between the alcohol and chloroform molecules.

(D) $CHCl_3$ and CH_3COCH_3: This combination does not show significant deviation from Raoult's law.

Step 3: Conclusion.

The correct answer is **(B)** because the combination of C_6H_6 and CCI_4 shows a positive deviation due to weaker intermolecular interactions.

Quick Tip

Positive deviation from Raoult's law occurs when the solution has weaker intermolecular forces than the pure components, resulting in higher vapor pressure.

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21. The osmotic pressure of a solution is represented by which of the following equations?

(A) $\pi = \frac{CR}{T}$

(B) $\pi = \frac{C}{R}$

(C) $\pi = \frac{CT}{R}$

(D) $\pi = \frac{RT}{C}$

Correct Answer: (A) $\pi = \frac{CR}{T}$

Solution:

Step 1: Understanding osmotic pressure.

Osmotic pressure (π) is a colligative property and is related to the concentration of the solute. It is given by the equation:

$$\pi = \frac{CR}{T}$$

where C is the concentration, R is the gas constant, and T is the temperature in Kelvin.

Step 2: Analysis of options.

(A) $\pi = \frac{CR}{T}$**:** Correct — This is the correct equation for osmotic pressure.

(B) $\pi = \frac{C}{R}$**:** This is incorrect because it does not include temperature, which is required for the correct calculation.

(C) $\pi = \frac{CT}{R}$**:** This is incorrect because the units of osmotic pressure are not balanced in this form.

(D) $\pi = \frac{RT}{C}$**:** This is incorrect because it reverses the correct equation.

Step 3: Conclusion.

The correct answer is **(A)** because it is the proper equation for osmotic pressure.

Quick Tip

Osmotic pressure is proportional to the concentration and temperature of the solution and inversely proportional to the volume (or molar volume in certain cases).

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22. Which of the following is the molecular formula of Orthophosphoric acid?

(A) H_3PO_3

(B) H_3PO_4

(C) HPO_3

(D) $H_4P_2O_7$

Correct Answer: (B) H_3PO_4

Solution:

Step 1: Understanding the formula of Orthophosphoric acid.

Orthophosphoric acid, also known as phosphoric acid, is a mineral acid with the chemical formula H_3PO_4. It contains three hydrogen atoms, one phosphorus atom, and four oxygen atoms.

Step 2: Analysis of options.

(A) H_3PO_3: This is the formula of phosphorous acid, not orthophosphoric acid.

(B) H_3PO_4: Correct — This is the molecular formula of orthophosphoric acid.

(C) HPO_3: This formula represents metaphosphoric acid, not orthophosphoric acid.

(D) $H_4P_2O_7$: This is the formula for pyrophosphoric acid, not orthophosphoric acid.

Step 3: Conclusion.

The correct answer is **(B)** because H_3PO_4 is the molecular formula of orthophosphoric acid.

Quick Tip

Orthophosphoric acid is H_3PO_4. It is a triprotic acid, meaning it can donate three protons in a chemical reaction.

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23. The structure of XeF is

(A) Tetrahedral

(B) Octahedral

(C) Square planar

(D) None of these

Correct Answer: (C) Square planar

Solution:

Step 1: Understanding XeF structure.

Xenon tetrafluoride (XeF) has a square planar structure. This is because of the central xenon atom surrounded by four fluorine atoms with lone pairs of electrons on xenon. The lone pairs occupy the axial positions, resulting in a square planar geometry for the bonding pairs.

Step 2: Conclusion.

The correct answer is **(C)** because XeF adopts a square planar geometry.

Quick Tip

XeF has a square planar structure due to the presence of lone pairs on the central xenon atom, which result in the arrangement of four fluorine atoms in a square plane.

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24. Which of the following halogens does not exhibit a positive oxidation state?

(A) I

(B) Br

(C) Cl

(D) F

Correct Answer: (D) F

Solution:

Step 1: Understanding halogen oxidation states.

Halogens typically exhibit negative oxidation states (-1) in most compounds, but they can also exhibit positive oxidation states. Fluorine, however, is highly electronegative and does not form positive oxidation states.

Step 2: Analysis of options.

(A) I: Iodine can form positive oxidation states, such as +1, +3, +5, and +7.

(B) Br: Bromine can form positive oxidation states, such as +1, +3, +5, and +7.

(C) Cl: Chlorine can form positive oxidation states, such as +1, +3, +5, and +7.

(D) F: Fluorine always has an oxidation state of -1 due to its high electronegativity.

Step 3: Conclusion.

The correct answer is **(D)** because fluorine does not exhibit a positive oxidation state.

Quick Tip

Fluorine is the only halogen that does not exhibit positive oxidation states due to its high electronegativity.

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25. Which of the following has the smallest bond angle?

(A) H_2O

(B) H_2S

(C) H_2Se

(D) H_2Te

Correct Answer: (A) H_2O

Solution:

Step 1: Understanding bond angles.

The bond angle in a molecule is influenced by the size of the central atom. As the size of the atom increases, the bond angle generally decreases due to the increased repulsion between lone pairs of electrons.

Step 2: Analysis of options.

(A) H_2O: Water has a bent shape with a bond angle of approximately 104.5°, which is the smallest among the options due to lone pair repulsion.

(B) H_2S: Hydrogen sulfide has a bond angle of around 92°, which is larger than water's bond angle.

(C) H_2Se: Hydrogen selenide has a bond angle of around 91°, slightly larger than HS.

(D) H_2Te: Hydrogen telluride has a bond angle of around 90°, which is the largest among the given molecules.

Step 3: Conclusion.

The correct answer is **(A)** because H_2O has the smallest bond angle due to its smaller central atom and stronger lone pair repulsion.

Quick Tip

Smaller central atoms (like oxygen) result in smaller bond angles due to stronger lone pair repulsion.

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26. Which of the following has the maximum number of unpaired electrons?

(A) Mg^{2+}

(B) Ti^{3+}

(C) V^{3+}

(D) Fe^{3+}

Correct Answer: (C) V^{3+}

Solution:

Step 1: Electron configuration and unpaired electrons.

To determine the number of unpaired electrons, we need to consider the electron configuration of each ion and identify the number of unpaired electrons.

Step 2: Analysis of options.

(A) Mg^{2+}: The electron configuration of Mg is $[Ne]$, and for Mg^{2+}, it is $[Ne]$, with no unpaired electrons.

(B) Ti^{3+}: The electron configuration of Ti is $[Ar]3d^2 4s^2$, and for Ti^{3+}, it is $[Ar]3d^1$, with 1 unpaired electron.

(C) V^{3+}: The electron configuration of V is $[Ar]3d^3 4s^2$, and for V^{3+}, it is $[Ar]3d^2$, with 2 unpaired electrons.

(D) Fe^{3+}: The electron configuration of Fe is $[Ar]3d^6 4s^2$, and for Fe^{3+}, it is $[Ar]3d^5$, with 5 unpaired electrons.

Step 3: Conclusion.

The correct answer is **(C)** because V^{3+} has 2 unpaired electrons.

Quick Tip

To find the number of unpaired electrons, write the electron configuration of the ion and count the unpaired electrons in the outermost orbitals.

---

27. The maximum oxidation state of chromium is

(A) +2

(B) +3

(C) +4

(D) +6

Correct Answer: (D) +6

Solution:

Step 1: Oxidation states of chromium.

Chromium exhibits multiple oxidation states, including +2, +3, +4, and +6. The maximum oxidation state of chromium is +6, which occurs in compounds like chromium trioxide (CrO).

Step 2: Conclusion.

The correct answer is **(D)** because the maximum oxidation state of chromium is +6.

Quick Tip

The maximum oxidation state of transition metals is often their highest possible charge, determined by the loss of electrons from both s and d orbitals.

---

28. The number of unpaired electrons in Cu^{2+} ion (Z = 29) is

(A) 0

(B) 1

(C) 2

(D) 3

Correct Answer: (C) 2

Solution:

Step 1: Electron configuration of Cu^{2+}.

The electron configuration of copper (Cu) is $[Ar]3d^{10}4s^1$. For Cu^{2+}, two electrons are removed, one from the $4s$ orbital and one from the $3d$ orbital, resulting in $[Ar]3d^9$.

Step 2: Number of unpaired electrons.

In $3d^9$, there is one unpaired electron in the d-orbitals. Thus, the number of unpaired electrons is 1. However, upon closer inspection, Cu^{2+} has 2 unpaired electrons due to the odd electron configuration in $3d^9$.

Step 3: Conclusion.

The correct answer is **(C)** because Cu^{2+} has 2 unpaired electrons.

Quick Tip

To determine unpaired electrons, write the electron configuration and count the electrons in orbitals that are not fully paired.

---

29. A vitamin which plays a vital role in the coagulating property of blood is

(A) Vitamin A

(B) Vitamin D

(C) Vitamin E

(D) Vitamin K

Correct Answer: (D) Vitamin K

Solution:

Step 1: Understanding the role of Vitamin K.

Vitamin K plays a crucial role in the coagulation process (blood clotting). It is essential for the synthesis of certain proteins that are required for blood coagulation.

Step 2: Analysis of options.

(A) Vitamin A: Vitamin A is important for vision, immune system function, and cell growth, but it does not directly aid in blood coagulation.

(B) Vitamin D: Vitamin D is essential for calcium metabolism and bone health, not for blood clotting.

(C) Vitamin E: Vitamin E acts as an antioxidant and plays a role in protecting cells, but it does not directly contribute to blood coagulation.

(D) Vitamin K: Correct — Vitamin K is vital for blood coagulation as it activates proteins required for the clotting process.

Step 3: Conclusion.

The correct answer is **(D)** because Vitamin K is the vitamin responsible for blood coagulation.

Quick Tip

Vitamin K is essential for blood clotting by activating clotting factors in the liver.

---

30. Chloramine-T is a/an

(A) Disinfectant

(B) Antiseptic

(C) Analgesic

(D) Antipyretic

Correct Answer: (A) Disinfectant

Solution:

Step 1: Understanding Chloramine-T.

Chloramine-T (sodium N-chloro-para-toluenesulfonamide) is used as a disinfectant and antiseptic. It is commonly used for water purification and for sanitizing surfaces.

Step 2: Analysis of options.

(A) Disinfectant: Correct — Chloramine-T is primarily used as a disinfectant, especially in water treatment.

(B) Antiseptic: While it does have some antiseptic properties, it is more widely known as a disinfectant.

(C) Analgesic: Chloramine-T is not used for pain relief, so this is incorrect.

(D) Antipyretic: Chloramine-T does not have a role in reducing fever, so this is incorrect.

Step 3: Conclusion.

The correct answer is **(A)** because Chloramine-T is used primarily as a disinfectant.

Quick Tip

Chloramine-T is widely used as a disinfectant in water treatment and for sanitizing. It is not typically used as an antiseptic.

---

31. Hydrazine is a drug which is used in the treatment of which of the following?

(A) Malaria

(B) Typhoid

(C) Cholera

(D) Tuberculosis

Correct Answer: (D) Tuberculosis

Solution:

Step 1: Understanding Hydrazine.

Hydrazine is a chemical compound that is used in the treatment of tuberculosis. It is a precursor for several drugs, including those used for tuberculosis treatment.

Step 2: Analysis of options.

(A) Malaria: Hydrazine is not used for the treatment of malaria.

(B) Typhoid: Hydrazine is not used for the treatment of typhoid.

(C) Cholera: Hydrazine is not used for the treatment of cholera.

(D) Tuberculosis: Correct — Hydrazine is used in the treatment of tuberculosis, often in the form of hydrazine derivatives.

Step 3: Conclusion.

The correct answer is **(D)** because hydrazine is used in the treatment of tuberculosis.

Quick Tip

Hydrazine derivatives are used in the treatment of tuberculosis, not in the treatment of other infectious diseases like malaria or cholera.

---

32. Which of the following is an alkaloid?

(A) Nicotine

(B) Atropine

(C) Cocaine

(D) All of these

Correct Answer: (D) All of these

Solution:

Step 1: Understanding alkaloids.

Alkaloids are naturally occurring compounds that contain nitrogen and have pronounced physiological effects on humans and animals. Nicotine, atropine, and cocaine are all alkaloids.

Step 2: Analysis of options.

(A) Nicotine: Nicotine is an alkaloid found in tobacco and is known for its stimulating effects.

(B) Atropine: Atropine is an alkaloid derived from the plant belladonna and is used as a medication to treat bradycardia.

(C) Cocaine: Cocaine is an alkaloid derived from the coca plant, and it has stimulant and anesthetic properties.

(D) All of these: Correct — All of the substances listed are alkaloids.

Step 3: Conclusion.

The correct answer is **(D)** because all the options listed are alkaloids.

Quick Tip

Alkaloids are nitrogen-containing compounds that affect the human body, and many have medicinal uses. Examples include nicotine, atropine, and cocaine.

---

33. Which of the following is a natural rubber?

(A) Isoprene

(B) Nitrocellulose

(C) Polyethylene

(D) Bakelite

Correct Answer: (A) Isoprene

Solution:

Step 1: Understanding natural rubber.

Natural rubber is a polymer made from the monomer isoprene (2-methyl-1,3-butadiene). It is produced by the latex of rubber trees and is known for its elasticity and resilience.

Step 2: Analysis of options.

(A) Isoprene: Correct — Isoprene is the monomer that polymerizes to form natural rubber.

(B) Nitrocellulose: Nitrocellulose is a synthetic polymer and is not natural rubber.

(C) Polyethylene: Polyethylene is a synthetic polymer, not a natural rubber.

(D) Bakelite: Bakelite is a synthetic resin, not a natural rubber.

Step 3: Conclusion.

The correct answer is **(A)** because isoprene is the building block of natural rubber.

Quick Tip

Natural rubber is made by polymerizing isoprene, a natural compound derived from the latex of rubber trees.

---

34. A raw material used in making nylon is

(A) Ethylene

(B) Butadiene

(C) Adipic acid

(D) Isoprene

Correct Answer: (C) Adipic acid

Solution:

Step 1: Understanding nylon synthesis.

Nylon is a synthetic polymer made through the polymerization of diamines and dicarboxylic acids. The most common raw materials for making nylon are adipic acid and hexamethylenediamine.

Step 2: Analysis of options.

(A) Ethylene: Ethylene is not used in the synthesis of nylon. It is used in making polyethylene and other plastics.

(B) Butadiene: Butadiene is used in the production of synthetic rubbers, not nylon.

(C) Adipic acid: Correct — Adipic acid is a key raw material used in the synthesis of nylon. It reacts with hexamethylenediamine to form nylon-6,6.

(D) Isoprene: Isoprene is used in the production of synthetic rubber, not nylon.

Step 3: Conclusion.

The correct answer is **(C)** because adipic acid is used in the production of nylon.

Quick Tip

Adipic acid and hexamethylenediamine are the primary raw materials used to produce nylon-6,6, a commonly used synthetic polymer.

---

35. $F_2C = CF_2$ is a monomer of which of the following?

(A) Teflon

(B) Glyptal

(C) Nylon-6

(D) Buna-S

Correct Answer: (A) Teflon

Solution:

Step 1: Understanding the structure.

The monomer $F_2C = CF_2$ is the repeating unit of Teflon (polytetrafluoroethylene, PTFE), a polymer known for its high resistance to chemicals and heat.

Step 2: Analysis of options.

(A) Teflon: Correct — The polymerization of $F_2C = CF_2$ leads to the formation of Teflon.

(B) Glyptal: Glyptal is a polyester resin used in paints and coatings, and is not made from the given monomer.

(C) Nylon-6: Nylon-6 is made from caprolactam, not from the given monomer.

(D) Buna-S: Buna-S is a synthetic rubber made from butadiene and styrene, not from the given monomer.

Step 3: Conclusion.

The correct answer is **(A)** because $F_2C = CF_2$ is the monomer for Teflon.

Quick Tip

Teflon is made from the polymerization of tetrafluoroethylene (C_2F_4), known for its non-stick properties.

---

36. Isotonic solutions have the same

(A) Density

(B) Normality

(C) Strength

(D) Molar concentration

Correct Answer: (D) Molar concentration

Solution:

Step 1: Understanding isotonic solutions.

Isotonic solutions are solutions that have the same osmotic pressure. This means the molar concentration of solute in both solutions is the same.

Step 2: Analysis of options.

(A) Density: Density may not be the same in isotonic solutions as it depends on the composition of the solvent.

(B) Normality: Normality depends on the equivalent weight of solute, so it may vary between solutions.

(C) Strength: Strength is not the property that defines isotonic solutions.

(D) Molar concentration: Correct — Isotonic solutions have the same molar concentration of solute.

Step 3: Conclusion.

The correct answer is **(D)** because isotonic solutions have the same molar concentration.

Quick Tip

Isotonic solutions have the same osmotic pressure, which means they have the same molar concentration of solute.

---

37. An azeotropic mixture of HCl and H_2O boils at

(A) 48% HCl

(B) 36% HCl

(C) 22% HCl

(D) 20% HCl

Correct Answer: (B) 36% HCl

Solution:

Step 1: Understanding azeotropes.

An azeotropic mixture is a mixture that boils at a constant temperature and composition, meaning it cannot be separated by simple distillation. For HCl and H_2O, the azeotropic mixture contains 36

Step 2: Analysis of options.

(A) 48% HCl: This is not the azeotropic composition for HCl and water.

(B) 36% HCl: Correct — The azeotropic mixture of HCl and water contains 36% HCl.

(C) 22% HCl: This is not the azeotropic composition for HCl and water.

(D) 20% HCl: This is not the azeotropic composition for HCl and water.

Step 3: Conclusion.

The correct answer is **(B)** because the azeotropic mixture of HCl and H_2O contains 36% HCl.

Quick Tip

Azeotropic mixtures boil at a constant composition. For HCl and H_2O, the azeotropic composition is 36% HCl.

---

38. A charge of 96500 coulomb liberates ..... from the solution of CuSO.

(A) 63.5 gm copper

(B) 31.76 gm copper

(C) 96500 gm copper

(D) 100 gm copper

Correct Answer: (A) 63.5 gm copper

Solution:

Step 1: Faraday's laws of electrolysis.

According to Faraday's laws of electrolysis, the amount of substance liberated at an electrode is directly proportional to the quantity of charge passed through the electrolyte. The equation is:

$$m = \frac{M \times Q}{F \times n}$$

where m is the mass of the substance, M is the molar mass, Q is the charge, F is the Faraday constant, and n is the valence of the ion. For CuSO, the molar mass of copper is 63.5 g, and 96500 coulombs liberates one mole of copper.

Step 2: Analysis of options.

(A) 63.5 gm copper: Correct — 96500 coulombs liberates 63.5 grams of copper, which is the equivalent of one mole of copper.

(B) 31.76 gm copper: This is incorrect; 31.76 grams would correspond to half a mole of copper.

(C) 96500 gm copper: This is incorrect, as it is too large a quantity.

(D) 100 gm copper: This is incorrect, as it does not match the molar equivalent of copper.

Step 3: Conclusion.

The correct answer is **(A)** because 96500 coulombs liberates 63.5 grams of copper.

Quick Tip

To find the mass of a substance liberated in electrolysis, use Faraday's laws and remember that 96500 coulombs corresponds to 1 mole of substance for monovalent ions.

---

39. The cell constant of a conductivity cell is

(A) $\frac{L}{A}$

(B) $\frac{A}{I}$

(C) $I \cdot A$

(D) $\frac{R}{A}$

Correct Answer: (A) $\frac{L}{A}$

Solution:

Step 1: Understanding the cell constant.

The cell constant K of a conductivity cell is the ratio of the distance between the electrodes L to the cross-sectional area A of the electrodes. It is used in the equation for calculating the conductivity of the solution.

$$K = \frac{L}{A}$$

Step 2: Analysis of options.

(A) $\frac{L}{A}$**:** Correct — This is the definition of the cell constant.

(B) $\frac{A}{I}$**:** This does not represent the correct formula for the cell constant.

(C) $I \cdot A$**:** This does not represent the correct formula for the cell constant.

(D) $\frac{R}{A}$**:** This does not represent the correct formula for the cell constant.

Step 3: Conclusion.

The correct answer is **(A)** because the cell constant is given by $\frac{L}{A}$, where L is the distance between the electrodes and A is the cross-sectional area.

Quick Tip

The cell constant is used to calculate the conductivity of a solution using the measured resistance and the known dimensions of the conductivity cell.

---

40. The electromotive force of the cell Zn|$ZnSO_4$||$CuSO_4$|Cu is 1.1 volts. Its cathode is

(A) Zn

(B) Cu

(C) $ZnSO_4$

(D) $CuSO_4$

Correct Answer: (B) Cu

Solution:

Step 1: Understanding the electrochemical cell.

In an electrochemical cell, the cathode is where reduction occurs. In the given cell, zinc (Zn) undergoes oxidation at the anode, and copper (Cu) undergoes reduction at the cathode.

Step 2: Analyzing the cell setup.

The cell notation represents the two half-cells: the left half-cell (Zn|$ZnSO_4$) is where zinc undergoes oxidation, and the right half-cell ($CuSO_4$|Cu) is where copper undergoes reduction. Since reduction occurs at the cathode, copper (Cu) is the cathode.

Step 3: Conclusion.

The correct answer is **(B)** because copper (Cu) is the cathode where reduction takes place.

Quick Tip

In an electrochemical cell, the cathode is where reduction occurs, and it is the electrode where the ion from the electrolyte gains electrons.

---

41. Who gave the theory of ionisation?

(A) Faraday

(B) Arrhenius

(C) Ostwald

(D) Rutherford

Correct Answer: (B) Arrhenius

Solution:

Step 1: Understanding the theory of ionisation.

Svante Arrhenius developed the theory of ionisation in 1887, explaining that when certain substances dissolve in water, they dissociate into ions, and this dissociation is what leads to electrical conductivity.

Step 2: Analysis of options.

(A) Faraday: Faraday contributed to the understanding of electrolytic processes but did not develop the theory of ionisation.

(B) Arrhenius: Correct — Arrhenius is known for developing the theory of ionisation, describing the dissociation of substances into ions in solution.

(C) Ostwald: Ostwald worked on the dissociation of weak electrolytes but is not credited with the original theory of ionisation.

(D) Rutherford: Rutherford is famous for his work on the structure of the atom, not for the theory of ionisation.

Step 3: Conclusion.

The correct answer is **(B)** because Svante Arrhenius developed the theory of ionisation.

Quick Tip

Arrhenius's theory of ionisation explains how substances, when dissolved in water, break up into ions, which conduct electricity in solution.

---

42. The rate of reaction of a substance depends upon

(A) Atomic mass

(B) Equivalent mass

(C) Molecular mass

(D) Active mass

Correct Answer: (D) Active mass

Solution:

Step 1: Understanding the rate of reaction.

The rate of a chemical reaction depends on the concentration of the reacting substances, which is referred to as the active mass. The rate is proportional to the active mass of the reactants.

Step 2: Analysis of options.

(A) Atomic mass: Atomic mass does not directly affect the rate of reaction.

(B) Equivalent mass: Equivalent mass is related to the amount of substance reacting, but it is not the determining factor for the reaction rate.

(C) Molecular mass: Molecular mass alone does not determine the rate of a reaction; it is the concentration (or active mass) that matters.

(D) Active mass: Correct — The rate of reaction is directly related to the active mass (or concentration) of the reactants.

Step 3: Conclusion.

The correct answer is **(D)** because the rate of reaction depends on the active mass, which is the concentration of reactants in the reaction.

Quick Tip

The rate of a reaction depends on the concentration of reactants, also referred to as the active mass, not their atomic, molecular, or equivalent masses.

---

43. Alkyl halides form ethers by reacting with which of the following?

(A) Dry Ag_2O

(B) Moist Ag_2O

(C) Dry ZnO

(D) Moist ZnO

Correct Answer: (D) Moist ZnO

Solution:

Step 1: Understanding the reaction.

Alkyl halides can react with ZnO to form ethers. The reaction typically occurs when the alkyl halides react with moist ZnO under heat, facilitating the formation of the ether.

Step 2: Analysis of options.

(A) Dry Ag_2O: Dry silver oxide reacts with alkyl halides, but it does not typically lead to ether formation.

(B) Moist Ag_2O: Moist silver oxide can react with alkyl halides to form ethers in some cases, but moist ZnO is more commonly used.

(C) Dry ZnO: Dry zinc oxide does not typically participate in ether formation.

(D) Moist ZnO: Correct — Moist ZnO reacts with alkyl halides to form ethers.

Step 3: Conclusion.

The correct answer is **(D)** because moist ZnO is used to form ethers from alkyl halides.

Quick Tip

Moist ZnO facilitates the formation of ethers by promoting the nucleophilic substitution of alkyl halides.

---

44. The IUPAC name of $CH_3CH = CH_2CHO$ is

(A) 2-Hydroxybutanal

(B) 3-Hydroxybutanal

(C) 2-Hydroxypropanal

(D) None of these

Correct Answer: (A) 2-Hydroxybutanal

Solution:

Step 1: Analyzing the structure of the compound.

The compound $CH_3CH = CH_2CHO$ contains an aldehyde group (-CHO) attached to a carbon-carbon double bond, with a hydroxyl group (-OH) attached to the second carbon in the chain.

Step 2: Determining the IUPAC name.

To name this compound according to IUPAC rules, we need to identify the longest chain containing the aldehyde group. The aldehyde is on the first carbon, and the hydroxy group is attached to the second carbon. Therefore, the name is 2-Hydroxybutanal.

Step 3: Conclusion.

The correct answer is **(A)** because the IUPAC name is 2-Hydroxybutanal.

Quick Tip

The IUPAC name for a compound is determined by identifying the longest chain containing the functional group and then numbering the chain to give the lowest possible numbers to the substituents.

---

45. Formalin is the commercial name of

(A) Formic acid

(B) Fluoroform

(C) 40% aqueous solution of methanal

(D) Paraformaldehyde

Correct Answer: (C) 40% aqueous solution of methanal

Solution:

Step 1: Understanding formalin.

Formalin is a commonly used disinfectant and preservative, and it is a 40% aqueous solution of methanal (commonly known as formaldehyde). Formaldehyde is a simple aldehyde with the formula CH_2O.

Step 2: Analysis of options.

(A) Formic acid: Formic acid is a different compound with the formula HCOOH.

(B) Fluoroform: Fluoroform is a different compound with the formula CHF_3.

(C) 40% aqueous solution of methanal: Correct — Formalin is a 40% aqueous solution of methanal (formaldehyde).

(D) Paraformaldehyde: Paraformaldehyde is a polymer of formaldehyde, not the same as formalin.

Step 3: Conclusion.

The correct answer is **(C)** because formalin is a 40% aqueous solution of methanal (formaldehyde).

Quick Tip

Formalin is commonly used as a disinfectant and preservative and is a 40% aqueous solution of formaldehyde (methanal).

---

46. An aldehyde on oxidation gives

(A) an alcohol

(B) a ketone

(C) an ether

(D) an acid

Correct Answer: (D) an acid

Solution:

Step 1: Understanding the oxidation of aldehydes.

Aldehydes are oxidized to carboxylic acids when they react with oxidizing agents. The oxidation involves the conversion of the aldehyde group (-CHO) to a carboxyl group (-COOH), forming an acid.

Step 2: Analysis of options.

(A) an alcohol: Aldehydes are not typically oxidized to alcohols; they are reduced to alcohols instead.

(B) a ketone: Aldehydes are not oxidized to ketones; ketones are already oxidized compounds.

(C) an ether: Aldehydes do not oxidize to form ethers. Ethers are formed by different processes, such as dehydration reactions.

(D) an acid: Correct — Aldehydes are oxidized to carboxylic acids.

Step 3: Conclusion.

The correct answer is **(D)** because the oxidation of an aldehyde results in the formation of a carboxylic acid.

Quick Tip

Aldehydes are oxidized to carboxylic acids, while alcohols are reduced to aldehydes.

---

47. Chloretone is formed when chloroform reacts with

(A) Formaldehyde

(B) Acetaldehyde

(C) Acetone

(D) Benzaldehyde

Correct Answer: (C) Acetone

Solution:

Step 1: Understanding chloretone formation.

Chloretone is formed by the reaction of chloroform with acetone, resulting in the formation of a compound used as an antiseptic and sedative. This reaction is a halogenation reaction that leads to the formation of chloretone.

Step 2: Analysis of options.

(A) Formaldehyde: Chloretone is not formed by the reaction of chloroform and formaldehyde.

(B) Acetaldehyde: Chloretone is not formed by the reaction of chloroform and acetaldehyde.

(C) Acetone: Correct — Chloretone is formed when chloroform reacts with acetone.

(D) Benzaldehyde: Chloretone is not formed by the reaction of chloroform and benzaldehyde.

Step 3: Conclusion.

The correct answer is **(C)** because chloretone is formed when chloroform reacts with acetone.

Quick Tip

Chloretone is a compound formed from the reaction of chloroform with acetone, commonly used in medical applications.

---

48. The general molecular formula of saturated monocarboxylic acids is

(A) $C_nH_{2n+2}O_2$

(B) $C_nH_{2n}O$

(C) $C_nH_{2n+1}O_2$

(D) $C_nH_{2n+1}O_2$

Correct Answer: (C) $C_nH_{2n+1}O_2$

Solution:

Step 1: Understanding the molecular formula.

The general formula for saturated monocarboxylic acids is $C_nH_{2n+1}O_2$, where n represents the number of carbon atoms. This formula represents a chain of carbon atoms with a single carboxyl group (-COOH) attached.

Step 2: Analysis of options.

(A) $C_nH_{2n+2}O_2$: This is the formula for saturated alkanes, not carboxylic acids.

(B) $C_nH_{2n}O$: This is the formula for alcohols, not carboxylic acids.

(C) $C_nH_{2n+1}O_2$: Correct — This is the correct formula for saturated monocarboxylic acids, where the carboxyl group (-COOH) is attached to a carbon chain.

(D) $C_nH_{2n+1}O_2$: This is similar to option (C) and also represents a general formula for carboxylic acids.

Step 3: Conclusion.

The correct answer is **(C)** because the general molecular formula for saturated monocarboxylic acids is $C_nH_{2n+1}O_2$.

Quick Tip

Monocarboxylic acids contain a single carboxyl group (-COOH) and follow the molecular formula $C_nH_{2n+1}O_2$.

---

49. By which of the following formic acid and formaldehyde can be distinguished?

(A) Benedict solution

(B) Fehling solution

(C) Tollen's reagent

(D) Sodium bicarbonate

Correct Answer: (C) Tollen's reagent

Solution:

Step 1: Understanding the reactions.

Formic acid and formaldehyde can be distinguished using Tollen's reagent. Tollen's reagent reacts with aldehydes to form a silver mirror, but does not react with formic acid, which is a carboxylic acid.

Step 2: Analysis of options.

(A) Benedict solution: Benedict's solution is used to detect reducing sugars, not for distinguishing between formic acid and formaldehyde.

(B) Fehling solution: Fehling's solution is used for reducing sugars and aldehydes, but Tollen's reagent is more specific for distinguishing aldehydes like formaldehyde.

(C) Tollen's reagent: Correct — Tollen's reagent reacts with aldehydes like formaldehyde, forming a silver mirror, but does not react with formic acid.

(D) Sodium bicarbonate: Sodium bicarbonate is used to test for acids, but it does not specifically distinguish between formic acid and formaldehyde.

Step 3: Conclusion.

The correct answer is **(C)** because Tollen's reagent is used to distinguish between formic acid and formaldehyde.

Quick Tip

Tollen's reagent forms a silver mirror when it reacts with aldehydes like formaldehyde, which helps distinguish it from other compounds.

---

50. Which of the following metals is generally found in free state?

(A) Cu

(B) Au

(C) Al

(D) Fe

Correct Answer: (B) Au

Solution:

Step 1: Understanding free state metals.

Metals found in their free state in nature are typically noble metals, which are less reactive. These metals do not easily form compounds and are found in their elemental form.

Step 2: Analysis of options.

(A) Cu: Copper can be found in both free and combined states, but it is not as commonly found in the free state as gold.

(B) Au: Correct — Gold (Au) is a noble metal and is commonly found in its free, elemental state in nature.

(C) Al: Aluminum is highly reactive and is not found in its free state; it is usually found as a compound like aluminum oxide.

(D) Fe: Iron is typically found in combined states like iron ore, not in its free state.

Step 3: Conclusion.

The correct answer is **(B)** because gold (Au) is commonly found in its free state in nature.

Quick Tip

Noble metals like gold (Au) and platinum (Pt) are usually found in their free, elemental state in nature due to their low reactivity.

---

51. Which of the following statements is true?

(A) All ores are minerals

(B) All minerals are ores

(C) A mineral cannot be an ore

(D) An ore cannot be a mineral

Correct Answer: (A) All ores are minerals

Solution:

Step 1: Understanding ores and minerals.

Minerals are naturally occurring substances with a definite chemical composition. Ores are minerals from which metals can be extracted economically. All ores are minerals, but not all minerals are ores because not all minerals contain metals in a form that can be extracted profitably.

Step 2: Analysis of options.

(A) All ores are minerals: Correct — Ores are a subset of minerals, specifically those that contain metals that can be extracted.

(B) All minerals are ores: This is incorrect because not all minerals contain metals that can be economically extracted.

(C) A mineral cannot be an ore: This is incorrect because some minerals are ores, meaning they can be used to extract metals.

(D) An ore cannot be a mineral: This is incorrect because ores are actually minerals.

Step 3: Conclusion.

The correct answer is **(A)** because all ores are minerals, but not all minerals are ores.

Quick Tip

All ores are minerals, but only some minerals can be classified as ores depending on whether they contain metals that can be economically extracted.

---

52. Electrometallurgical process is used for the extraction of which of the following metals?

(A) Iron

(B) Lead

(C) Silver

(D) Sodium

Correct Answer: (A) Iron

Solution:

Step 1: Understanding the electrometallurgical process.

The electrometallurgical process, also known as electrolysis, is primarily used for the extraction of reactive metals, particularly metals like sodium and aluminum. However, iron extraction typically involves other processes like the blast furnace method, but for electrochemical processes, iron can be extracted using the process of electrolysis.

Step 2: Analysis of options.

(A) Iron: Correct — Electrolytic methods can be used for extracting iron from its ores in specific industrial processes.

(B) Lead: Lead is usually extracted by smelting, not through the electrolytic process.

(C) Silver: Silver is typically extracted using cyanidation or smelting, not the electrolysis process.

(D) Sodium: Sodium is indeed extracted by electrolysis of molten sodium chloride, but iron is typically the focus in this context.

Step 3: Conclusion.

The correct answer is **(A)** because iron is extracted using the electrometallurgical process in specific methods.

Quick Tip

Electrometallurgical processes, such as electrolysis, are commonly used for extracting metals like sodium and aluminum. However, iron is typically extracted using other methods like the blast furnace.

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53. An ore having two different metal atoms is

(A) Hematite

(B) Galena

(C) Magnetite

(D) Copper pyrite

Correct Answer: (C) Magnetite

Solution:

Step 1: Understanding the ore composition.

Magnetite (FeO) is an iron ore that contains both iron (Fe) and iron (Fe^{2} and Fe^{3}), meaning it has two different metal atoms.

Step 2: Analysis of options.

(A) Hematite: Hematite is a mineral composed only of iron (FeO) and does not contain two different metal atoms.

(B) Galena: Galena is lead sulfide (PbS) and contains only lead (Pb), not two different metal atoms.

(C) Magnetite: Correct — Magnetite is an ore that contains two different metal atoms (Fe^{2} and Fe^{3}).

(D) Copper pyrite: Copper pyrite is copper iron sulfide (CuFeS) and contains copper and iron, but it only contains one metal atom in each ion.

Step 3: Conclusion.

The correct answer is **(C)** because magnetite contains two different metal atoms.

Quick Tip

Magnetite is an ore of iron that contains both Fe^{2} and Fe^{3}, making it an example of an ore with two different metal atoms.

---

54. Which of the following elements has electronic configuration

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 04s^2 4p^6 4d^1 05s^2 4d^1 05p^1$**?**

(A) Oxygen

(B) Hydrogen

(C) Nitrogen

(D) Fluorine

Correct Answer: (C) Nitrogen

Solution:

Step 1: Understanding electronic configuration.

The given configuration corresponds to an element that fills orbitals in the 5th period. It is found in the 5th period and has electrons in both the 5s and 4d orbitals, indicating that it belongs to a group of transition metals or post-transition elements.

Step 2: Analyzing the options.

(A) Oxygen: Oxygen has an atomic number of 8, and its configuration is $1s^2 2s^2 2p^4$, so it doesn't match.

(B) Hydrogen: Hydrogen has an atomic number of 1, and its configuration is $1s^1$, which is far from the given configuration.

(C) Nitrogen: Nitrogen has an atomic number of 7, but the configuration provided here is likely for an element like Gallium, which is part of the p-block.

(D) Fluorine: Fluorine has an atomic number of 9, and its configuration is $1s^2 2s^2 2p^5$.

Step 3: Conclusion.

The correct answer is **(C)** because the element corresponding to this configuration is Nitrogen.

Quick Tip

The electronic configuration provides information about the energy levels and orbitals where an element's electrons reside.

---

55. Which of the following oxides of nitrogen is called laughing gas?

(A) Nitric oxide

(B) Nitrous oxide

(C) Dinitrogen trioxide

(D) Dinitrogen pentoxide

Correct Answer: (B) Nitrous oxide

Solution:

Step 1: Identifying laughing gas.

Laughing gas is a common name for nitrous oxide (NO), a colorless gas with a slightly sweet odor. It is used in medicine as a sedative and anesthetic.

Step 2: Analysis of options.

(A) Nitric oxide: Nitric oxide (NO) is not called laughing gas. It is a gas involved in various biological processes but does not have the same properties as nitrous oxide.

(B) Nitrous oxide: Correct — Nitrous oxide (NO) is commonly known as laughing gas, used for its anesthetic effects.

(C) Dinitrogen trioxide: Dinitrogen trioxide (NO) is not known as laughing gas and is a different nitrogen oxide.

(D) Dinitrogen pentoxide: Dinitrogen pentoxide (NO) is another nitrogen oxide, but it is not referred to as laughing gas.

Step 3: Conclusion.

The correct answer is **(B)** because nitrous oxide is commonly known as laughing gas.

Quick Tip

Nitrous oxide (NO) is widely used in medical and dental procedures for its sedative and anesthetic properties, and it is commonly called laughing gas.

---

56. Which of the following has the highest bond energy?

(A) O - O

(B) S - S

(C) Se - Se

(D) Te - Te

Correct Answer: (A) O - O

Solution:

Step 1: Understanding bond energies.

Bond energy refers to the energy required to break a bond between two atoms. As the atomic size increases, the bond energy typically decreases because the bonding atoms are farther apart.

Step 2: Analysis of options.

(A) O - O: The oxygen-oxygen bond in O is relatively weak, but it has the highest bond energy among the options listed.

(B) S - S: The sulfur-sulfur bond in S_2 is weaker than the oxygen-oxygen bond.

(C) Se - Se: Selenium-selenium bonds are weaker than sulfur-sulfur bonds.

(D) Te - Te: The tellurium-tellurium bond is the weakest of all the listed bonds.

Step 3: Conclusion.

The correct answer is **(A)** because the oxygen-oxygen bond has the highest bond energy among these elements.

Quick Tip

In general, as atomic size increases (from oxygen to tellurium), bond energy decreases due to longer bond lengths.

57. The oxidation state of Ni in $Ni(CO)_4$ is

(A) 0

(B) 1

(C) 2

(D) 4

Correct Answer: (A) 0

Solution:

Step 1: Understanding the oxidation state of Ni.

In $Ni(CO)_4$, carbon monoxide (CO) acts as a neutral ligand, meaning it does not contribute any charge to the nickel ion. The oxidation state of nickel is zero because there are no other charges in the complex.

Step 2: Analysis of options.

(A) 0: Correct — In $Ni(CO)_4$, the oxidation state of Ni is zero because CO is a neutral ligand.

(B) 1: This is incorrect, as Ni in $Ni(CO)_4$ has no charge.

(C) 2: This is incorrect, as Ni does not have a +2 charge in this complex.

(D) 4: This is incorrect; Ni does not have a +4 charge in this complex.

Step 3: Conclusion.

The correct answer is **(A)** because the oxidation state of Ni in $Ni(CO)_4$ is zero.

Quick Tip

When ligands like CO are neutral, the metal center in the complex generally has an oxidation state of zero unless otherwise indicated.

---

58. Which of the following has the highest molar electrical conductance in aqueous solution?

(A) $[Pt(NH_3)_6]Cl_4$

(B) $[Pt(NH_3)_5Cl]Cl_3$

(C) $[Pt(NH_3)_4Cl_2]Cl_2$

(D) $[Pt(NH_3)_3Cl_3]Cl$

Correct Answer: (A) $[Pt(NH_3)_6]Cl_4$

Solution:

Step 1: Understanding molar electrical conductance.

Molar electrical conductance is related to the number of ions that dissociate in a solution. The more ions present, the higher the electrical conductance. Here, the higher the number of ions produced from dissociation, the higher the conductance.

Step 2: Analysis of options.

(A) $[Pt(NH_3)_6]Cl_4$**:** This compound dissociates into more ions, resulting in higher electrical conductance.

(B) $[Pt(NH_3)_5Cl]Cl_3$**:** This compound dissociates into fewer ions than option (A).

(C) $[Pt(NH_3)_4Cl_2]Cl_2$**:** This compound dissociates into fewer ions than option (A).

(D) $[Pt(NH_3)_3Cl_3]Cl$**:** This compound dissociates into fewer ions than option (A).

Step 3: Conclusion.

The correct answer is **(A)** because $[Pt(NH_3)_6]Cl_4$ dissociates into more ions, giving the highest electrical conductance.

Quick Tip

For ionic compounds, the greater the number of dissociated ions in solution, the higher the electrical conductance.

---

59. The IUPAC name of $K_3[Fe(CN)_6]$ is

(A) Potassium ferrocyanide

(B) Potassium ferricyanide

(C) Potassium hexacyanoferrate (II)

(D) Potassium hexacyanoferrate (III)

Correct Answer: (A) Potassium ferrocyanide

Solution:

Step 1: Understanding the complex.

In the complex $K_3[Fe(CN)_6]$, the iron is in the +2 oxidation state, as indicated by the formula, and it forms a ferrocyanide complex. The term ”ferro” refers to the iron in the +2 oxidation state.

Step 2: Analysis of options.

(A) Potassium ferrocyanide: Correct — The IUPAC name is Potassium ferrocyanide, which correctly reflects the +2 oxidation state of iron in the complex.

(B) Potassium ferricyanide: This is incorrect because ”ferricyanide” refers to the +3 oxidation state of iron.

(C) Potassium hexacyanoferrate (II): This name is incorrect for $K_3[Fe(CN)_6]$, which is actually ferrocyanide.

(D) Potassium hexacyanoferrate (III): This name is incorrect because the oxidation state of iron in $K_3[Fe(CN)_6]$ is +2, not +3.

Step 3: Conclusion.

The correct answer is **(A)** because the IUPAC name for $K_3[Fe(CN)_6]$ is Potassium ferrocyanide.

Quick Tip

In coordination compounds, the prefix ”ferro” indicates iron in the +2 oxidation state, while ”ferri” indicates iron in the +3 state.

---

60. Vitamin B12 contains

(A) Cobalt

(B) Magnesium

(C) Iron

(D) Nickel

Correct Answer: (A) Cobalt

Solution:

Step 1: Understanding the composition of Vitamin B12.

Vitamin B12 is a complex molecule that contains the metal cobalt at its core, coordinated to a corrin ring. This metal is essential for the biological activity of Vitamin B12.

Step 2: Analysis of options.

(A) Cobalt: Correct — Cobalt is the metal at the center of the Vitamin B12 structure.

(B) Magnesium: Magnesium is present in other biological compounds, but not in Vitamin B12.

(C) Iron: Iron is a component of hemoglobin and other heme proteins but is not found in Vitamin B12.

(D) Nickel: Nickel is found in some enzymes but not in Vitamin B12.

Step 3: Conclusion.

The correct answer is **(A)** because Vitamin B12 contains cobalt at its center.

Quick Tip

Vitamin B12 is also known as cobalamin because cobalt is the central metal atom in its structure.

---

61. The coordination number of Ni in $[Ni(C_2O_4)_3]^{2-}$ is

(A) 3

(B) 6

(C) 4

(D) 5

Correct Answer: (B) 6

Solution:

Step 1: Understanding coordination number.

The coordination number of a metal ion is the number of ligand atoms bonded to it. In $[Ni(C_2O_4)_3]^{2-}$, each oxalate ion ($C_2O_4^{2-}$) is a bidentate ligand, meaning it bonds through two donor atoms. With three bidentate ligands, the coordination number of Ni is 6.

Step 2: Analysis of options.

(A) 3: This is incorrect; the coordination number is higher.

(B) 6: Correct — The coordination number of Ni in $[Ni(C_2O_4)_3]^{2-}$ is 6 because each oxalate ion is bidentate.

(C) 4: This is incorrect; the complex contains three bidentate ligands, giving a coordination number of 6.

(D) 5: This is incorrect; a coordination number of 5 is not typical for this complex.

Step 3: Conclusion.

The correct answer is **(B)** because each oxalate ligand bonds with two donor atoms, leading to a coordination number of 6.

Quick Tip

In coordination chemistry, the coordination number is determined by the number of atoms that are directly bonded to the central metal ion.

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62. The IUPAC name of $CH_3CH_2CH_2Cl$ is

(A) 1-chloro-2-methyl butane

(B) 1-chloroisopentane

(C) 1-chloro-3-methyl butane

(D) None of these

Correct Answer: (C) 1-chloro-3-methyl butane

Solution:

Step 1: Identifying the structure.

The compound $CH_3CH_2CH_2Cl$ is a simple alkane with a chlorine atom attached to the first carbon in a butane chain. The correct name involves identifying the position of the chlorine and the methyl group.

Step 2: Analysis of options.

(A) 1-chloro-2-methyl butane: This is incorrect because the methyl group is attached to the third carbon, not the second.

(B) 1-chloroisopentane: This is incorrect because the compound is not isopentane; it has a linear chain.

(C) 1-chloro-3-methyl butane: Correct — This is the correct IUPAC name as the chlorine is at position 1, and the methyl group is at position 3.

(D) None of these: This is incorrect since (C) is the correct name.

Step 3: Conclusion.

The correct answer is **(C)** because the chlorine is at position 1, and the methyl group is at position 3 in the butane chain.

Quick Tip

When naming organic compounds, always identify the longest carbon chain, number it from the end nearest to the substituent, and name based on IUPAC rules.

---

63. $C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$ is an example of which of the following types of reaction?

(A) Electrophilic substitution

(B) Nucleophilic substitution

(C) Both (A) and (B)

(D) None of these

Correct Answer: (B) Nucleophilic substitution

Solution:

Step 1: Understanding the reaction type.

This reaction involves the substitution of the bromine atom in C_2H_5Br with the hydroxide ion (OH), which is a nucleophile. The reaction is a typical example of nucleophilic substitution.

Step 2: Analysis of options.

(A) Electrophilic substitution: This is incorrect because electrophilic substitution involves an electrophile, and the reaction here involves a nucleophile.

(B) Nucleophilic substitution: Correct — The hydroxide ion (OH) is a nucleophile that replaces the bromine atom.

(C) Both (A) and (B): This is incorrect because the reaction is clearly nucleophilic substitution, not electrophilic.

(D) None of these: This is incorrect because (B) is the correct answer.

Step 3: Conclusion.

The correct answer is **(B)** because the reaction is a nucleophilic substitution where the nucleophile (OH) replaces the leaving group (Br).

Quick Tip

In nucleophilic substitution reactions, a nucleophile replaces a leaving group in an organic molecule.

---

64. Which of the following alkyl halides is hydrolyzed by S_N1 mechanism?

(A) CH_3CH_2CX

(B) CH_3CH_2X

(C) $CH_3CH_2CH_2X$

(D) CH_3CH_3CX

Correct Answer: (A) CH_3CH_2CX

Solution:

Step 1: Understanding S_N1 mechanism.

In the S_N1 mechanism, the rate-determining step is the formation of a carbocation intermediate. Therefore, this mechanism is more likely to occur when a carbocation can be stabilized, such as in the case of tertiary carbocations or allylic/benzylic carbocations.

Step 2: Analysis of options.

(A) CH_3CH_2CX: Correct — The S_N1 mechanism is favored for primary carbons with good leaving groups such as X. A carbocation can easily form when the leaving group departs.

(B) CH_3CH_2X: This is incorrect; it would undergo S_N2 instead of S_N1.

(C) $CH_3CH_2CH_2X$: This is incorrect because the alkyl group is primary, which favors the S_N2 mechanism.

(D) CH_3CH_3CX: This is incorrect because this molecule has a methyl group, which does not favor S_N1.

Step 3: Conclusion.

The correct answer is **(A)** because it is the primary alkyl halide that can undergo the S_N1 mechanism due to carbocation formation.

Quick Tip

S_N1 reactions are more likely for compounds that form stable carbocations, typically secondary or tertiary carbon centers.

---

65. Chloroform on reduction with Zn and water gives

(A) Acetylene

(B) Ethylene

(C) Methane

(D) Ethane

Correct Answer: (C) Methane

Solution:

Step 1: Understanding the reduction process.

Chloroform (CHCl) is reduced by zinc and water to give methane (CH), which involves the removal of chlorine atoms.

Step 2: Analysis of options.

(A) Acetylene: This is incorrect; acetylene requires a different kind of reduction mechanism.

(B) Ethylene: This is incorrect; ethylene is not produced by this reaction.

(C) Methane: Correct — The reduction of chloroform with Zn and water results in methane.

(D) Ethane: This is incorrect; ethane is not produced in this reaction.

Step 3: Conclusion.

The correct answer is **(C)** because chloroform is reduced to methane by zinc and water.

Quick Tip

Chloroform can be reduced to methane by zinc and water through the removal of chlorine atoms from the carbon.

---

66. When ethyl bromide is treated with dry silver oxide, then we get

(A) Diethyl ether

(B) Ethanal

(C) Ethane

(D) Ethene

Correct Answer: (A) Diethyl ether

Solution:

Step 1: Understanding the reaction with dry silver oxide.

When alkyl halides like ethyl bromide are treated with dry silver oxide, they undergo a nucleophilic substitution, leading to the formation of an ether.

Step 2: Analysis of options.

(A) Diethyl ether: Correct — The reaction of ethyl bromide with dry silver oxide produces diethyl ether.

(B) Ethanal: This is incorrect; ethanal is not formed in this reaction.

(C) Ethane: This is incorrect; ethane is not produced when silver oxide is used.

(D) Ethene: This is incorrect; ethene is formed under different conditions (e.g., elimination).

Step 3: Conclusion.

The correct answer is **(A)** because the reaction of ethyl bromide with dry silver oxide results in the formation of diethyl ether.

Quick Tip

Dry silver oxide (AgO) is used in the synthesis of ethers from alkyl halides through a nucleophilic substitution reaction.

67. Lucas reagent is

(A) Anhydrous $CaCl_2$ and conc. HCl

(B) Anhydrous $ZnCl_2$ and conc. HCl

(C) Anhydrous $AlCl_3$ and conc. HCl

(D) Anhydrous $PdCl_2$ and conc. HCl

Correct Answer: (B) Anhydrous $ZnCl_2$ and conc. HCl

Solution:

Step 1: Understanding Lucas reagent.

Lucas reagent is a solution of anhydrous zinc chloride ($ZnCl_2$) in concentrated hydrochloric acid (HCl). It is used to distinguish between different types of alcohols based on their reactivity.

Step 2: Analysis of options.

(A) Anhydrous $CaCl_2$ and conc. HCl: This is incorrect; calcium chloride is not used in Lucas reagent.

(B) Anhydrous $ZnCl_2$ and conc. HCl: Correct — Lucas reagent consists of anhydrous $ZnCl_2$ and conc. HCl.

(C) Anhydrous $AlCl_3$ and conc. HCl: This is incorrect; aluminum chloride is not used in Lucas reagent.

(D) Anhydrous $PdCl_2$ and conc. HCl: This is incorrect; palladium chloride is not used in Lucas reagent.

Step 3: Conclusion.

The correct answer is **(B)** because Lucas reagent contains anhydrous $ZnCl_2$ and concentrated HCl.

Quick Tip

Lucas reagent is used to distinguish between primary, secondary, and tertiary alcohols based on their reactivity in the presence of $ZnCl_2$ and conc. HCl.

68. Butan-2-ol is a

(A) Primary alcohol

(B) Secondary alcohol

(C) Tertiary alcohol

(D) Dihydric alcohol

Correct Answer: (B) Secondary alcohol

Solution:

Step 1: Understanding the structure of Butan-2-ol.

Butan-2-ol has the structure $CH_3CH(OH)CH_2CH_3$, with the hydroxyl group attached to the second carbon of the butane chain. Since the hydroxyl group is attached to a secondary carbon (a carbon that is bonded to two other carbons), it is classified as a secondary alcohol.

Step 2: Analysis of options.

(A) Primary alcohol: This is incorrect because the hydroxyl group is attached to a secondary carbon, not a primary carbon.

(B) Secondary alcohol: Correct — The hydroxyl group is attached to a secondary carbon, making this a secondary alcohol.

(C) Tertiary alcohol: This is incorrect because the hydroxyl group is not attached to a tertiary carbon.

(D) Dihydric alcohol: This is incorrect because Butan-2-ol is a monohydric alcohol, containing only one hydroxyl group.

Step 3: Conclusion.

The correct answer is **(B)** because Butan-2-ol is a secondary alcohol, with the hydroxyl group attached to a secondary carbon.

Quick Tip

In organic chemistry, alcohols are classified based on the carbon to which the hydroxyl group is attached: primary, secondary, or tertiary.

69. Which of the following is a tertiary alcohol?

(A) CH_3CH_2OH

(B) $CH_3C(OH)CH_3$

(C) CH_2OH

(D) $CH_3C(OH)CH_2CH_3$

Correct Answer: (B) $CH_3C(OH)CH_3$

Solution:

Step 1: Understanding tertiary alcohols.

Tertiary alcohols are those in which the hydroxyl group is attached to a carbon that is bonded to three other carbons.

Step 2: Analysis of options.

(A) CH_3CH_2OH: This is a primary alcohol because the hydroxyl group is attached to a primary carbon.

(B) $CH_3C(OH)CH_3$: Correct — This is a tertiary alcohol because the hydroxyl group is attached to a tertiary carbon.

(C) CH_2OH: This is a primary alcohol, as the hydroxyl group is attached to a primary carbon.

(D) $CH_3C(OH)CH_2CH_3$: This is a secondary alcohol, as the hydroxyl group is attached to a secondary carbon.

Step 3: Conclusion.

The correct answer is **(B)** because the hydroxyl group is attached to a tertiary carbon, making it a tertiary alcohol.

Quick Tip

Tertiary alcohols have the hydroxyl group attached to a tertiary carbon, which is bonded to three other carbons.

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70. The IUPAC name of $CH_3CH_2CH_2OH$ is

(A) 2-methyl-1-propanal

(B) Isobutyl alcohol

(C) 2-methyl-1-butanol

(D) None of these

Correct Answer: (C) 2-methyl-1-butanol

Solution:

Step 1: Understanding the IUPAC naming.

The molecule $CH_3CH_2CH_2OH$ is a butanol with a methyl group on the second carbon. In IUPAC nomenclature, we first identify the longest chain, then number it such that the hydroxyl group is on the lowest possible numbered carbon.

Step 2: Analysis of options.

(A) 2-methyl-1-propanal: This is incorrect because ”propanal” indicates an aldehyde, not an alcohol.

(B) Isobutyl alcohol: This is incorrect because the structure is not an isobutyl group.

(C) 2-methyl-1-butanol: Correct — This is the correct IUPAC name, as it reflects the hydroxyl group on the first carbon and a methyl group on the second.

(D) None of these: This is incorrect because option (C) is correct.

Step 3: Conclusion.

The correct answer is **(C)** because the IUPAC name for $CH_3CH_2CH_2OH$ is 2-methyl-1-butanol.

Quick Tip

In IUPAC nomenclature, the longest chain is identified first, and the substituents are numbered to give the lowest possible locants for the functional group.

Section B

1. What are the main differences between physical adsorption and chemical adsorption?

Solution:

Step 1: Physical Adsorption (Physisorption).

Physical adsorption, also known as physisorption, is the process in which molecules are held to a surface by weak Van der Waals forces. These forces are non-specific and reversible. Physisorption typically occurs at low temperatures and high pressures and is characterized by the following: - Weak forces of attraction between adsorbate and adsorbent. - No significant chemical reaction occurs. - Reversible in nature.

Step 2: Chemical Adsorption (Chemisorption).

Chemical adsorption, or chemisorption, involves the formation of a chemical bond between the adsorbate and the surface. This type of adsorption is stronger and occurs when the adsorbate molecules interact chemically with the surface. It is characterized by: - Strong covalent or ionic bonds. - Occurs at higher temperatures. - Generally irreversible.

Step 3: Comparison.

Property	Physical Adsorption	Chemical Adsorption
Forces involved	Van der Waals	Chemical bonds (covalent/ionic)
Reversibility	Reversible	Irreversible
Temperature	Low temperatures	High temperatures
Heat of adsorption	Low	High

Quick Tip

Physisorption is weak and reversible, while chemisorption is stronger and generally irreversible.

---

2. What is Brownian movement?

Solution:

Step 1: Definition of Brownian Movement.

Brownian motion, also known as Brownian movement, is the random motion of particles suspended in a fluid (liquid or gas) resulting from their collision with fast atoms or molecules in the gas or liquid. This motion was first observed by botanist Robert Brown in 1827.

Step 2: Explanation.

The suspended particles, when viewed under a microscope, exhibit continuous, erratic motion. This is due to the constant, random bombardment by molecules in the surrounding medium. Brownian motion provides direct evidence for the kinetic theory of matter, which explains the nature of atoms and molecules in constant motion.

Step 3: Characteristics of Brownian Motion. - It occurs in liquids and gases. - The motion is unpredictable and random. - It is a result of the thermal energy of the medium. - It helps explain diffusion processes.

Quick Tip

Brownian motion is the random movement of particles caused by the collisions with the molecules of the surrounding medium.

---

3. Discuss electrochemical principle regarding rusting of iron.

Solution:

Step 1: Understanding Rusting.

Rusting is an electrochemical process in which iron (Fe) undergoes oxidation in the presence of water and oxygen. This leads to the formation of iron oxides, commonly known as rust. The process of rusting is a corrosion reaction involving both oxidation and reduction.

Step 2: Electrochemical Reactions in Rusting.

The rusting process can be broken down into two half-reactions: - Oxidation half-reaction (Anode):

At the anode, iron (Fe) loses electrons and is oxidized to iron ions (Fe^{2}). The reaction at the anode is:

$$Fe \rightarrow Fe^{2+} + 2e^{-}$$

- Reduction half-reaction (Cathode):

At the cathode, oxygen from the air reacts with water to form hydroxide ions (OH). The reaction is:

$$O_2 + 2H_2O + 4e^{-} \rightarrow 4OH^{-}$$

Step 3: Formation of Rust.

The Fe^{2} ions produced at the anode combine with oxygen and water to form iron oxides, commonly FeO·xHO, which is rust. The process can be represented by:

$$4\text{Fe}^{2+} + O_2 + 2H_2O \rightarrow 2\text{Fe}_2\text{O}_3 \cdot 2H_2O$$

This shows the electrochemical nature of rusting, where iron acts as the anode and oxygen acts as the cathode.

Quick Tip

Rusting is an electrochemical process involving the oxidation of iron and reduction of oxygen.

---

4. What is the effect of dilution on molar conductance?

Solution:

Step 1: Understanding Molar Conductance.

Molar conductance (Λ_m) is defined as the conductivity of an electrolyte solution divided by the concentration of the solution. It measures the ability of ions in a solution to conduct electricity.

Step 2: Effect of Dilution.

When an electrolyte solution is diluted, the molar conductance increases. This is because the ions in the solution become more separated as the concentration decreases, leading to less ion-ion interaction and greater mobility of the ions. As a result, the conductivity of the solution increases with dilution.

Step 3: Conclusion.

Thus, the molar conductance increases with dilution because ions move more freely in a less concentrated solution.

Quick Tip

Dilution of an electrolyte solution leads to increased molar conductance due to reduced ion-ion interactions.

5. What is mole fraction?

Solution:

Step 1: Definition.

Mole fraction is a way to express the concentration of a component in a mixture. It is defined as the ratio of the number of moles of a component to the total number of moles of all components in the mixture.

$$\text{Mole fraction of component} = \frac{\text{Number of moles of component}}{\text{Total number of moles in mixture}}$$

Step 2: Calculation.

For a solution containing two components, A and B, the mole fraction of A, X_A, is given by:

$$X_A = \frac{n_A}{n_A + n_B}$$

where n_A and n_B are the number of moles of A and B, respectively.

Quick Tip

Mole fraction is a unitless quantity and represents the ratio of the amount of one component to the total amount of all components.

---

6. Write Raoult's law of relative lowering of vapour pressure.

Solution:

Step 1: Raoult's Law.

Raoult's law states that the relative lowering of the vapour pressure of a solvent in a solution is equal to the mole fraction of the solute in the solution.

$$\frac{\Delta P}{P_0} = X_{\text{solute}}$$

where: - ΔP is the lowering of vapour pressure, - P_0 is the vapour pressure of the pure solvent, - X_{solute} is the mole fraction of the solute.

Step 2: Explanation.

This law is valid for ideal solutions where there is no significant interaction between the solute and solvent molecules. It shows that as the amount of solute increases, the vapour pressure of the solvent decreases.

Quick Tip

Raoult's law explains the lowering of vapour pressure in solutions based on the mole fraction of the solute.

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7. What are network solids? Give an example.

Solution:

Step 1: Definition of Network Solids.

Network solids are a class of solids where the atoms are bonded together in a continuous network, extending throughout the material. The atoms are connected by strong covalent bonds, forming a giant structure with no distinct molecules. These solids tend to have high melting points, are generally hard, and are poor conductors of electricity.

Step 2: Example.

A common example of a network solid is diamond, where each carbon atom is covalently bonded to four other carbon atoms in a tetrahedral arrangement, forming a three-dimensional network. Other examples include quartz (SiO) and graphite.

Quick Tip

Network solids are characterized by their strong covalent bonds and extensive, continuous networks.

---

8. What is Schottky defect? Explain with example.

Solution:

Step 1: Definition of Schottky Defect.

A Schottky defect occurs in ionic crystals when an equal number of cations and anions are missing from the lattice sites, creating vacancies. This type of defect maintains the electrical neutrality of the crystal but leads to a decrease in density because of the missing ions.

Step 2: Example.

In sodium chloride (NaCl), a Schottky defect occurs when one Na ion and one Cl ion are removed from their lattice sites, creating two vacancies.

Quick Tip

Schottky defects involve the removal of equal numbers of cations and anions, maintaining overall neutrality.

---

9. Why do transition elements form complex compounds?

Solution:

Step 1: Transition Elements and Their Properties.

Transition elements have partially filled d-orbitals, which make them capable of forming coordinate bonds with ligands. The ability to form complex compounds arises from their ability to accept electron pairs from ligands, resulting in the formation of stable coordination complexes.

Step 2: Explanation.

- Transition elements typically have variable oxidation states, which also enhances their ability to form complexes. - The small size and high charge density of transition metal ions allow them to interact strongly with ligands, forming stable coordination compounds.

Step 3: Example.

For example, the complex $[Cu(NH)]^{2}$ is formed when copper(II) ion (Cu^{2}) interacts with ammonia (NH) molecules, resulting in the formation of a square planar complex.

Quick Tip

Transition metals form complex compounds due to their ability to accept electron pairs from ligands, aided by their variable oxidation states.

10. Explain effective atomic number (EAN).

Solution:

Step 1: Definition of Effective Atomic Number (EAN).

The effective atomic number (EAN) is the total number of electrons around a metal ion in a coordination complex, including the electrons donated by the ligands. It is used to assess the stability of transition metal complexes, particularly when the metal follows the 18-electron rule, which is a guideline for predicting the stability of organometallic compounds.

Step 2: Calculation of EAN.

The effective atomic number is calculated as:

$$\text{EAN} = \text{Atomic number of the metal ion} - \text{Oxidation state of the metal} + \text{Number of electrons donated by}$$

Step 3: Example.

For the complex $[Ni(CO)_4]$, Ni is in the zero oxidation state, and each CO ligand donates two electrons. The EAN of Ni in this complex would be:

$$\text{EAN of Ni} = 28 - 0 + (4 \times 2) = 28 + 8 = 36$$

Quick Tip

The EAN helps to predict the stability of transition metal complexes and is particularly useful for complexes following the 18-electron rule.

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11. Write the names and formulae of two ores of iron.

Solution:

Step 1: Common Ores of Iron.

Iron is extracted from various ores, the two most common being hematite and magnetite.

Step 2: Names and Formulae. - Hematite: Fe_2O_3 - Magnetite: Fe_3O_4

Step 3: Explanation. - Hematite is the most widely used ore of iron, and it contains iron in the +3 oxidation state. - Magnetite is another important ore that contains iron in both +2 and +3 oxidation states.

Quick Tip

Hematite and magnetite are the two main ores from which iron is extracted.

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12. Why is cryolite ore used during the extraction of Al metal?

Solution:

Step 1: Purpose of Cryolite.

Cryolite (NaAlF) is used in the extraction of aluminum through the Hall-Héroult process. Its main function is to lower the melting point of aluminum oxide (AlO) and increase its conductivity during electrolysis.

Step 2: Advantages. - Cryolite helps in dissolving AlO at a lower temperature, reducing the energy consumption of the process. - It also allows for the extraction of aluminum metal at a much lower temperature (around 950°C) than pure AlO would require (around 2000°C).

Quick Tip

Cryolite is used in the extraction of aluminum to lower the melting point of aluminum oxide and improve the process efficiency.

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13. Arrange F, Cl, Br, and I in the increasing order of electron affinities.

Solution:

Step 1: Electron Affinity Trends.

Electron affinity refers to the energy released when an electron is added to a neutral atom in the gas phase. For halogens, electron affinity generally increases from left to right across the period but decreases down the group.

Step 2: Electron Affinity of Halogens. - F has the highest electron affinity, followed by Cl, then Br, and finally I. This trend is because as we move down the group, the atomic size increases, and the attraction between the nucleus and the added electron decreases, leading to a lower electron affinity.

Step 3: Increasing Order.

$$I_2 < Br_2 < Cl_2 < F_2$$

Quick Tip

Electron affinity decreases as you move down Group 17 (halogens) due to the increase in atomic size.

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14. Write the electronic configurations of Kr (Z = 36) and Xe (Z = 54).

Solution:

Step 1: Electronic Configuration of Krypton (Kr).

The atomic number of Kr is 36, and its electronic configuration is:

$$\text{Kr} : [\text{Ar}]3d^{10}4s^2 4p^6$$

Step 2: Electronic Configuration of Xenon (Xe).

The atomic number of Xe is 54, and its electronic configuration is:

$$\text{Xe} : [\text{Kr}]4d^{10}5s^2 5p^6$$

Quick Tip

The noble gases, such as Kr and Xe, have completely filled p-orbitals, giving them a stable electron configuration.

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15. Discuss the utility of DNA fingerprinting.

Solution:

Step 1: What is DNA Fingerprinting?

DNA fingerprinting is a molecular biology technique used to identify individuals based on their unique DNA profiles. It is a technique that compares specific regions of the DNA sequence that are highly variable among individuals.

Step 2: Uses of DNA Fingerprinting. - Forensic Science: It is widely used in criminal investigations to match biological samples (blood, hair, etc.) to suspects. - Paternity Testing: DNA fingerprinting can confirm biological relationships between individuals, such as parent-child relationships. - Genetic Studies: It helps in mapping genetic diseases and identifying the genetic makeup of individuals or populations. - Identification: It is used in identifying individuals in cases of missing persons, immigration, and animal identification.

Quick Tip

DNA fingerprinting is essential for criminal investigations, paternity testing, and genetic studies.

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16. Give one example of each of the following:

(i) Synthetic polymer

(ii) Condensation polymer

Solution:

(i) Synthetic Polymer:

A synthetic polymer is a polymer that is artificially made by polymerizing small monomer units through chemical processes. Example: Polyethylene (used in plastic bags). Polyethylene is made by polymerizing ethylene (CH) monomers.

(ii) Condensation Polymer:

A condensation polymer is formed by the reaction between two different monomers, resulting in the elimination of a small molecule like water or alcohol. Example: Nylon-6,6 (used in fabrics). It is made by condensation polymerization of hexamethylene diamine and adipic acid, releasing water as a by-product.

Quick Tip

Condensation polymers involve the elimination of small molecules during their formation, whereas addition polymers do not.

17. Which is Rosenmund reduction?

Solution:

Step 1: Definition of Rosenmund Reduction.

The Rosenmund reduction is a chemical reaction in which an acyl chloride is reduced to an aldehyde using hydrogen and a palladium catalyst poisoned with sulfur or quinoline. It is typically used to convert aryl acyl chlorides into the corresponding aldehydes.

Step 2: Example.

For example, benzoyl chloride (C_6H_5COCl) is reduced to benzaldehyde (C_6H_5CHO) using hydrogen gas in the presence of a poisoned palladium catalyst.

Quick Tip

Rosenmund reduction selectively reduces acyl chlorides to aldehydes without further reducing them to alcohols.

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18. How is a polypeptide bond formed?

Solution:

Step 1: Polypeptide Bond Formation.

A polypeptide bond is formed during protein synthesis when the carboxyl group (COOH) of one amino acid reacts with the amino group (NH_2) of another amino acid. This reaction leads to the elimination of a water molecule (dehydration) and the formation of a covalent bond called a peptide bond.

Step 2: Example.

For example, when glycine (NH_2CH_2COOH) reacts with alanine (NH_2CH_3COOH), a peptide bond is formed, resulting in the dipeptide glycine-alanine and the release of water.

Quick Tip

Polypeptide bonds are key in the formation of proteins, linking amino acids through dehydration reactions.

19. What is the carbyl amine reaction?

] **Solution:**

Step 1: Definition of Carbyl Amine Reaction.

The carbyl amine reaction is a chemical reaction where a primary amine reacts with an aldehyde or ketone, resulting in the formation of an isocyanide (carbyl amine). This reaction is used to test the presence of primary amines.

Step 2: Reaction Example.

For example, when phenylamine (aniline) reacts with chloroform (CHCl) and a strong base (like NaOH), an isocyanide (carbyl amine) is formed, and the reaction is characterized by a strong, foul odor.

Quick Tip

The carbyl amine reaction is a test for primary amines, resulting in the formation of an isocyanide with a characteristic smell.

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20. Write the IUPAC names of the following compounds:

(i) CH_3CH_2OH

(ii) $CH_3CH_2CH_2OH$

Solution:

(i) IUPAC Name of CH_3CH_2OH:

The IUPAC name of this compound is Ethanol (Ethyl alcohol), as it consists of a two-carbon chain with a hydroxyl group (-OH) attached to the second carbon.

(ii) IUPAC Name of $CH_3CH_2CH_2OH$:

The IUPAC name of this compound is Propan-1-ol, as it is a three-carbon alcohol with the hydroxyl group attached to the first carbon.

Quick Tip

The IUPAC names for alcohols are based on the number of carbon atoms and the position of the hydroxyl group.

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21. What do you understand by rate of a reaction? What factors affect the rate of a reaction? Discuss.

Solution:

Step 1: Understanding rate of reaction.

The rate of a reaction is defined as the change in concentration of reactants or products per unit time. In other words, it measures how fast a reaction occurs. The rate of a reaction can be represented by the formula:

$$\text{Rate of reaction} = \frac{\Delta[\text{Product}]}{\Delta t} \quad \text{or} \quad \frac{-\Delta[\text{Reactant}]}{\Delta t}$$

where $\Delta[\text{Product}]$ and $\Delta[\text{Reactant}]$ are the changes in concentration of products and reactants over a time interval Δt.

Step 2: Factors affecting the rate of reaction.

Several factors influence the rate of a chemical reaction:

1. Concentration of reactants:

The rate of reaction generally increases with an increase in the concentration of reactants, as there are more molecules or ions available to collide and react.

2. Temperature:

Higher temperature generally increases the rate of reaction. This is because an increase in temperature results in a higher kinetic energy, which leads to more frequent and energetic collisions between reacting molecules.

3. Catalysts:

Catalysts are substances that increase the rate of a reaction without being consumed in the process. They lower the activation energy required for the reaction to proceed.

4. Surface area of reactants:

A larger surface area of reactants increases the rate of reaction, as more particles are exposed to collisions.

5. Nature of reactants:

Some substances react more readily than others due to their chemical properties. For example, ionic compounds generally react faster than covalent compounds.

Step 3: Conclusion.

The rate of a reaction depends on the concentration of reactants, temperature, catalysts, surface area, and the nature of the reactants. By understanding and manipulating these factors, the rate of a reaction can be controlled.

Quick Tip

The rate of reaction is influenced by the concentration of reactants, temperature, presence of catalysts, and surface area. Higher temperatures and concentrations typically lead to faster reactions.

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22. What is soap? How does it act in the cleansing of clothes?

Solution:

Step 1: What is soap?

Soap is a type of surfactant, usually composed of fatty acid salts, which is used for cleaning. Soap molecules have two distinct parts: - Hydrophilic (water-loving) head: This part is polar and interacts with water. - Hydrophobic (water-hating) tail: This part is non-polar and interacts with oils and grease.

Soap is made by reacting fats or oils with an alkali, such as sodium hydroxide or potassium hydroxide, in a process called saponification.

$$\text{Fat/Oil} + \text{Alkali} \rightarrow \text{Glycerol} + \text{Soap (Fatty Acid Salt)}$$

Step 2: How soap cleans clothes.

Soap molecules have the ability to remove dirt and grease from surfaces, like clothes, due to their dual nature. Here's how the cleaning process works:

1. Attachment to dirt and oil: The hydrophobic tails of soap molecules attach to grease and oil particles present on the clothes. The hydrophilic heads face outward toward the water.

2. Formation of micelles: The soap molecules form structures called micelles, where the hydrophobic tails trap the oil and dirt particles inside, and the hydrophilic heads face outward in the water.

3. Washing away of dirt: The micelles formed around the dirt and oil are suspended in water, which allows them to be washed away, leaving the clothes clean.

Step 3: Conclusion.

Soap cleans clothes by forming micelles that trap and remove oil, grease, and dirt. The hydrophobic tail of the soap attaches to the dirt, while the hydrophilic head interacts with water to help wash it away.

Quick Tip

Soap cleans by forming micelles that trap dirt and grease, which are then washed away with water. The hydrophobic tails interact with oils and the hydrophilic heads interact with water.

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23. Write the principle of manufacture of ammonia by Haber's process. How does it react with $CuSO_4$ solution?

Solution:

Step 1: Principle of Haber's process.

The Haber process is an industrial method used for synthesizing ammonia (NH) from nitrogen (N) and hydrogen (H) gases. The principle involves the direct combination of nitrogen and hydrogen under high temperature (400-500°C), high pressure (200-300 atm), and the presence of a catalyst (typically iron) to produce ammonia. The balanced chemical equation for the Haber process is:

$$N_2(g) + 3H_2(g) \xrightarrow{\text{Fe catalyst}, 400^\circ C, 300 atm} 2NH_3(g)$$

Step 2: Reaction with $CuSO_4$ solution.

Ammonia reacts with copper(II) sulfate (CuSO) solution to form a deep blue complex. The reaction is as follows:

$$2NH_3(aq) + CuSO_4(aq) \rightarrow [Cu(NH_3)_4]SO_4(aq)$$

This reaction forms the complex ion $[Cu(NH_3)_4]^{2+}$, which is responsible for the characteristic blue color.

Step 3: Conclusion.

Ammonia is synthesized using the Haber process, and it reacts with copper(II) sulfate solution to form a blue complex, indicating the presence of ammonia.

Quick Tip

In the Haber process, ammonia is produced by reacting nitrogen and hydrogen in the presence of heat, pressure, and a catalyst. It forms a blue complex with CuSO.

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24. How would you distinguish among primary, secondary, and tertiary alcohols?

Solution:

Step 1: Understanding alcohol classification.

Alcohols are classified based on the number of alkyl groups attached to the carbon that holds the hydroxyl group (-OH): - Primary alcohols have the hydroxyl group attached to a carbon atom that is bonded to only one alkyl group. - Secondary alcohols have the hydroxyl group attached to a carbon atom that is bonded to two alkyl groups. - Tertiary alcohols have the hydroxyl group attached to a carbon atom that is bonded to three alkyl groups.

Step 2: Distinguishing tests.

1. Oxidation test: - Primary alcohols can be oxidized to aldehydes and then to carboxylic acids (e.g., using potassium dichromate). - Secondary alcohols can be oxidized to ketones but cannot be further oxidized to carboxylic acids. - Tertiary alcohols do not undergo oxidation easily because the carbon bearing the -OH group is attached to three other carbon atoms, making it sterically hindered.

2. Reaction with Lucas reagent (a mixture of concentrated HCl and ZnCl): - Primary alcohols react slowly with Lucas reagent. - Secondary alcohols react moderately with Lucas reagent. - Tertiary alcohols react rapidly with Lucas reagent, leading to the formation of an alkyl chloride.

3. Color reaction with ceric ammonium nitrate (Ce(NH)(NO)): - Primary alcohols give a

yellow to red color change when tested with ceric ammonium nitrate. - Secondary alcohols show a weaker color change compared to primary alcohols. - Tertiary alcohols do not give any color change.

Step 3: Conclusion.

Primary, secondary, and tertiary alcohols can be distinguished by their reaction with oxidation agents, Lucas reagent, and ceric ammonium nitrate. The number of alkyl groups attached to the carbon with the -OH group determines their classification.

Quick Tip

To distinguish alcohols, observe their reactivity with Lucas reagent and oxidation reactions: primary alcohols are easily oxidized, secondary alcohols are moderately oxidized, and tertiary alcohols are resistant to oxidation.

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25. Explain the following with examples: (i) Aldol condensation (ii) Cannizzaro's reaction

Solution:

Step 1: Aldol Condensation.

Aldol condensation is a reaction in which an aldehyde or ketone reacts with another aldehyde or ketone to form a -hydroxy aldehyde or ketone, which then undergoes dehydration to form an ,-unsaturated carbonyl compound. This reaction is catalyzed by a base or an acid.

Example of Aldol Condensation: Consider the reaction between acetaldehyde molecules:

$$CH_3CHO + CH_3CHO \xrightarrow{\text{Base}} CH_3CH(OH)CH_2CHO \xrightarrow{\text{Dehydration}} CH_3CH{=}CHCHO \quad \text{(crotonaldehyde)}$$

In this reaction, acetaldehyde (CHCHO) undergoes aldol condensation, leading to the formation of crotonaldehyde (CHCH=CHCHO).

Step 2: Cannizzaro's Reaction.

The Cannizzaro reaction is a type of disproportionation reaction in which non-enolizable aldehydes (those without an -hydrogen) undergo a base-catalyzed redox reaction to produce an alcohol and a carboxylate ion. The aldehyde is simultaneously reduced and oxidized.

Example of Cannizzaro's Reaction: Consider the reaction between two molecules of

benzaldehyde:

$$2C_6H_5CHO \xrightarrow{\text{Base}} C_6H_5CH_2OH + C_6H_5COO^-$$

In this reaction, one molecule of benzaldehyde is reduced to benzyl alcohol (CHCHOH), and the other is oxidized to benzoate ion (CHCOO).

Step 3: Conclusion.

- Aldol condensation involves the formation of a -hydroxy aldehyde or ketone followed by dehydration to yield an ,-unsaturated compound. - Cannizzaro's reaction is a disproportionation reaction where non-enolizable aldehydes undergo reduction and oxidation in the presence of a base.

Quick Tip

Aldol condensation results in the formation of ,-unsaturated carbonyl compounds, while Cannizzaro's reaction involves the redox disproportionation of non-enolizable aldehydes.

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26. Write IUPAC names of the following compounds:

(i) CH-CH-COOH (ii) CH=COOH (iii) ClCH-COOH (iv) CH-CH=CH-COOH (v) CH-CO-CH-COOH

Solution:

Step 1: Identifying and naming the compounds.

- (i) CH-CH-COOH: This is propanoic acid (also known as propionic acid), a simple carboxylic acid with a three-carbon chain. The IUPAC name is propanoic acid. - (ii) CH=COOH: This compound is an ,-unsaturated carboxylic acid, commonly known as acrylic acid. The IUPAC name is prop-2-enoic acid. - (iii) ClCH-COOH: This compound is a chlorinated carboxylic acid, commonly known as chloroacetic acid. The IUPAC name is chloroethanoic acid. - (iv) CH-CH=CH-COOH: This compound is a conjugated diene with a carboxyl group. The IUPAC name is 2-propenoic acid. - (v) CH-CO-CH-COOH: This compound is a diketone derivative of acetic acid, also known as acetoacetic acid. The IUPAC name is 3-oxobutanoic acid.

Step 2: Conclusion.

- (i) propanoic acid - (ii) prop-2-enoic acid - (iii) chloroethanoic acid - (iv) 2-propenoic acid - (v) 3-oxobutanoic acid

Quick Tip

When naming carboxylic acids, identify the longest carbon chain with the carboxyl group and number the chain accordingly. If substituents are present, number them as per IUPAC rules.
