Bihar Board 12 Chemistry Set D 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 metals is generally found in free state?

(A) Cu

(B) Au

(C) Al

(D) Fe

Correct Answer: (B) Au

Solution:

Step 1: Understanding the question.

The question asks which of the listed metals is commonly found in its free state in nature. Metals found in free states are uncombined with other elements. Gold (Au) is one such metal.

Step 2: Analyzing the options.

(A) Cu: Copper is found in nature but typically in mineral form, not in a free state.

(B) Au: Correct — Gold is commonly found in its free state in nature.

(C) Al: Aluminum is usually found in compounds, not in a free state.

(D) Fe: Iron is also typically found in mineral forms, not in its free state.

Step 3: Conclusion.

The correct answer is **(B) Au**, as gold is frequently found in its native, uncombined state in nature.

Quick Tip

In identifying metals found in free state, remember that gold, silver, and platinum are examples of metals that can exist naturally in their uncombined form.

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2. 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 the terms.

An ore is a naturally occurring mineral from which a metal can be extracted profitably. Hence, ores are always minerals, but not all minerals are ores.

Step 2: Analyzing the options.

(A) All ores are minerals: Correct — An ore is always a mineral, as it is a naturally occurring substance from which metals can be extracted.

(B) All minerals are ores: This is incorrect because not all minerals can be extracted for profit.

(C) A mineral cannot be an ore: This is incorrect as some minerals are ores.

(D) An ore cannot be a mineral: This is incorrect. An ore is a type of mineral.

Step 3: Conclusion.

The correct answer is **(A) All ores are minerals**, as ores are naturally occurring minerals from which metals can be extracted.

Quick Tip

Remember, all ores are minerals, but not all minerals are ores. Ores are specific minerals that can be economically mined for metal extraction.

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3. 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 Electrometallurgical Process.

The electrometallurgical process involves using electricity to extract metals from their ores. It is commonly used for the extraction of metals like iron.

Step 2: Analyzing the options.

(A) Iron: Correct — Iron is extracted through electrometallurgical processes such as electrolysis.

(B) Lead: Lead is typically extracted through pyrometallurgical processes, not electrometallurgical ones.

(C) Silver: Silver extraction involves a variety of processes, including cyanidation, not electrometallurgy.

(D) Sodium: Sodium is extracted using the Downs process, not by electrometallurgical methods.

Step 3: Conclusion.

The correct answer is **(A) Iron**, as it is commonly extracted using electrometallurgical processes.

Quick Tip

Electrometallurgy uses electricity for extracting metals, particularly when metals are highly reactive.

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4. An ore having two different metal atoms is:

(A) Haematite

(B) Galena

(C) Magnetite

(D) Copper pyrite

Correct Answer: (D) Copper pyrite

Solution:

Step 1: Understanding ore composition.

An ore having two different metal atoms is called a polymetallic ore. Copper pyrite is an example of such an ore, as it contains both copper and iron.

Step 2: Analyzing the options.

(A) Haematite: Haematite is an iron ore and does not contain two different metal atoms.

(B) Galena: Galena is a lead ore and does not have two different metal atoms.

(C) Magnetite: Magnetite is an iron ore and contains only iron.

(D) Copper pyrite: Correct — Copper pyrite contains both copper and iron, making it a polymetallic ore.

Step 3: Conclusion.

The correct answer is **(D) Copper pyrite**, which contains two different metal atoms: copper and iron.

Quick Tip

Polymetallic ores contain two or more metals in the same ore, like copper pyrite.

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5. Which of the following elements has electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$?

(A) Oxygen

(B) Hydrogen

(C) Nitrogen

(D) Fluorine

Correct Answer: (D) Fluorine

Solution:

Step 1: Identifying the element with the given electronic configuration.

The electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$ corresponds to the element fluorine, which has atomic number 9.

Step 2: Analyzing the options.

(A) Oxygen: Oxygen has an electronic configuration of $1s^2 2s^2 2p^4$, not matching the given configuration.

(B) Hydrogen: Hydrogen's configuration is $1s^1$, which doesn't match the given configuration.

(C) Nitrogen: Nitrogen has an electronic configuration of $1s^2 2s^2 2p^3$.

(D) Fluorine: Correct — Fluorine's electronic configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$.

Step 3: Conclusion.

The correct answer is **(D) Fluorine**, as it has the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$.

Quick Tip

The electronic configuration of elements helps in identifying the element and understanding its chemical properties. Fluorine's configuration is typical for halogens.

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6. 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: Understanding the question.

Laughing gas is the common name for nitrous oxide, a chemical compound with the formula N_2O, which is known for its euphoric effects when inhaled.

Step 2: Analyzing the options.

(A) Nitric oxide: This is not laughing gas; it is a different nitrogen oxide used in various industrial applications.

(B) Nitrous oxide: Correct — Nitrous oxide, or laughing gas, is used as an anesthetic and recreational drug.

(C) Dinitrogen trioxide: This is another nitrogen oxide but not the laughing gas.

(D) Dinitrogen pentoxide: This compound is used in making nitric acid and is not laughing gas.

Step 3: Conclusion.

The correct answer is **(B) Nitrous oxide**, as it is commonly referred to as laughing gas.

Quick Tip

Laughing gas is a chemical compound known for its use in medicine and entertainment, and it is also referred to as nitrous oxide (N_2O).

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7. 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 energy.

Bond energy refers to the energy required to break a bond between two atoms. Generally, smaller atoms with higher electronegativity have stronger bonds and higher bond energies.

Step 2: Analyzing the options.

(A) O - O: Correct — The bond energy for the oxygen-oxygen bond is higher due to the small size and high electronegativity of oxygen.

(B) S - S: This bond is weaker than the O - O bond because sulfur atoms are larger and have lower electronegativity.

(C) Se - Se: Selenium has a larger atomic radius, which leads to weaker bonds compared to oxygen.

(D) Te - Te: Tellurium has an even larger atomic radius, and its bond energy is lower than that of oxygen.

Step 3: Conclusion.

The correct answer is **(A) O - O**, as oxygen has the highest bond energy among the given options.

Quick Tip

The strength of a bond generally increases as the atoms become smaller and more electronegative, which is why the O - O bond has the highest bond energy in this case.

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

(A) 0

(B) +1

(C) +2

(D) +3

Correct Answer: (A) 0

Solution:

Step 1: Understanding the compound.

In the complex Ni$(CO)_4$, carbon monoxide (CO) is a neutral ligand, meaning it does not affect the oxidation state of the metal.

Step 2: Determining the oxidation state of Ni.

Since CO is neutral and there are four CO molecules in the complex, the oxidation state of nickel remains 0 in Ni$(CO)_4$.

Step 3: Conclusion.

The correct answer is **(A) 0**, as the oxidation state of nickel in Ni$(CO)_4$ is 0.

Quick Tip

When calculating oxidation states, remember that neutral ligands like CO do not change the oxidation state of the central metal atom.

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

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

(B) $[Pt(NH_3)_3Cl]Cl_3$

(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.

The molar electrical conductance of a compound depends on the number of ions produced in solution. More dissociation results in higher electrical conductance.

Step 2: Analyzing the options.

(A) $\mathbf{[Pt(NH_3)_6]Cl_4}$**:** Correct — This complex dissociates to produce 4 ions, giving it the highest conductance.

(B) $\mathbf{[Pt(NH_3)_3Cl]Cl_3}$**:** This dissociates into 4 ions but with a lower dissociation capacity than option (A).

(C) $\mathbf{[Pt(NH_3)_4Cl_2]Cl_2}$**:** This complex dissociates into fewer ions than option (A).

(D) $\mathbf{[Pt(NH_3)_3Cl_3]Cl}$**:** This has the lowest dissociation, resulting in fewer ions.

Step 3: Conclusion.

The correct answer is **(A)** $\mathbf{[Pt(NH_3)_6]Cl_4}$, as it dissociates into the most ions, leading to the highest molar electrical conductance.

Quick Tip

When determining molar electrical conductance, remember that more dissociation into ions leads to higher conductance.

10. 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: (C) Potassium hexacyanoferrate (II)

Solution:

Step 1: Understanding the complex.

$K_3[Fe(CN)_6]$ contains iron in the +2 oxidation state, making it a hexacyanoferrate(II) complex.

Step 2: Analyzing the options.

(A) Potassium ferrocyanide: This is a common name, but not the IUPAC name.

(B) Potassium ferricyanide: Ferricyanide corresponds to iron in the +3 oxidation state, not +2.

(C) Potassium hexacyanoferrate (II): Correct — This is the IUPAC name because iron is in the +2 oxidation state.

(D) Potassium hexacyanoferrate (III): This would be the name if iron were in the +3 oxidation state.

Step 3: Conclusion.

The correct answer is **(C) Potassium hexacyanoferrate (II)**.

Quick Tip

The IUPAC name of a coordination compound reflects the oxidation state of the metal. Hexacyanoferrate (II) means iron is in the +2 state.

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11. Vitamin B12 contains:

(A) Cobalt

(B) Magnesium

(C) Iron

(D) Nickel

Correct Answer: (A) Cobalt

Solution:

Step 1: Understanding Vitamin B12.

Vitamin B12 contains cobalt at its core, which is essential for its biological function.

Step 2: Analyzing the options.

(A) Cobalt: Correct — Cobalt is the central metal in Vitamin B12.

(B) Magnesium: Magnesium is not a component of Vitamin B12.

(C) Iron: Iron is not a component of Vitamin B12.

(D) Nickel: Nickel is not a part of Vitamin B12.

Step 3: Conclusion.

The correct answer is **(A) Cobalt**, as cobalt is the central atom in Vitamin B12.

Quick Tip

Vitamin B12 is a complex molecule with cobalt at its core, essential for its biological activity in the body.

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

(A) 3

(B) 6

(C) 4

(D) 5

Correct Answer: (C) 4

Solution:

Step 1: Understanding coordination number.

The coordination number refers to the number of ligands directly attached to the central metal atom. In this case, $[Ni(C_2O_4)_3]^{2-}$, each oxalate ion ($C_2O_4^{2-}$) is a bidentate ligand, meaning it binds to the central Ni atom through two donor atoms.

Step 2: Analyzing the options.

(A) 3: Incorrect — There are 3 oxalate ligands, but each binds through two donor atoms, so the coordination number is not 3.

(B) 6: Incorrect — 6 would be the coordination number if the complex had 6 monodentate ligands.

(C) 4: Correct — The 3 bidentate oxalate ions contribute a coordination number of 6 (3×2).

(D) 5: Incorrect — 5 is not a valid coordination number in this case.

Step 3: Conclusion.

The correct answer is **(C) 4**, as the coordination number is 4 due to the 3 bidentate ligands.

Quick Tip

The coordination number is determined by the number of donor atoms from the ligands that are attached to the central metal ion. In the case of bidentate ligands, each ligand contributes 2 to the coordination number.

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13. The IUPAC name of $CH_3CH_2CH_2CH_2Cl$ 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: Understanding the structure of the compound.

The given compound $CH_3CH_2CH_2CH_2Cl$ is a chlorobutane. The position of the chloro group is at the first carbon, and a methyl group is attached at the third carbon.

Step 2: Analyzing the options.

(A) 1-chloro-2-methyl butane: Incorrect — The methyl group is at the third position, not the second.

(B) 1-chloroisopentane: Incorrect — This name does not match the structure of the compound.

(C) 1-chloro-3-methyl butane: Correct — This is the correct IUPAC name based on the structure of the compound.

(D) None of these: Incorrect — Option (C) is the correct answer.

Step 3: Conclusion.

The correct answer is **(C) 1-chloro-3-methyl butane**.

Quick Tip

When naming organic compounds, ensure that substituents like methyl or chloro groups are placed at the correct position according to IUPAC rules.

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14. $C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$ **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.

In the given reaction $C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$, the hydroxide ion ($OH^-$) attacks the carbon attached to the bromine atom in C_2H_5Br, displacing the bromine atom and replacing it with a hydroxyl group. This is a typical nucleophilic substitution reaction.

Step 2: Analyzing the options.

(A) Electrophilic substitution: Incorrect — This type of substitution involves an electrophile attacking a nucleophilic site, not applicable here.

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

(C) Both (A) and (B): Incorrect — This is not both types of substitution, only nucleophilic.

(D) None of these: Incorrect — Option (B) is correct.

Step 3: Conclusion.

The correct answer is **(B) Nucleophilic substitution**.

Quick Tip

In nucleophilic substitution reactions, a nucleophile replaces a leaving group (in this case, Br) from a carbon atom.

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15. 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 Orthophosphoric acid.

Orthophosphoric acid, also known as phosphoric acid, has the molecular formula H_3PO_4. It is the most common form of phosphoric acid.

Step 2: Analyzing the options.

(A) H_3PO_3**:** This is the formula for metaphosphoric acid, not orthophosphoric acid.

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

(C) HPO_3**:** This is the formula for orthophosphoric acid in its monobasic form, not the full molecule.

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

Step 3: Conclusion.

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

Quick Tip

Orthophosphoric acid has the molecular formula H_3PO_4, and it is widely used in industry and chemistry.

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16. The structure of XeF_4 is:

(A) Tetrahedral

(B) Octahedral

(C) Square planar

(D) None of these

Correct Answer: (C) Square planar

Solution:

Step 1: Understanding the structure of XeF_4.

Xenon tetrafluoride (XeF_4) has a square planar geometry, which is due to the presence of two lone pairs on the central xenon atom.

Step 2: Analyzing the options.

(A) Tetrahedral: Incorrect — A tetrahedral geometry would involve four single bonds, but XeF_4 has a square planar geometry due to the lone pairs.

(B) Octahedral: Incorrect — This geometry would involve six bonding regions, which is not the case for XeF_4.

(C) Square planar: Correct — XeF_4 has a square planar geometry because of the lone pairs and bonding pairs of fluorine.

(D) None of these: Incorrect — The correct answer is square planar.

Step 3: Conclusion.

The correct answer is **(C) Square planar**.

Quick Tip

In molecules like XeF_4, the presence of lone pairs on the central atom can affect the molecular geometry.

17. 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 oxidation states of halogens.

Halogens generally exhibit a negative oxidation state (-1), but some of them can show positive oxidation states in compounds with highly electronegative elements like oxygen.

Step 2: Analyzing the options.

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

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

(C) Cl: Chlorine can show positive oxidation states as well.

(D) F: Correct — Fluorine does not exhibit a positive oxidation state because it is the most electronegative element and always has an oxidation state of -1 in compounds.

Step 3: Conclusion.

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

Quick Tip

Fluorine is the only halogen that cannot exhibit a positive oxidation state due to its high electronegativity.

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18. 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.

In general, bond angles decrease as the size of the central atom increases because larger atoms have more diffuse electron clouds.

Step 2: Analyzing the options.

(A) H_2O**:** Correct — Water has a bond angle of 104.5°, which is the smallest among the options because oxygen is small and highly electronegative.

(B) H_2S**:** The bond angle in H_2S is 92°, which is larger than H_2O.

(C) H_2Se**:** The bond angle in H_2Se is 91°, which is slightly larger than H_2S.

(D) H_2Te**:** The bond angle in H_2Te is the smallest among these, but still larger than H_2O.

Step 3: Conclusion.

The correct answer is **(A)** H_2O, as water has the smallest bond angle.

Quick Tip

The bond angle decreases as the atomic size of the central atom increases. Water has the smallest bond angle because oxygen is small and highly electronegative.

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19. 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: (B) Ti^{3+}

Solution:

Step 1: Understanding unpaired electrons.

The number of unpaired electrons is determined by the electron configuration of the ion.

Step 2: Analyzing the options.

(A) Mg^{2+}**:** Magnesium has an electron configuration of $[Ne]$, with no unpaired electrons.

(B) Ti^{3+}**:** Titanium in the $+3$ state has an electron configuration of $[Ar]3d^1$, meaning 1 unpaired electron.

(C) V^{3+}**:** Vanadium in the $+3$ state has an electron configuration of $[Ar]3d^2$, meaning 2 unpaired electrons.

(D) Fe^{3+}**:** Iron in the $+3$ state has an electron configuration of $[Ar]3d^5$, meaning 5 unpaired electrons.

Step 3: Conclusion.

The correct answer is **(B)** Ti^{3+}, as it has the maximum number of unpaired electrons.

Quick Tip

The number of unpaired electrons is highest when the electron configuration leaves more electrons in degenerate orbitals. Ti^{3+} has the most unpaired electrons.

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20. The maximum oxidation state of chromium is:

(A) +2

(B) +3

(C) +4

(D) +6

Correct Answer: (D) +6

Solution:

Step 1: Understanding the oxidation states of chromium.

Chromium can have multiple oxidation states, ranging from +2 to +6, with +6 being the highest oxidation state.

Step 2: Analyzing the options.

(A) +2: This is one of the oxidation states of chromium, but not the maximum.

(B) +3: This is a common oxidation state of chromium, but it is not the highest.

(C) +4: Chromium can also have a +4 oxidation state, but it is not the highest.

(D) +6: Correct — The maximum oxidation state of chromium is +6.

Step 3: Conclusion.

The correct answer is **(D) +6**, as chromium's highest oxidation state is +6.

Quick Tip

The maximum oxidation state of chromium is +6, which is seen in compounds like chromium trioxide (CrO_3).

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

(A) 0

(B) 1

(C) 2

(D) 3

Correct Answer: (C) 2

Solution:

Step 1: Understanding electron configuration.

Copper has an atomic number of 29, and its electron configuration in the neutral state is $[Ar]3d^{10}4s^1$. In the Cu^{2+} state, it loses two electrons, one from the $4s$ orbital and one from the $3d$ orbital, giving it a $3d^9$ configuration.

Step 2: Analyzing the options.

(A) 0: Incorrect — There are unpaired electrons in the $3d$ orbital of Cu^{2+}.

(B) 1: Incorrect — There are two unpaired electrons in the $3d$ orbital.

(C) 2: Correct — Cu^{2+} has 2 unpaired electrons in its $3d^9$ configuration.

(D) 3: Incorrect — There are only 2 unpaired electrons in Cu^{2+}, not 3.

Step 3: Conclusion.

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

Quick Tip

The number of unpaired electrons can be determined by looking at the electron configuration, considering the number of electrons in degenerate orbitals.

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22. 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 those that have the same osmotic pressure, meaning they have the same molar concentration of solute particles.

Step 2: Analyzing the options.

(A) Density: Incorrect — Isotonic solutions do not necessarily have the same density, as this can vary based on the nature of the solute.

(B) Normality: Incorrect — Normality is related to the equivalents of solute, and isotonic solutions may not have the same normality.

(C) Strength: Incorrect — Strength refers to the concentration of active ions or molecules, which is not necessarily the same in isotonic solutions.

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

Step 3: Conclusion.

The correct answer is **(D) Molar concentration**, as isotonic solutions have the same molar concentration of solute particles.

Quick Tip

Isotonic solutions have the same osmotic pressure due to having equal molar concentrations of solute particles.

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23. An azeotropic mixture of HCl and H_2O has:

(A) 48% HCl

(B) 36% HCl

(C) 22.2% HCl

(D) 20.2% HCl

Correct Answer: (B) 36% HCl

Solution:

Step 1: Understanding azeotropes.

An azeotrope is a mixture of two liquids that has a constant boiling point and composition during distillation. The azeotrope for HCl and water contains approximately 36

Step 2: Analyzing the options.

(A) 48% HCl: Incorrect — This is not the composition of the azeotropic mixture.

(B) 36% HCl: Correct — The azeotrope of HCl and water has 36% HCl by mass.

(C) 22.2% HCl: Incorrect — This is not the correct percentage for the azeotropic mixture.

(D) 20.2% HCl: Incorrect — This is also not the correct percentage for the azeotropic mixture.

Step 3: Conclusion.

The correct answer is **(B) 36% HCl**, which is the composition of the azeotropic mixture of HCl and water.

Quick Tip

Azeotropes have a constant composition during distillation, and for HCl and water, the azeotrope contains 36% HCl.

24. A charge of 96500 coulomb liberates ..... from the solution of $CuSO_4$.

(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: Understanding the concept.

According to Faraday's law of electrolysis, the mass of the substance liberated during electrolysis is directly proportional to the charge passed. For copper, 96500 coulombs of charge liberates 63.5 grams of copper.

Step 2: Analyzing the options.

(A) 63.5 gm copper: Correct — 96500 coulombs of charge will liberate 63.5 gm of copper.

(B) 31.76 gm copper: Incorrect — This is not the correct amount.

(C) 96500 gm copper: Incorrect — This is much higher than the correct value.

(D) 100 gm copper: Incorrect — This is also not the correct value.

Step 3: Conclusion.

The correct answer is **(A) 63.5 gm copper**, as 96500 coulombs of charge will liberate this amount of copper.

Quick Tip

Faraday's law states that 96500 coulombs of charge liberate 63.5 grams of copper from a copper sulfate solution.

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25. The cell constant of a conductivity cell is:

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

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

(C) $l \cdot A$

(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 given by $K = \frac{l}{A}$, where l is the length of the cell and A is the cross-sectional area. This constant relates the measured resistance to the conductivity of the solution.

Step 2: Analyzing the options.

(A) $\frac{l}{A}$**:** Correct — This is the correct expression for the cell constant.

(B) $\frac{A}{l}$**:** Incorrect — This is the inverse of the correct expression.

(C) $l \cdot A$**:** Incorrect — This does not represent the cell constant.

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

Step 3: Conclusion.

The correct answer is **(A)** $\frac{l}{A}$, as this is the definition of the cell constant.

Quick Tip

The cell constant is defined as $K = \frac{l}{A}$, where l is the length and A is the cross-sectional area of the conductivity cell.

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26. The electromotive force of the cell Zn|$ZnSO_4$||$CuSO_4$|Cu is 1.1 volt. Its cathode is:

(A) Zn

(B) Cu

(C) $ZnSO_4$

(D) $CuSO_4$

Correct Answer: (B) Cu

Solution:

Step 1: Understanding the cell.

The given electrochemical cell is a Galvanic cell, where the cell potential (emf) is 1.1 V. The cell consists of a zinc electrode in a zinc sulfate solution and a copper electrode in a copper sulfate solution. The cathode is the electrode where reduction occurs.

Step 2: Analyzing the options.

(A) Zn: Incorrect — Zinc is the anode where oxidation occurs.

(B) Cu: Correct — Copper is the cathode, where reduction takes place in this galvanic cell.

(C) $ZnSO_4$: Incorrect — This is the electrolyte in the anode compartment, not the cathode.

(D) $CuSO_4$: Incorrect — This is the electrolyte in the cathode compartment, not the electrode.

Step 3: Conclusion.

The correct answer is **(B) Cu**, as the copper electrode is the cathode in this galvanic cell.

Quick Tip

In a Galvanic cell, the cathode is the site of reduction, where electrons are gained by the species. In this cell, copper is the cathode.

---

27. 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, which states that when certain substances dissolve in water, they dissociate into ions. This was a groundbreaking theory that helped explain many aspects of electrolytic conduction.

Step 2: Analyzing the options.

(A) Faraday: Incorrect — Faraday worked on the laws of electrolysis but did not propose the theory of ionisation.

(B) Arrhenius: Correct — Arrhenius proposed the theory of ionisation in 1887.

(C) Ostwald: Incorrect — Ostwald worked on chemical equilibria and did not propose the ionisation theory.

(D) Rutherford: Incorrect — Rutherford was a physicist known for his work on atomic structure, not ionisation theory.

Step 3: Conclusion.

The correct answer is **(B) Arrhenius**, as he is credited with developing the theory of ionisation.

Quick Tip

Arrhenius' theory of ionisation is fundamental in explaining how substances like acids, bases, and salts dissociate into ions in water.

---

28. 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 reaction rate.

The rate of a chemical reaction is directly proportional to the active mass (concentration) of the reactants. Active mass refers to the concentration of the substance that is involved in the reaction.

Step 2: Analyzing the options.

(A) Atomic mass: Incorrect — The rate of reaction is not dependent on atomic mass.

(B) Equivalent mass: Incorrect — Equivalent mass does not directly influence the rate of reaction.

(C) Molecular mass: Incorrect — The molecular mass does not directly affect the rate of reaction, but the concentration or active mass does.

(D) Active mass: Correct — The rate of reaction depends on the active mass (concentration) of the reactants.

Step 3: Conclusion.

The correct answer is **(D) Active mass**, as the rate of reaction depends on the concentration of the reactants.

Quick Tip

The rate of reaction is influenced by the concentration (active mass) of the reactants, and it follows the rate law expression.

---

29. Which of the following alkyl halides is hydrolysed by S_N1 mechanism?

(A) CH_3CH_2CHX

(B) CH_3CH_2X

(C) $CH_3CH_2CH_2X$

(D) CH_3CH_3CX

Correct Answer: (D) CH_3CH_3CX

Solution:

Step 1: Understanding the S_N1 mechanism.

The S_N1 mechanism involves the formation of a carbocation intermediate. This mechanism is favored by tertiary alkyl halides, which stabilize the carbocation, or halides with a good leaving group.

Step 2: Analyzing the options.

(A) CH_3CH_2CHX: Incorrect — This is a primary alkyl halide and would follow the S_N2 mechanism, not S_N1.

(B) CH_3CH_2X**:** Incorrect — This is also a primary alkyl halide and would follow S_N2.

(C) $CH_3CH_2CH_2X$**:** Incorrect — This is a secondary alkyl halide and may favor S_N2 over S_N1.

(D) CH_3CH_3CX**:** Correct — This is a tertiary alkyl halide, which is ideal for the S_N1 mechanism because the carbocation formed would be stabilized.

Step 3: Conclusion.

The correct answer is **(D)** CH_3CH_3CX, as it undergoes the S_N1 mechanism.

Quick Tip

Tertiary alkyl halides are most likely to undergo the S_N1 mechanism due to the stability of the carbocation intermediate.

---

30. Chloroform on reduction with Zn and water gives:

(A) Acetylene

(B) Ethylene

(C) Ethane

(D) Methane

Correct Answer: (D) Methane

Solution:

Step 1: Understanding the reaction.

Chloroform ($CHCl_3$) undergoes reduction with zinc (Zn) and water to produce methane (CH_4). This is a well-known reaction for producing methane.

Step 2: Analyzing the options.

(A) Acetylene: Incorrect — Reduction of chloroform does not produce acetylene.

(B) Ethylene: Incorrect — This is not the product of chloroform reduction.

(C) Ethane: Incorrect — Ethane is not produced in this reaction.

(D) Methane: Correct — The reduction of chloroform gives methane.

Step 3: Conclusion.

The correct answer is **(D) Methane**, as this is the product of the reduction of chloroform.

Quick Tip

The reduction of chloroform with zinc and water is a method to prepare methane.

---

31. 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.

When ethyl bromide (C_2H_5Br) is treated with dry silver oxide (Ag_2O), the silver oxide replaces the bromine atom, resulting in the formation of diethyl ether ($C_2H_5OC_2H_5$).

Step 2: Analyzing the options.

(A) Diethyl ether: Correct — The reaction produces diethyl ether.

(B) Ethanal: Incorrect — This is an aldehyde and not produced by this reaction.

(C) Ethane: Incorrect — This is an alkane and not produced in this reaction.

(D) Ethene: Incorrect — Ethene is not produced in this reaction.

Step 3: Conclusion.

The correct answer is **(A) Diethyl ether**, as it is the product of the reaction between ethyl bromide and dry silver oxide.

Quick Tip

Treating alkyl halides with silver oxide is a common method for producing ethers through nucleophilic substitution.

32. The 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: (C) Anhydrous $AlCl_3$ and conc. HCl

Solution:

Step 1: Understanding the Lucas reagent.

The Lucas reagent is a mixture of anhydrous aluminum chloride ($AlCl_3$) and concentrated hydrochloric acid (HCl). It is used to test the reactivity of alcohols, especially in the Lucas test for alcohol classification.

Step 2: Analyzing the options.

(A) Anhydrous $CaCl_2$ and conc. HCl: Incorrect — This is not the Lucas reagent.

(B) Anhydrous $ZnCl_2$ and conc. HCl: Incorrect — Zinc chloride is used in some reactions but not in the Lucas reagent.

(C) Anhydrous $AlCl_3$ and conc. HCl: Correct — This is the Lucas reagent used for alcohol tests.

(D) Anhydrous $PdCl_2$ and conc. HCl: Incorrect — Palladium chloride is not part of the Lucas reagent.

Step 3: Conclusion.

The correct answer is **(C) Anhydrous $AlCl_3$ and conc. HCl**, as it forms the Lucas reagent.

Quick Tip

The Lucas reagent is used to classify alcohols based on their reactivity with hydrochloric acid and aluminum chloride.

33. Butan-2-ol is:

(A) Primary alcohol

(B) Secondary alcohol

(C) Tertiary alcohol

(D) Dihydric alcohol

Correct Answer: (B) Secondary alcohol

Solution:

Step 1: Understanding Butan-2-ol.

Butan-2-ol is an alcohol with the hydroxyl group (-OH) attached to the second carbon of a four-carbon chain. This makes it a secondary alcohol, as the hydroxyl group is attached to a carbon that is bonded to two other carbon atoms.

Step 2: Analyzing the options.

(A) Primary alcohol: Incorrect — A primary alcohol has the hydroxyl group attached to a carbon bonded to only one other carbon.

(B) Secondary alcohol: Correct — Butan-2-ol is a secondary alcohol.

(C) Tertiary alcohol: Incorrect — A tertiary alcohol has the hydroxyl group attached to a carbon bonded to three other carbon atoms.

(D) Dihydric alcohol: Incorrect — A dihydric alcohol contains two hydroxyl groups, which is not the case for butan-2-ol.

Step 3: Conclusion.

The correct answer is **(B) Secondary alcohol**, as Butan-2-ol is a secondary alcohol.

Quick Tip

Secondary alcohols have the hydroxyl group attached to a carbon that is bonded to two other carbon atoms.

---

34. Which of the following is a tertiary alcohol?

(A) CH_3CH_2OH

(B) $CH_3C(OH)CH_3$

(C) CH_3OH

(D) $CH_3C(OH)C_2H_5$

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

Solution:

Step 1: Understanding tertiary alcohols.

Tertiary alcohols have the hydroxyl group attached to a carbon atom that is bonded to three other carbon atoms.

Step 2: Analyzing the options.

(A) CH_3CH_2OH**:** Incorrect — This is ethanol, a primary alcohol.

(B) $CH_3C(OH)CH_3$**:** Correct — This is a tertiary alcohol, as the hydroxyl group is attached to a carbon bonded to three other carbon atoms (methyl groups).

(C) CH_3OH**:** Incorrect — This is methanol, a primary alcohol.

(D) $CH_3C(OH)C_2H_5$**:** Incorrect — This is a secondary alcohol.

Step 3: Conclusion.

The correct answer is **(B)** $CH_3C(OH)CH_3$, as it is a tertiary alcohol.

Quick Tip

Tertiary alcohols have the hydroxyl group attached to a carbon bonded to three other carbon atoms.

---

35. 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 compound.

The compound $CH_3CH_2CH_2OH$ is a primary alcohol. The IUPAC name is determined by identifying the longest chain and the position of substituents.

Step 2: Analyzing the options.

(A) 2-methyl-1-propanal: Incorrect — This name is for an aldehyde, not an alcohol.

(B) Isobutyl alcohol: Incorrect — This is the common name for a different structure.

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

(D) None of these: Incorrect — Option (C) is the correct answer.

Step 3: Conclusion.

The correct answer is **(C) 2-methyl-1-butanol**.

Quick Tip

The IUPAC name for alcohols includes the position of the hydroxyl group and any substituents. In this case, the hydroxyl group is on the first carbon, and a methyl group is on the second carbon.

---

36. With which of the following does acetic acid not form acetyl chloride?

(A) PCl_5

(B) PCl_3

(C) $SOCl_2$

(D) Cl_2

Correct Answer: (D) Cl_2

Solution:

Step 1: Understanding the reaction.

Acetic acid reacts with chlorinating agents like PCl_5, PCl_3, and $SOCl_2$ to form acetyl chloride. However, Cl_2 (chlorine gas) does not react in the same way and does not form acetyl chloride.

Step 2: Analyzing the options.

(A) PCl_5**:** Incorrect — Acetic acid reacts with PCl_5 to form acetyl chloride.

(B) PCl_3**:** Incorrect — Acetic acid also reacts with PCl_3 to form acetyl chloride.

(C) $SOCl_2$**:** Incorrect — $SOCl_2$ also forms acetyl chloride with acetic acid.

(D) Cl_2**:** Correct — Chlorine gas does not form acetyl chloride with acetic acid.

Step 3: Conclusion.

The correct answer is **(D)** Cl_2.

Quick Tip

Chlorinating agents like PCl_5, PCl_3, and $SOCl_2$ are used to convert acetic acid to acetyl chloride, but chlorine gas does not react in the same manner.

---

37. Acetamide is:

(A) Acidic

(B) Alkaline

(C) Amphoteric

(D) Neutral

Correct Answer: (D) Neutral

Solution:

Step 1: Understanding acetamide.

Acetamide (CH_3CONH_2) is a neutral organic compound. It is derived from acetic acid and ammonia. As an amide, it does not exhibit acidic or basic properties but remains neutral in nature.

Step 2: Analyzing the options.

(A) Acidic: Incorrect — Acetamide is not acidic.

(B) Alkaline: Incorrect — Acetamide is not alkaline.

(C) Amphoteric: Incorrect — Acetamide is not amphoteric.

(D) Neutral: Correct — Acetamide is neutral.

Step 3: Conclusion.

The correct answer is **(D) Neutral**, as acetamide is neutral.

Quick Tip

Amides like acetamide are neutral compounds and do not exhibit acidic or basic properties.

---

38. $CH_3 - C - NH_2$ **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.

The given compound is $CH_3 - C - NH_2$, which is a primary amine. In this case, the amino group (-NH_2) is attached to a carbon atom that is also attached to one other carbon atom (methyl group).

Step 2: Analyzing the options.

(A) Primary amine: Correct — This compound is a primary amine because the amino group is attached to a carbon atom that is bonded to only one other carbon.

(B) Secondary amine: Incorrect — A secondary amine would have the amino group attached to a carbon bonded to two other carbons.

(C) Tertiary amine: Incorrect — A tertiary amine would have the amino group attached to a carbon bonded to three other carbons.

(D) Quaternary salt: Incorrect — A quaternary salt would have a positively charged nitrogen and four bonds to carbon, which is not the case here.

Step 3: Conclusion.

The correct answer is **(A) Primary amine**, as the compound has the amino group attached to a primary carbon.

Quick Tip

In a primary amine, the nitrogen is attached to a carbon that is bonded to only one other carbon.

---

39. 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.

When methylamine reacts with chloroform ($CHCl_3$) and alcoholic KOH, it undergoes the isonitrile (or isocyanide) synthesis reaction, leading to the formation of methyl isonitrile (CH_3NC).

Step 2: Analyzing the options.

(A) CH_3OH**:** Incorrect — This is methanol, which is not produced in this reaction.

(B) CH_3CN**:** Incorrect — This is acetonitrile, not the product of this reaction.

(C) CH_3CHO**:** Incorrect — This is acetaldehyde, not the product of this reaction.

(D) CH_3NC**:** Correct — Methylamine reacts with chloroform and KOH to form methyl isonitrile (CH_3NC).

Step 3: Conclusion.

The correct answer is **(D)** CH_3NC, as methyl isonitrile is produced in this reaction.

Quick Tip

Methylamine reacts with chloroform and alcoholic KOH to produce isonitriles (or isocyanides), which are characterized by the group $-NC$.

---

40. Which of the following is the most basic?

(A) $C_6H_5NH_2$

(B) C_6H_5NH

(C) $C_2H_5NH_2$

(D) C_2H_5NH

Correct Answer: (C) $C_2H_5NH_2$

Solution:

Step 1: Understanding basicity.

The basicity of amines depends on the availability of the lone pair of electrons on nitrogen to accept a proton. Alkyl groups increase the electron density on nitrogen, making the amine more basic, while phenyl groups decrease the electron density, making the amine less basic.

Step 2: Analyzing the options.

(A) $C_6H_5NH_2$**:** Incorrect — Aniline ($C_6H_5NH_2$) has a phenyl group attached to nitrogen, which decreases its basicity.

(B) C_6H_5NH**:** Incorrect — This is an aniline derivative with a negative charge on nitrogen, making it less basic.

(C) $C_2H_5NH_2$**:** Correct — Ethylamine ($C_2H_5NH_2$) is more basic due to the electron-donating effect of the ethyl group.

(D) C_2H_5NH**:** Incorrect — This is an ethylamine derivative with a negative charge on nitrogen, making it less basic.

Step 3: Conclusion.

The correct answer is **(C)** $C_2H_5NH_2$, as it is the most basic.

Quick Tip

Alkyl groups increase the electron density on nitrogen, making the amine more basic, while phenyl groups decrease it.

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41. 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 protein structure.

Proteins have a helical structure, and this structure is stabilized primarily by hydrogen bonds. These bonds help maintain the secondary structure of proteins such as alpha-helices.

Step 2: Analyzing the options.

(A) Ionic bond: Incorrect — Ionic bonds are important in protein structure but do not stabilize the helical structure.

(B) Covalent bond: Incorrect — Covalent bonds are strong but are not primarily responsible for stabilizing the helical structure of proteins.

(C) van-der Waals forces: Incorrect — These forces are weak and contribute to protein stability but are not the primary force in stabilizing the helix.

(D) Hydrogen bond: Correct — Hydrogen bonds are responsible for stabilizing the helical structure of proteins.

Step 3: Conclusion.

The correct answer is **(D) Hydrogen bond**, as hydrogen bonds stabilize the helical structure of proteins.

Quick Tip

Hydrogen bonds are crucial in maintaining the secondary structure of proteins, particularly in alpha-helices and beta-pleated sheets.

---

42. Which of the following is a ketose?

(A) Glucose

(B) Fructose

(C) Sucrose

(D) Starch

Correct Answer: (B) Fructose

Solution:

Step 1: Understanding ketoses and aldoses.

A ketose is a type of monosaccharide that contains a ketone group (-C=O) in its structure. Among the options, fructose is a ketose, while glucose is an aldose (it contains an aldehyde group).

Step 2: Analyzing the options.

(A) Glucose: Incorrect — Glucose is an aldose, not a ketose.

(B) Fructose: Correct — Fructose is a ketose because it contains a ketone group.

(C) Sucrose: Incorrect — Sucrose is a disaccharide composed of glucose and fructose, but it is not a ketose itself.

(D) Starch: Incorrect — Starch is a polysaccharide, not a monosaccharide.

Step 3: Conclusion.

The correct answer is **(B) Fructose**, as it is a ketose.

Quick Tip

Ketoses contain a ketone group in their structure, while aldoses contain an aldehyde group. Fructose is a common ketose.

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

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

(B) $CH_3COC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$

(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: Understanding the reaction order.

A first-order reaction depends on the concentration of one reactant raised to the first power. If the rate of reaction is dependent on the concentration of only one reactant, it is first-order.

Step 2: Analyzing the options.

(A) $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$**:** This is a first-order reaction because the rate depends on the concentration of one reactant.

(B) $CH_3COC_2H_5 + NaOH \rightarrow CH_3COONa + C_2H_5OH$**:** This is a first-order reaction, as it is a simple ester hydrolysis.

(C) $2H_2O_2 \rightarrow 2H_2O + O_2$**:** This is a first-order decomposition reaction.

(D) $2N_2O_5 \rightarrow 4NO_2 + O_2$**:** This is a second-order reaction because it involves the decomposition of dinitrogen pentoxide, which requires two molecules to collide, making it second-order.

Step 3: Conclusion.

The correct answer is **(D)** $2N_2O_5 \rightarrow 4NO_2 + O_2$, as it is not a first-order reaction.

Quick Tip

In a first-order reaction, the rate is proportional to the concentration of a single reactant raised to the first power.

44. The unit of rate constant of a second-order reaction is:

(A) $\text{mol}^{-1}\,\text{sec}^{-1}$

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

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

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

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

Solution:

Step 1: Understanding rate constants.

For a second-order reaction, the rate constant k has units of $\text{mol}^{-1}\,\text{sec}^{-1}$. This is because the rate of reaction depends on the concentration of the reactants raised to the second power, and the rate is typically expressed in terms of concentration per time.

Step 2: Analyzing the options.

(A) $\text{mol}^{-1}\,\text{sec}^{-1}$: Correct — This is the unit of the rate constant for a second-order reaction.

(B) $\text{mol}^{-1}\,\text{L}\,\text{sec}^{-1}$: Incorrect — This unit does not match for a second-order reaction.

(C) $\text{mol}\,\text{L}^{-1}\,\text{sec}^{-1}$: Incorrect — This is not the correct unit for the rate constant of a second-order reaction.

(D) $\text{mol}^{-1}\,\text{L}\,\text{sec}^{-1}$: Incorrect — This is not the correct unit for a second-order reaction.

Step 3: Conclusion.

The correct answer is **(A) $\text{mol}^{-1}\,\text{sec}^{-1}$**.

Quick Tip

For a second-order reaction, the unit of the rate constant is $\text{mol}^{-1}\,\text{sec}^{-1}$.

---

45. If the rate equation for a reaction is $\frac{dx}{dt} = k[H]^1[B]^{1/2}$, 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 law for a reaction is generally expressed as $\frac{dx}{dt} = k[A]^m[B]^n$, where m and n are the orders with respect to reactants A and B, respectively. The overall order is the sum of these exponents.

Step 2: Analyzing the options.

In the rate equation $\frac{dx}{dt} = k[H]^1[B]^{1/2}$, the order with respect to H is 1, and the order with respect to B is $\frac{1}{2}$. Therefore, the overall order of the reaction is $1 + \frac{1}{2} = \frac{3}{2}$.

Step 3: Conclusion.

The correct answer is **(C)** $\frac{3}{2}$, as the overall order is the sum of the exponents in the rate equation.

Quick Tip

The order of a reaction is the sum of the exponents in the rate equation with respect to each reactant.

---

46. According to Freundlich adsorption isotherm:

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

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

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

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

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

Solution:

Step 1: Understanding the Freundlich adsorption isotherm.

The Freundlich adsorption isotherm describes the adsorption of a gas onto a solid and is given by the equation $\frac{x}{m} = kp^{1/n}$, where x is the mass of the adsorbate, m is the mass of the adsorbent, p is the pressure, and k and n are constants.

Step 2: Analyzing the options.

(A) $\frac{x}{m} = kp^{1/n}$**:** Correct — This is the correct form of the Freundlich adsorption isotherm.

(B) $\frac{m}{x} = k \cdot p^{1/n}$**:** Incorrect — This equation does not match the Freundlich isotherm.

(C) $xm = kp^{1/n}$**:** Incorrect — This is not the correct equation for the isotherm.

(D) $\frac{x}{m} = k \cdot p^{1/n}$**:** Incorrect — This equation is not correct.

Step 3: Conclusion.

The correct answer is **(A)** $\frac{x}{m} = kp^{1/n}$, which is the equation for the Freundlich adsorption isotherm.

Quick Tip

The Freundlich adsorption isotherm expresses the relationship between the amount of adsorbate and the pressure of the gas in the form $\frac{x}{m} = kp^{1/n}$.

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47. 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 structure of milk.

Milk is a colloidal dispersion where fat globules are dispersed in water. This makes it an example of fat dispersed in water.

Step 2: Analyzing the options.

(A) Fat dispersed in water: Correct — This is the correct description of milk, where fat globules are suspended in water.

(B) Water dispersed in fat: Incorrect — This is not the correct composition of milk.

(C) Water dispersed in oil: Incorrect — This is not the composition of milk.

(D) Fat dispersed in fat: Incorrect — This is not the correct composition of milk.

Step 3: Conclusion.

The correct answer is **(A) Fat dispersed in water**, as milk is a colloidal system with fat dispersed in water.

Quick Tip

Milk is an example of a colloidal dispersion where fat is dispersed in water, and this is the correct description.

---

48. Which of the following is a lyophilic colloid?

(A) Milk

(B) Gum

(C) Fog

(D) Blood

Correct Answer: (B) Gum

Solution:

Step 1: Understanding lyophilic colloids.

Lyophilic colloids are colloidal systems in which the dispersed phase has a strong affinity for the dispersion medium, making them more stable and easier to prepare. Examples of lyophilic colloids include gum, starch, and gelatin.

Step 2: Analyzing the options.

(A) Milk: Incorrect — Milk is a lyophobic colloid, where fat is dispersed in water.

(B) Gum: Correct — Gum is a lyophilic colloid, where the dispersed phase has an affinity for water.

(C) Fog: Incorrect — Fog is a lyophobic colloid, where water droplets are dispersed in air.

(D) Blood: Incorrect — Blood is a complex colloidal system, but not specifically lyophilic.

Step 3: Conclusion.

The correct answer is **(B) Gum**, as it is a lyophilic colloid.

Quick Tip

Lyophilic colloids are characterized by a strong affinity between the dispersed phase and the dispersion medium, making them stable and easy to prepare. Gum is an example.

---

49. 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 the Haber's process.

Haber's process involves the synthesis of ammonia from nitrogen and hydrogen gases. The reaction is catalyzed by a combination of iron (Fe) and molybdenum (Mo) as the catalyst.

Step 2: Analyzing the options.

(A) Al_2O_3**:** Incorrect — Al_2O_3 is not the catalyst used in the Haber's process.

(B) Fe + Mo: Correct — Iron combined with molybdenum is used as the catalyst in the Haber's process.

(C) CuO: Incorrect — Copper oxide is not used in the Haber's process.

(D) Pt: Incorrect — Platinum is not used in the Haber's process.

Step 3: Conclusion.

The correct answer is **(B) Fe + Mo**, as these are the catalysts used in the Haber's process.

Quick Tip

In the Haber's process, a combination of iron and molybdenum is used as the catalyst for the synthesis of ammonia.

50. 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 function of Vitamin K.

Vitamin K is essential for the process of blood coagulation. It is involved in the synthesis of clotting factors, which are required for proper blood clotting.

Step 2: Analyzing the options.

(A) Vitamin A: Incorrect — Vitamin A is important for vision and immune function, not blood coagulation.

(B) Vitamin D: Incorrect — Vitamin D regulates calcium and phosphorus metabolism, not blood coagulation.

(C) Vitamin E: Incorrect — Vitamin E acts as an antioxidant, not directly related to blood coagulation.

(D) Vitamin K: Correct — Vitamin K plays a crucial role in blood coagulation.

Step 3: Conclusion.

The correct answer is **(D) Vitamin K**, as it is directly involved in blood clotting.

Quick Tip

Vitamin K is vital for blood coagulation as it helps in the synthesis of clotting factors.

51. 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 is primarily used as a disinfectant. It is an antimicrobial agent often used in water treatment and as a wound disinfectant.

Step 2: Analyzing the options.

(A) Disinfectant: Correct — Chloramine-T is used as a disinfectant.

(B) Antiseptic: Incorrect — While it has antiseptic properties, it is primarily known as a disinfectant.

(C) Analgesic: Incorrect — Chloramine-T is not an analgesic.

(D) Antipyretic: Incorrect — Chloramine-T is not used to reduce fever.

Step 3: Conclusion.

The correct answer is **(A) Disinfectant**, as Chloramine-T is primarily used for disinfection.

Quick Tip

Chloramine-T is a disinfectant used in water treatment and as a topical antiseptic.

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52. 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 the role of hydrazine.

Hydrazine is a drug that is primarily used in the treatment of tuberculosis, a bacterial infection that primarily affects the lungs.

Step 2: Analyzing the options.

(A) Malaria: Incorrect — Hydrazine is not used in the treatment of malaria.

(B) Typhoid: Incorrect — Hydrazine is not used in the treatment of typhoid fever.

(C) Cholera: Incorrect — Hydrazine is not used in the treatment of cholera.

(D) Tuberculosis: Correct — Hydrazine is used in the treatment of tuberculosis.

Step 3: Conclusion.

The correct answer is **(D) Tuberculosis**, as hydrazine is used to treat this condition.

Quick Tip

Hydrazine is a medication used in the treatment of tuberculosis, a serious bacterial infection of the lungs.

---

53. 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 a group of naturally occurring organic compounds that mostly contain basic nitrogen atoms. Nicotine, atropine, and cocaine are all examples of alkaloids.

Step 2: Analyzing the options.

(A) Nicotine: Correct — Nicotine is a well-known alkaloid found in tobacco.

(B) Atropine: Correct — Atropine is an alkaloid used in medicine for its antimuscarinic effects.

(C) Cocaine: Correct — Cocaine is an alkaloid with stimulant effects, derived from the coca plant.

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

Step 3: Conclusion.

The correct answer is **(D) All of these**, as all the options are alkaloids.

Quick Tip

Alkaloids are natural compounds that contain nitrogen and are known for their pharmacological effects. Examples include nicotine, atropine, and cocaine.

---

54. 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 obtained from the latex of rubber trees, and its main constituent is isoprene, a hydrocarbon monomer.

Step 2: Analyzing the options.

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

(B) Nitrocellulose: Incorrect — Nitrocellulose is not a natural rubber; it is a compound used in film production and other applications.

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

(D) Bakelite: Incorrect — Bakelite is a synthetic polymer used for its electrical insulating properties, not natural rubber.

Step 3: Conclusion.

The correct answer is **(A) Isoprene**, as it is the monomer used to make natural rubber.

Quick Tip

Isoprene is the primary monomer in natural rubber, and it is obtained from the latex of rubber trees.

---

55. 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 the raw materials for nylon.

Nylon is a synthetic polymer made from the condensation of adipic acid and hexamethylenediamine. Adipic acid is the primary raw material in making nylon.

Step 2: Analyzing the options.

(A) Ethylene: Incorrect — Ethylene is a raw material for making polyethylene, not nylon.

(B) Butadiene: Incorrect — Butadiene is used for making synthetic rubbers, not nylon.

(C) Adipic acid: Correct — Adipic acid is used as a key raw material in the synthesis of nylon.

(D) Isoprene: Incorrect — Isoprene is used for making synthetic rubber, not nylon.

Step 3: Conclusion.

The correct answer is **(C) Adipic acid**, as it is used in the production of nylon.

Quick Tip

Adipic acid is one of the key raw materials used in the production of nylon, along with hexamethylenediamine.

56. $F_2C = CF_2$ **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 monomer.

$F_2C = CF_2$ is the monomer used in the production of Teflon, a synthetic fluoropolymer known for its non-stick properties.

Step 2: Analyzing the options.

(A) Teflon: Correct — Teflon is made from the polymerization of $F_2C = CF_2$.

(B) Glyptal: Incorrect — Glyptal is made from the polymerization of maleic acid and ethylene glycol, not $F_2C = CF_2$.

(C) Nylon-6: Incorrect — Nylon-6 is made from the polymerization of caprolactam, not $F_2C = CF_2$.

(D) Buna-S: Incorrect — Buna-S is a synthetic rubber made from styrene and butadiene, not $F_2C = CF_2$.

Step 3: Conclusion.

The correct answer is **(A) Teflon**, as it is made from the polymerization of $F_2C = CF_2$.

Quick Tip

Teflon is a polymer made from the monomer $F_2C = CF_2$, and it is known for its non-stick properties.

57. 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 the crystal structure of diamond.

Diamond is a covalent crystal, where each carbon atom is bonded to four other carbon atoms in a three-dimensional tetrahedral structure. This structure gives diamond its hardness and high melting point.

Step 2: Analyzing the options.

(A) Ionic crystal: Incorrect — Ionic crystals are composed of positively and negatively charged ions, such as sodium chloride, not diamond.

(B) Covalent crystal: Correct — Diamond is a covalent crystal with a strong three-dimensional network of covalent bonds.

(C) Molecular crystal: Incorrect — Molecular crystals are composed of molecules held together by intermolecular forces, not covalent bonds like in diamond.

(D) Metallic crystal: Incorrect — Metallic crystals are composed of metal atoms held together by metallic bonds, not covalent bonds.

Step 3: Conclusion.

The correct answer is **(B) Covalent crystal**, as diamond has a covalent crystal structure.

Quick Tip

Diamond is a covalent crystal, where each carbon atom is bonded to four other carbon atoms in a tetrahedral structure, making it incredibly hard.

---

58. 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 NaCl (sodium chloride) crystal structure is face-centred cubic (FCC), where each sodium ion is surrounded by six chloride ions, and each chloride ion is surrounded by six sodium ions. This results in a highly symmetrical arrangement.

Step 2: Analyzing the options.

(A) Hexagonal close packing: Incorrect — This structure is typical of metals like magnesium, not NaCl.

(B) Face centred cubic: Correct — NaCl adopts a face-centred cubic structure.

(C) Square planar: Incorrect — Square planar is not a common structure for ionic crystals.

(D) Body centred cubic: Incorrect — Body-centred cubic is not the structure of NaCl.

Step 3: Conclusion.

The correct answer is **(B) Face centred cubic**, as this is the structure of NaCl.

Quick Tip

NaCl forms a face-centred cubic structure where each ion is surrounded symmetrically by ions of the opposite charge.

---

59. Which of the following is an amorphous solid?

(A) Diamond

(B) Graphite

(C) Common salt

(D) Glass

Correct Answer: (D) Glass

Solution:

Step 1: Understanding amorphous solids.

Amorphous solids lack a regular, repeating structure. Unlike crystalline solids, they do not have an ordered arrangement of atoms. Glass is an example of an amorphous solid.

Step 2: Analyzing the options.

(A) Diamond: Incorrect — Diamond is a crystalline solid with a highly ordered structure.

(B) Graphite: Incorrect — Graphite is a crystalline solid with a layered structure.

(C) Common salt: Incorrect — Common salt (NaCl) is a crystalline solid with a regular arrangement of ions.

(D) Glass: Correct — Glass is an amorphous solid without a regular atomic arrangement.

Step 3: Conclusion.

The correct answer is **(D) Glass**, as it is an amorphous solid.

Quick Tip

Amorphous solids, like glass, lack a regular atomic structure, unlike crystalline solids.

---

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

(A) 6

(B) 4

(C) 8

(D) 12

Correct Answer: (C) 8

Solution:

Step 1: Understanding octahedral voids.

An octahedral void is surrounded by six atoms in a regular octahedral shape, but when considering the geometry in the context of a crystal lattice, it is surrounded by eight atoms (spheres).

Step 2: Analyzing the options.

(A) 6: Incorrect — An octahedral void is surrounded by eight atoms, not six.

(B) 4: Incorrect — A tetrahedral void is surrounded by four atoms, not an octahedral void.

(C) 8: Correct — An octahedral void is surrounded by eight atoms.

(D) 12: Incorrect — A cubic void would be surrounded by twelve atoms.

Step 3: Conclusion.

The correct answer is **(C) 8**, as an octahedral void is surrounded by eight atoms in the crystal lattice.

Quick Tip

An octahedral void is surrounded by eight spheres in the crystal lattice, forming a regular octahedron.

---

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

(A) Molarity

(B) Normality

(C) Formality

(D) Molality

Correct Answer: (C) Formality

Solution:

Step 1: Understanding the modes of concentration.

Molarity, normality, and molality all depend on the temperature because they involve volume, and volume changes with temperature. Formality, however, is defined by the amount of solute and does not depend on temperature.

Step 2: Analyzing the options.

(A) Molarity: Incorrect — Molarity depends on the volume, which changes with temperature.

(B) Normality: Incorrect — Normality depends on the volume, which changes with temperature.

(C) Formality: Correct — Formality is independent of temperature changes because it is based on the molar concentration of the solute.

(D) Molality: Incorrect — Molality depends on the mass of the solvent, but changes in temperature can affect solute-solvent interactions.

Step 3: Conclusion.

The correct answer is **(C) Formality**, as it does not depend on temperature.

Quick Tip

Formality is independent of temperature, unlike molarity, normality, and molality, which all depend on temperature.

---

62. Which of the following shows positive deviation from Raoult's law?

(A) C_6H_6 and $C_6H_5CH_3$

(B) C_6H_6 and CCl4

(C) $CHCl_3$ and C_2H_5OH

(D) $CHCl_3$ and CH_3COCH_3

Correct Answer: (B) C_6H_6 and CCl4

Solution:

Step 1: Understanding Raoult's Law and its deviations.

Raoult's law states that the partial vapor pressure of each volatile component in a solution is directly proportional to its mole fraction. Positive deviation from Raoult's law occurs when the vapor pressure of the solution is higher than expected due to weaker interactions between the components.

Step 2: Analyzing the options.

(A) C_6H_6 **and** $C_6H_5CH_3$**:** Incorrect — This pair follows Raoult's law since the interactions between benzene and toluene are similar.

(B) C_6H_6 **and CCl4:** Correct — Benzene and carbon tetrachloride show positive deviation because the interactions between the two are weaker than between similar molecules.

(C) $CHCl_3$ **and** C_2H_5OH**:** Incorrect — Chloroform and ethanol show negative deviation due to stronger hydrogen bonding.

(D) $CHCl_3$ **and** CH_3COCH_3**:** Incorrect — These components do not show positive deviation.

Step 3: Conclusion.

The correct answer is **(B)** C_6H_6 **and CCl4**, as this combination shows positive deviation from Raoult's law.

Quick Tip

Positive deviation from Raoult's law occurs when the interactions between molecules are weaker than expected, leading to an increase in vapor pressure.

---

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

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

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

(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 is the pressure exerted by a solution when it is separated from a pure solvent by a semipermeable membrane. The formula for osmotic pressure is given by $\pi = \frac{CR}{T}$, where C is the concentration, R is the gas constant, and T is the temperature in Kelvin.

Step 2: Analyzing the options.

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

(B) $\pi = \frac{C}{RT}$**:** Incorrect — This equation does not represent osmotic pressure correctly.

(C) $\pi = \frac{CT}{R}$**:** Incorrect — This equation does not match the formula for osmotic pressure.

(D) $\pi = \frac{RT}{C}$**:** Incorrect — This equation does not represent osmotic pressure.

Step 3: Conclusion.

The correct answer is **(A)** $\pi = \frac{CR}{T}$, which represents the osmotic pressure of a solution.

Quick Tip

Osmotic pressure is given by the formula $\pi = \frac{CR}{T}$, which relates the pressure to the concentration, temperature, and gas constant.

---

64. 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: (A) Dry Ag_2O

Solution:

Step 1: Understanding the reaction.

Alkyl halides react with silver oxide (AgO) or zinc oxide (ZnO) to form ethers. This reaction is generally performed with dry silver oxide, as it facilitates the formation of ethers without any moisture.

Step 2: Analyzing the options.

(A) Dry Ag_2O**:** Correct — Dry Ag_2O reacts with alkyl halides to form ethers.

(B) Moist Ag_2O**:** Incorrect — Moist Ag_2O is not as effective for ether formation as dry Ag_2O.

(C) Dry ZnO**:** Incorrect — Dry ZnO is not typically used to form ethers in this reaction.

(D) Moist ZnO**:** Incorrect — Moist ZnO is not used for ether formation with alkyl halides.

Step 3: Conclusion.

The correct answer is **(A) Dry** Ag_2O, as it is used to form ethers by reacting with alkyl halides.

Quick Tip

Alkyl halides react with dry silver oxide to form ethers. Ensure that the silver oxide is dry to get effective ether formation.

---

65. The IUPAC name of $CH_3 - CH_2 - CH_2 - CHO$ is:

(A) 2-Hydroxybutanal

(B) 3-Hydroxybutanal

(C) 2-Hydroxypropanal

(D) None of these

Correct Answer: (B) 3-Hydroxybutanal

Solution:

Step 1: Analyzing the structure.

The given structure is $CH_3 - CH_2 - CH_2 - CHO$, which is butanal (butyraldehyde), with a hydroxyl group (-OH) attached to the third carbon. Therefore, the correct IUPAC name includes the functional group and position.

Step 2: Analyzing the options.

(A) 2-Hydroxybutanal: Incorrect — The hydroxyl group is not on the second carbon; it is on the third.

(B) 3-Hydroxybutanal: Correct — The hydroxyl group is on the third carbon, making this the correct name.

(C) 2-Hydroxypropanal: Incorrect — This is not the correct name, as the structure corresponds to butanal, not propanal.

(D) None of these: Incorrect — Option (B) is correct.

Step 3: Conclusion.

The correct answer is **(B) 3-Hydroxybutanal**, as the hydroxyl group is on the third carbon of butanal.

Quick Tip

When naming aldehydes with additional groups, always number the chain starting from the carbonyl group (CHO), and name the other groups accordingly.

---

66. 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 the commercial name for a 40% aqueous solution of methanal (formaldehyde), which is commonly used as a disinfectant and preservative.

Step 2: Analyzing the options.

(A) Formic acid: Incorrect — Formic acid is a different compound, not formalin.

(B) Fluoroform: Incorrect — Fluoroform is not the commercial name for formalin.

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

(D) Paraformaldehyde: Incorrect — Paraformaldehyde is a polymer of formaldehyde, not the commercial name.

Step 3: Conclusion.

The correct answer is **(C) 40% aqueous solution of methanal**, as formalin refers to this solution.

Quick Tip

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

67. 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.

When an aldehyde undergoes oxidation, it is converted into a carboxylic acid. This is a typical reaction for aldehydes, where the carbonyl group (C=O) is oxidized.

Step 2: Analyzing the options.

(A) An alcohol: Incorrect — Oxidation of an aldehyde results in an acid, not an alcohol.

(B) A ketone: Incorrect — Aldehydes are oxidized to acids, not ketones.

(C) An ether: Incorrect — Aldehydes do not convert to ethers upon oxidation.

(D) An acid: Correct — The oxidation of an aldehyde results in a carboxylic acid.

Step 3: Conclusion.

The correct answer is **(D) An acid**, as aldehydes are oxidized to acids.

Quick Tip

Aldehydes are oxidized to carboxylic acids upon oxidation, typically by reagents like potassium permanganate or chromium compounds.

---

68. Chlortone is formed when chloroform reacts with:

(A) Formaldehyde

(B) Acetaldehyde

(C) Acetone

(D) Benzaldehyde

Correct Answer: (A) Formaldehyde

Solution:

Step 1: Understanding the formation of chlortone.

Chlortone is formed when chloroform reacts with formaldehyde under basic conditions. This reaction is a classic example of the formation of a chloroform derivative.

Step 2: Analyzing the options.

(A) Formaldehyde: Correct — Chlortone is formed by the reaction of chloroform and formaldehyde.

(B) Acetaldehyde: Incorrect — Chlortone is not formed by the reaction of chloroform with acetaldehyde.

(C) Acetone: Incorrect — Chlortone is not formed with acetone.

(D) Benzaldehyde: Incorrect — Chlortone is not formed with benzaldehyde.

Step 3: Conclusion.

The correct answer is **(A) Formaldehyde**, as chlortone is formed when chloroform reacts with formaldehyde.

Quick Tip

Chlortone is formed when chloroform reacts with formaldehyde, a reaction that occurs under basic conditions.

---

69. The general molecular formula of saturated, monocarboxylic acids is:

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

(B) $C_nH_{2n}O$

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

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

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

Solution:

Step 1: Understanding the molecular formula.

The general molecular formula for a saturated monocarboxylic acid is $C_nH_{2n+2}O_2$, where the molecule contains carbon, hydrogen, and oxygen, with a carboxyl group (-COOH) attached to a saturated carbon chain.

Step 2: Analyzing the options.

(A) $C_nH_{2n+2}O$**:** Incorrect — This formula is not correct for saturated monocarboxylic acids.

(B) $C_nH_{2n}O$**:** Incorrect — This formula does not include the correct number of hydrogens and oxygen atoms.

(C) $C_nH_{2n+2}O_2$**:** Correct — This is the correct molecular formula for saturated monocarboxylic acids.

(D) $C_nH_{2n+1}O_2$**:** Incorrect — This formula does not match the general molecular formula of saturated monocarboxylic acids.

Step 3: Conclusion.

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

Quick Tip

The general molecular formula for saturated monocarboxylic acids is $C_nH_{2n+2}O_2$, where the carboxyl group (-COOH) is attached to a saturated carbon chain.

---

70. By which of the following can formic acid and formaldehyde 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 reagents.

Tollen's reagent (ammoniacal silver nitrate solution) is used to distinguish aldehydes (such

as formaldehyde) from other functional groups like carboxylic acids (formic acid). Tollen's reagent reacts with aldehydes but not carboxylic acids.

Step 2: Analyzing the options.

(A) Benedict solution: Incorrect — Benedict's solution is used to test for reducing sugars, not aldehydes or carboxylic acids.

(B) Fehling solution: Incorrect — Fehling's solution also tests for reducing sugars and aldehydes, but Tollen's reagent is more specific for distinguishing aldehydes from carboxylic acids.

(C) Tollen's reagent: Correct — Tollen's reagent is used to distinguish aldehydes (like formaldehyde) from carboxylic acids (like formic acid). It forms a silver mirror when reacting with aldehydes.

(D) Sodium bicarbonate: Incorrect — Sodium bicarbonate is used to test for the presence of carboxylic acids, but it cannot distinguish between formic acid and formaldehyde.

Step 3: Conclusion.

The correct answer is **(C) Tollen's reagent**, as it can distinguish aldehydes from carboxylic acids.

Quick Tip

Tollen's reagent reacts with aldehydes but not carboxylic acids, making it useful for distinguishing between formaldehyde (an aldehyde) and formic acid (a carboxylic acid).

Section B

1. Which is Rosenmund reduction?

Solution:

Step 1: Understanding Rosenmund reduction.

Rosenmund reduction is a reaction in which acyl chlorides are reduced to aldehydes using hydrogen gas in the presence of palladium on barium sulfate (Pd/BaSO) as a catalyst. This reaction is specific for selective reduction of acyl chlorides to aldehydes, avoiding the further reduction to alcohols.

Quick Tip

Rosenmund reduction is used to selectively reduce acyl chlorides to aldehydes using Pd/BaSO as a catalyst.

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2. How is polypeptide bond formed?

Solution:

Step 1: Understanding polypeptide bonds.

Polypeptide bonds, also known as peptide bonds, are formed between the carboxyl group (-COOH) of one amino acid and the amino group (-NH) of another amino acid through a dehydration reaction. During this reaction, a molecule of water is eliminated, and the remaining atoms form the peptide bond (-CO-NH-).

Quick Tip

Polypeptide bonds are formed by a dehydration reaction between the carboxyl and amino groups of two amino acids.

---

3. Arrange F_2, Cl_2, Br_2, and I_2 in the increasing order of electron affinities.

Solution:

Step 1: Understanding electron affinity.

Electron affinity refers to the energy change when an electron is added to a neutral atom. Higher electron affinity means the atom more readily accepts an electron.

Step 2: Analyzing the order of electron affinities.

Electron affinity generally increases across a period and decreases down a group. For halogens, the trend in electron affinity is:

$$F_2 > Cl_2 > Br_2 > I_2$$

Step 3: Conclusion.

The correct order of increasing electron affinities is:

$$I_2 < Br_2 < Cl_2 < F_2$$

Quick Tip

For halogens, the electron affinity increases from bottom to top in the periodic table, meaning F_2 has the highest electron affinity and I_2 has the lowest.

---

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

Solution:

Step 1: Understanding the electronic configuration.

The electronic configuration of an element refers to the distribution of electrons in its atomic orbitals. The general rule to write the configuration is the Aufbau principle, Pauli exclusion principle, and Hund's rule.

Step 2: Configuration for Krypton (Kr) with Z = 36.

Krypton (Kr) is a noble gas with atomic number 36. The electron configuration of Kr is:

$$1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6$$

Here, all orbitals are filled up to $4p^6$, which accounts for 36 electrons.

Step 3: Configuration for Xenon (Xe) with Z = 54.

Xenon (Xe) has atomic number 54. The electron configuration of Xe is:

$$1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6\,5s^2\,4d^{10}\,5p^6$$

The configuration follows a similar pattern, filling up to $5p^6$, which accounts for all 54 electrons.

Step 4: Conclusion.

The electronic configurations are:

$$\text{Kr: } 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6$$

$$\text{Xe: } 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^{10}\,4p^6\,5s^2\,4d^{10}\,5p^6$$

Quick Tip

Noble gases like Krypton and Xenon have completely filled electron shells, which are highly stable.

---

5. Discuss the utility of DNA fingerprinting.

Solution:

Step 1: Understanding DNA fingerprinting.

DNA fingerprinting (or DNA profiling) is a technique used to identify individuals based on the unique patterns in their DNA. This method involves comparing specific sequences of DNA to determine genetic differences.

Step 2: Applications of DNA fingerprinting.

DNA fingerprinting has several important uses, including:

- Forensic Science: DNA profiling is widely used in criminal investigations to match DNA found at crime scenes to suspects. This helps to identify perpetrators or exclude innocent individuals from suspicion.

- Paternity Testing: It is used to determine biological relationships, such as confirming paternity.

- Genetic Research: DNA fingerprinting is used in genetic studies to track inherited traits and study biodiversity in species.

- Medical Applications: It helps in diagnosing genetic disorders and in organ transplantation to match donors and recipients.

Step 3: Technology behind DNA fingerprinting.

The process involves extracting DNA from a sample (blood, hair, skin cells, etc.), amplifying it using polymerase chain reaction (PCR), and then analyzing specific regions of the genome that are known to vary among individuals.

Step 4: Conclusion.

DNA fingerprinting is an essential tool in forensic science, medical diagnostics, and genetic research. It helps to accurately identify individuals based on their genetic code, providing valuable information in both legal and scientific contexts.

Quick Tip

DNA fingerprinting is a powerful tool for identifying individuals and studying genetic relationships. Its accuracy and reliability make it invaluable in forensic science and medical research.

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6. Give one example of each of the following:

(i) Synthetic polymer

(ii) Condensation polymer

Solution:

Step 1: Understanding synthetic and condensation polymers.

- Synthetic polymer: A synthetic polymer is a man-made polymer produced through chemical reactions. These polymers are typically derived from petroleum-based monomers.
- Condensation polymer: A condensation polymer is formed through a condensation reaction, where two or more monomers combine with the elimination of a small molecule, usually water.

Step 2: Examples of each type.

(i) Synthetic polymer: An example is Polyethylene (PE), which is made from the polymerization of ethylene monomers.

(ii) Condensation polymer: An example is Nylon-6,6, which is made from the condensation of hexamethylenediamine and adipic acid, eliminating water.

Step 3: Conclusion.

- Synthetic polymer: Polyethylene (PE). - Condensation polymer: Nylon-6,6.

Quick Tip

Synthetic polymers like polyethylene are made from petroleum-based monomers, while condensation polymers like Nylon-6,6 are made by combining monomers with the elimination of a small molecule like water.

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

Solution:

Step 1: Identifying the ores of iron.

Iron is mainly obtained from two ores:

- Hematite: Formula Fe_2O_3 - Magnetite: Formula Fe_3O_4

Step 2: Explanation.

- Hematite is a major ore of iron and consists of iron(III) oxide (Fe_2O_3). - Magnetite contains both iron(II) and iron(III) oxides, with the formula Fe_3O_4.

Step 3: Conclusion.

- Ore 1: Hematite, Fe_2O_3. - Ore 2: Magnetite, Fe_3O_4.

Quick Tip

Hematite and Magnetite are the primary ores of iron, each containing iron oxides in different oxidation states.

---

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

Solution:

Step 1: Understanding cryolite's role.

Cryolite (NaAlF) is used in the extraction of aluminium metal from its ore, bauxite (AlO). Cryolite serves several important functions during electrolysis:

- Lowering the melting point: Cryolite lowers the melting point of aluminium oxide, making it easier to electrolyze. The melting point of AlO is around 2000°C, but with cryolite, it is reduced to about 950°C. - Improving conductivity: Cryolite increases the conductivity of the molten electrolyte, making the electrolytic process more efficient.

Step 2: Conclusion.

Cryolite is used to reduce the melting point and improve the conductivity of the electrolyte during the extraction of aluminium, making the process more efficient and cost-effective.

Quick Tip

Cryolite plays a crucial role in the electrolysis of bauxite for aluminium extraction by lowering the melting point and improving conductivity.

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9. What are network solids? Give an example.

Solution:

Step 1: Understanding network solids.

Network solids (also called covalent solids or giant covalent structures) are solids where atoms are covalently bonded to each other in a continuous network extending in all directions. These solids are characterized by strong covalent bonds throughout the structure.

Step 2: Examples of network solids.

- Diamond: In diamond, each carbon atom is covalently bonded to four other carbon atoms, forming a strong three-dimensional network.

- Graphite: Although graphite is a network solid, the layers of carbon atoms are held together by weaker van der Waals forces, allowing them to slide over each other.

Step 3: Conclusion.

Network solids include materials like diamond and graphite, which feature strong covalent bonds throughout their structure.

Quick Tip

Network solids, like diamond and graphite, have strong covalent bonds in their structures, leading to high melting points and hardness.

---

10. What are Schottky defects? Explain with an example.

Solution:

Step 1: Understanding Schottky defects.

Schottky defects occur in ionic crystals when an equal number of cations and anions are

missing from their lattice positions, creating vacancies. This type of defect maintains the electrical neutrality of the crystal.

Step 2: Example of Schottky defects.

- Example: Sodium chloride (NaCl): In sodium chloride, a Schottky defect would occur if one sodium ion (Na) and one chloride ion (Cl) are missing from their lattice positions, leaving vacancies.

Step 3: Conclusion.

Schottky defects involve the creation of vacancies in ionic crystals, resulting in the absence of both cations and anions in the lattice structure.

Quick Tip

Schottky defects maintain electrical neutrality by creating equal numbers of vacancies for cations and anions in the lattice structure.

---

11. What is mole fraction?

Solution:

Step 1: Defining mole fraction.

Mole fraction is a measure of the concentration of a component in a mixture. It is defined as the ratio of the number of moles of a particular component to the total number of moles of all components in the mixture. The formula for mole fraction is:

$$\text{Mole fraction of component A} = \frac{\text{moles of A}}{\text{total moles of all components}}$$

Step 2: Example.

For a solution containing two components, A and B, the mole fraction of 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. Similarly, for component B:

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

Step 3: Conclusion.

Mole fraction is a dimensionless quantity, and it is often used in calculations involving solutions and gases.

Quick Tip

Mole fraction is the ratio of the moles of a component to the total moles in the mixture and is used in calculating colligative properties.

---

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

Solution:

Step 1: Understanding Raoult's law.

Raoult's law states that the partial vapour pressure of a solvent in a solution is directly proportional to its mole fraction. For a solution containing a non-volatile solute, the relative lowering of vapour pressure can be expressed as:

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

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

Step 2: Application of Raoult's Law.

Raoult's law applies to ideal solutions, where the solute and solvent do not react chemically and follow ideal solution behavior. The relative lowering of vapour pressure is proportional to the concentration of the solute.

Step 3: Conclusion.

Raoult's law of relative lowering of vapour pressure helps in determining the vapor pressure and the concentration of solutes in solutions.

Quick Tip

Raoult's law helps to calculate the lowering of vapour pressure in ideal solutions, which is directly proportional to the mole fraction of the solute.

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13. Discuss electrochemical principle regarding rusting of iron.

Solution:

Step 1: Understanding rusting.

Rusting of iron is an electrochemical process where iron reacts with oxygen and moisture to form iron oxide (rust). It involves both oxidation and reduction reactions. The electrochemical principles behind rusting are as follows:

Step 2: Oxidation half-reaction.

Iron (Fe) at the anode undergoes oxidation, losing electrons:

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

The iron ions Fe^{2+} then react with water and oxygen to form iron (III) oxide (rust).

Step 3: Reduction half-reaction.

At the cathode, oxygen from the air is reduced by gaining electrons:

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

Step 4: Overall reaction.

The overall reaction is the combination of the oxidation and reduction processes:

$$4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$$

which further dehydrates to form rust (iron oxide).

Step 5: Conclusion.

The rusting of iron is a typical example of an electrochemical corrosion process, involving oxidation at the anode and reduction at the cathode, leading to the formation of iron oxide (rust).

Quick Tip

Rusting of iron is an electrochemical process that involves oxidation of iron and reduction of oxygen, leading to the formation of iron oxide (rust).

---

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

Solution:

Step 1: Defining molar conductance.

Molar conductance (Λ_m) is the ability of a solution to conduct electricity, depending on the concentration of ions. It is defined as the conductivity of the solution divided by the molar concentration of the solution.

Step 2: Effect of dilution.

When a solution is diluted, the number of ions per unit volume decreases, but the ionic mobility increases because the ions are more free to move. As a result, the molar conductance increases with dilution. For very dilute solutions, the molar conductance approaches a constant value, known as the limiting molar conductance (Λ_0).

Step 3: Conclusion.

Dilution increases the molar conductance because the ions become more mobile as the concentration decreases. At infinite dilution, molar conductance reaches a limiting value.

Quick Tip

Molar conductance increases with dilution due to the increased mobility of ions in more diluted solutions.

---

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

Solution:

Step 1: Understanding adsorption.

Adsorption is the process where molecules or ions are attracted and accumulate on the surface of a solid or liquid. There are two main types of adsorption: physical adsorption and chemical adsorption.

Step 2: Physical adsorption.

Physical adsorption, also known as physisorption, is caused by weak van der Waals forces between the adsorbate and adsorbent. Key points include: - It is a reversible process. - It occurs at low temperatures. - It does not involve any chemical bond formation. - Adsorption

decreases with increasing temperature.

Step 3: Chemical adsorption.

Chemical adsorption, or chemisorption, involves the formation of strong chemical bonds between the adsorbate and adsorbent. Key points include: - It is an irreversible process. - It occurs at higher temperatures. - It involves the formation of chemical bonds (covalent or ionic). - Adsorption increases with increasing temperature.

Step 4: Conclusion.

- Physical adsorption involves weak forces and is reversible, while chemical adsorption involves strong bonds and is irreversible. - Physical adsorption is temperature-dependent, while chemical adsorption depends on the formation of chemical bonds.

Quick Tip

Physical adsorption is a weak interaction process, while chemical adsorption involves strong covalent or ionic bonds.

---

16. What is Brownian movement?

Solution:

Step 1: Defining Brownian movement.

Brownian movement is the random, erratic motion of particles suspended in a fluid (liquid or gas) resulting from the constant collisions with molecules of the fluid.

Step 2: Explanation.

- Brownian motion was first observed by Robert Brown in 1827. - It occurs because the suspended particles are bombarded by the molecules of the surrounding medium, leading to continuous random movement. - This movement is more pronounced in smaller particles and is directly related to temperature and the viscosity of the medium.

Step 3: Conclusion.

Brownian movement is a result of the continuous bombardment of small particles by molecules of the surrounding medium, exhibiting random motion.

Quick Tip

Brownian motion is a physical phenomenon that shows how small particles move randomly due to molecular collisions.

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17. What is carbyl amine reaction?

Solution:

Step 1: Defining carbyl amine reaction.

The carbyl amine reaction involves the reaction of primary amines with carbonyl compounds (like aldehydes or ketones) to form an isocyanide (carbylamine). It is an important test for the presence of a primary amine group.

Step 2: Chemical equation.

When a primary amine reacts with an aldehyde or ketone in the presence of a base (like sodium hydroxide), an isocyanide (carbyl amine) is formed:

$$\text{R-NH}_2 + \text{R'C} = O \xrightarrow{\text{NaOH}} \text{RNC} + \text{H}_2\text{O}$$

where R and R' represent alkyl or aryl groups.

Step 3: Conclusion.

The carbyl amine reaction is used to detect primary amines and is characterized by the formation of an isocyanide, which has a distinctive smell.

Quick Tip

The carbyl amine reaction is used to test for primary amines, producing an isocyanide with a characteristic smell.

---

18. Write the IUPAC names of the following compounds:

Solution:

Step 1: Identifying the compounds.

The given compounds are: (i) $CH_3 - CH_2 - CH_2 - OH$ (ii) $CH_3 - CH_2 - CH_2 - OH$

Step 2: Naming the compounds.

(i) The compound $CH_3 - CH_2 - CH_2 - OH$ is a straight-chain alcohol. According to IUPAC rules, it is named propan-1-ol. (ii) The compound $CH_3 - CH_2 - CH_2 - OH$ is the same as the first one, hence it is also named propan-1-ol.

Step 3: Conclusion.

- IUPAC name for (i): propan-1-ol. - IUPAC name for (ii): propan-1-ol.

Quick Tip

When naming alcohols, the longest chain containing the hydroxyl group (-OH) is numbered from the end closest to the -OH group.

---

19. Why do transition elements form complex compounds?

Solution:

Step 1: Understanding the transition elements.

Transition elements are elements found in the d-block of the periodic table. These elements have partially filled d orbitals, which allow them to bond with other molecules or ions.

Step 2: Formation of complex compounds.

- Transition metals tend to form complex compounds due to their ability to accept electron pairs from ligands (molecules or ions that can donate electrons). - Their partially filled d orbitals allow them to form coordinate bonds with ligands. - Transition elements have multiple oxidation states, which makes them more likely to form complexes with a variety of ligands. - These complexes are stabilized by the arrangement of ligands around the metal ion, leading to a more stable configuration.

Step 3: Conclusion.

Transition elements form complex compounds because of their ability to accept electron pairs from ligands, their multiple oxidation states, and the stability of the resulting complexes.

Quick Tip

Transition metals form complex compounds due to their partially filled d orbitals and ability to coordinate with ligands.

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20. Explain effective atomic number (EAN).

Solution:

Step 1: Defining effective atomic number.

The effective atomic number (EAN) is the number of electrons that are effectively surrounding the central atom in a coordination complex. It includes the electrons contributed by the central atom and the ligands.

Step 2: Formula for EAN.

The formula to calculate the effective atomic number is:

EAN = Atomic number of central metal atom+Number of electrons donated by ligands−Electrons cont

Step 3: Example.

For example, in the complex $[Ni(CO)_4]$, the effective atomic number is: - Ni has an atomic number of 28. - Each CO ligand donates 2 electrons, so for 4 CO ligands, the total number of electrons donated is $4 \times 2 = 8$. - Therefore, the EAN for $[Ni(CO)_4]$ is:

$$EAN = 28 + 8 = 36$$

Step 4: Conclusion.

The effective atomic number (EAN) is a concept used in coordination chemistry to calculate the total number of electrons in the valence shell of the central metal ion in a complex.

Quick Tip

EAN helps in understanding the stability and bonding of coordination complexes by calculating the effective number of electrons around the central metal atom.

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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 Δ[Product] and Δ[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.
