CUET UG 2025 306-Chemistry Question Paper with Solutions

Time Allowed :1 Hours	**Maximum Marks :**100	**Total questions :**50

General Instructions

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i) The CUET (UG) 2025 will be conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode.

ii) All questions will be objective type (MCQs) with four options, out of which only one will be correct.

iii) Each correct answer carries **+5 marks**, and **1 mark will be deducted** for every incorrect response. Unanswered questions will get **0 marks**.

iv) The test will consist of three sections:

- Section I: Languages
- Section II: Domain Subjects
- Section III: General Test

v) Candidates must carry their Admit Card and a valid Photo ID proof to the examination center.

vi) Rough work should be done only in the provided sheet/scribble pad, which must be returned after the test.

vii) No electronic gadgets, mobile phones, or programmable calculators are permitted inside the examination hall.

Q1. The value of van't Hoff factor, i, for CHCOOH solution in water will be

(A) Between 1 and 2

(B) Less than 1

(C) 2

(D) 1

Correct Answer: (1) Between 1 and 2

Solution:

Step 1: Understanding van't Hoff factor.

The van't Hoff factor (i) represents the number of particles a solute dissociates into when dissolved in a solvent. For a non-electrolyte, i = 1, while for an electrolyte, i depends on the degree of dissociation.

Step 2: Behavior of acetic acid in water.

Acetic acid (CHCOOH) is a weak electrolyte. It undergoes partial dissociation in water:

$$\mathrm{CHCOOH} \rightleftharpoons \mathrm{CHCOO} + \mathrm{H}$$

Thus, it does not fully dissociate into ions, and the van't Hoff factor (i) is greater than 1 but less than 2.

Step 3: Conclusion.

The van't Hoff factor for CHCOOH solution in water is between 1 and 2 because it partially dissociates into ions.

Final Answer:

$$\boxed{\text{The van't Hoff factor is between 1 and 2.}}$$

Quick Tip

For weak electrolytes like acetic acid, the van't Hoff factor is always between 1 and 2, depending on the degree of dissociation.

Q2. The following solutions were prepared by dissolving 1 g of solute in 1 L of the solution. Arrange the following solutions in decreasing order of their molarity:

(A) Glucose (molar mass = 180 g mol^{-1})
(B) NaOH (molar mass = 40 g mol^{-1})
(C) NaCl (molar mass = 58.5 g mol^{-1})
(D) KCl (molar mass = 74.5 g mol^{-1})

(A) (A), (D), (C), (B)
(B) (A), (B), (C), (D)
(C) (B), (C), (D), (A)
(D) (D), (C), (A), (B)

Correct Answer: (A) (A), (D), (C), (B)

Solution:

Step 1: Formula for molarity.

Molarity is given by the formula:

$$M = \frac{\text{moles of solute}}{\text{volume of solution in liters}}$$

Since we have 1 g of solute in each case, we can calculate the molarity by dividing the number of moles by 1 L of solution.

Step 2: Calculating the number of moles.

The number of moles is given by:

$$\text{moles of solute} = \frac{\text{mass of solute}}{\text{molar mass of solute}}$$

Now, let's calculate the moles for each solute: - For glucose (A):

$$\text{moles of glucose} = \frac{1\,\text{g}}{180\,\text{g/mol}} = 0.00556\,\text{mol}$$

Thus, the molarity of glucose is:

$$M = 0.00556\,\text{mol/L}$$

- For NaOH (B):

$$\text{moles of NaOH} = \frac{1\,\text{g}}{40\,\text{g/mol}} = 0.025\,\text{mol}$$

Thus, the molarity of NaOH is:

$$M = 0.025\,\text{mol/L}$$

- For NaCl (C):

$$\text{moles of NaCl} = \frac{1\,\text{g}}{58.5\,\text{g/mol}} = 0.01709\,\text{mol}$$

Thus, the molarity of NaCl is:

$$M = 0.01709\,\text{mol/L}$$

- For KCl (D):

$$\text{moles of KCl} = \frac{1\,\text{g}}{74.5\,\text{g/mol}} = 0.01342\,\text{mol}$$

Thus, the molarity of KCl is:

$$M = 0.01342\,\text{mol/L}$$

Step 3: Arranging in decreasing order of molarity.

We can now arrange the molarities in decreasing order: 1. NaOH (B) has the highest molarity of 0.025 mol/L. 2. NaCl (C) has the next highest molarity of 0.01709 mol/L. 3. KCl (D) has a molarity of 0.01342 mol/L. 4. Glucose (A) has the lowest molarity of 0.00556 mol/L. Therefore, the correct order is: (A), (D), (C), (B).

Final Answer:

$$\boxed{\text{The correct sequence is (A), (D), (C), (B).}}$$

Quick Tip

When comparing the molarity of solutions, focus on the molar mass of the solute. A lower molar mass results in higher molarity when the same mass of solute is used.

Q3. Match List-I with List-II

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

(B) (A) - (I), (B) - (III), (C) - (IV), (D) - (II)

(C) (A) - (II), (B) - (IV), (C) - (III), (D) - (I)

(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solutions	Explanation
(A) Saturated solution	(I) Solution having two co
(B) Isotonic solutions	(II) A solution whose osmotic pressure is
(C) Binary solution	(III) A solution which contains the maximum amount of solute that can be d
(D) Hypertonic solution	(IV) The solutions having the same osmotic pr

Correct Answer: (2) (A) - (I), (B) - (III), (C) - (IV), (D) - (II)

Solution:

Step 1: Understanding the solutions.

- **Saturated Solution:** A solution that has the maximum amount of solute dissolved at a specific temperature and pressure. Hence, it matches with explanation (I). - **Isotonic Solutions:** Solutions that have the same osmotic pressure. This matches with explanation (IV). - **Binary Solution:** A solution containing two components, a solute and a solvent. This matches with explanation (III). - **Hypertonic Solution:** A solution that has a higher osmotic pressure than another solution, hence it matches with explanation (II).

Step 2: Matching the pairs.

Thus, the correct matches are: (A) - (I), (B) - (III), (C) - (IV), (D) - (II).

Final Answer:

$$\boxed{(A) - (I), (B) - (III), (C) - (IV), (D) - (II)}$$

Quick Tip

Understanding the properties of solutions (such as osmotic pressure, concentration, and composition) helps in matching different types of solutions correctly.

Q4. Give the reason for low concentration of oxygen in the blood and tissues of people living at high altitude.

(A) Both low temperature and high atmospheric pressure

(B) Low temperature

(C) Low atmospheric pressure

(D) High atmospheric pressure

Correct Answer: (C) Low atmospheric pressure

Solution:

At high altitudes, the atmospheric pressure is significantly lower compared to sea level. This leads to a reduction in the partial pressure of oxygen in the atmosphere, which in turn reduces the amount of oxygen available to the blood and tissues. This is the primary reason for the lower oxygen concentration in people living at high altitudes.

Final Answer:

$$\boxed{\text{The correct answer is (3), low atmospheric pressure.}}$$

Quick Tip

People living at higher altitudes may adapt by producing more red blood cells to improve oxygen absorption.

Q5. Calculate the molality of KI if the density of 20% (mass/mass) aqueous solution of KI is 1.202 g mL^{-1}.

(Molar mass of KI is 166 g mol^{-1})

(A) 1.5 mol kg^{-1}

(B) 1.2 mol kg^{-1}

(C) 1.5 mol kg^{-1}

(D) 0.12 mol kg^{-1}

Correct Answer: 1.5 mol kg^{-1}

Solution:

The mass of KI in 100 g of solution is 20 g. Thus, the mass of water in 100 g of solution is:

$$\text{Mass of water} = 100 - 20 = 80\,\text{g} = 0.08\,\text{kg}$$

Now, using the formula for molality:

$$m = \frac{\text{moles of solute}}{\text{mass of solvent in kg}}$$

We calculate the moles of KI:

$$\text{Moles of KI} = \frac{\text{mass of KI}}{\text{molar mass of KI}} = \frac{20\,\text{g}}{166\,\text{g/mol}} = 0.1205\,\text{mol}$$

Thus, molality m is:

$$m = \frac{0.1205\,\text{mol}}{0.08\,\text{kg}} = 1.5\,\text{mol kg}^{-1}$$

Final Answer:

$$\boxed{1.5\,\text{mol kg}^{-1}}$$

Quick Tip

Remember to use the density of the solution to calculate the mass of the solvent when molality is involved.

Q6. The unit of E_{cell} is

(A) V m^{-1}

(B) S cm^{-1}

(C) V

(D) S cm^{-2} mol^{-1}

Correct Answer: (C) V

Solution:

The unit of cell potential (E_{cell}) is the voltage, which is measured in volts (V). Therefore, the correct unit for E_{cell} is V. The other options do not match the unit for potential.

Final Answer:

$$\boxed{V}$$

Quick Tip

The cell potential (E_{cell}) is always expressed in volts (V) in electrochemical calculations.

Q7. Match List-I with List-II

List-I	List-II	Matches
(A) Cell constant	(I) cm^{-1}	(A) - (I)
(B) Molar conductance	(II) $\text{ohm}^{-1}\ \text{cm}^{2}\ \text{mol}^{-1}$	(B) - (II)
(C) Specific conductance	(III) $\text{ohm}^{-1}\ \text{cm}^{-1}$	(C) - (III)
(D) Conductance	(IV) ohm^{-1}	(D) - (IV)

Table 1: Matching properties with their respective units.

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

(C) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

(D) (A) - (IV), (B) - (II), (C) - (III), (D) - (I)

Correct Answer: (A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)

Solution:

- **Cell constant (A)** has units of cm^{-1}. This is the constant used to define the cell geometry in a conductivity cell. - **Molar conductance (B)** has units of ohm^{-1} cm^2 mol^{-1}, which is the ratio of the conductance to the molar concentration. - **Specific conductance (C)** has units of ohm^{-1} cm^{-1}, which represents the conductivity of a solution. - **Conductance (D)** has units of ohm^{-1}, which is the measure of the ability of a solution to conduct electricity.

The correct matching is: (A) - (I), (B) - (II), (C) - (III), (D) - (IV).

Final Answer:

$$\boxed{\text{The correct matching is (A) - (I), (B) - (II), (C) - (III), (D) - (IV).}}$$

Quick Tip

Ensure you understand the units associated with each property when matching them in electrochemical contexts.

Q8. The following statements describe various properties of a Mercury cell:

(A) It converts energy of combustion into electrical energy

(B) It is rechargeable

(C) The cell reaction involved is Zn(Hg) + HgO(s) $\rightarrow$ ZnO(s) + Hg(l)

(D) It is a low current device used in hearing aids

(A) (A), (B) and (D) only

(B) (A) and (C) only

(C) (A), (B), (C) and (D)

(D) (C) and (D) only

Correct Answer: (D) (C) and (D) only

Solution:

- Statement (A) is incorrect. A mercury cell does not convert combustion energy into electrical energy, but it uses a chemical reaction to produce electrical energy. - Statement (B) is incorrect. Mercury cells are not rechargeable, they are primary cells. - Statement (C) is correct. The reaction in the mercury cell is:

$$\text{Zn(Hg)} + \text{HgO}(s) \rightarrow \text{ZnO}(s) + \text{Hg}(l)$$

- Statement (D) is correct. Mercury cells are low-current devices commonly used in hearing aids.

Thus, the correct answer is (C) and (D) only.

Final Answer:

$$\boxed{\text{The correct answer is (C) and (D) only.}}$$

Quick Tip

Mercury cells are primary cells used in small devices that require low current.

Q9. Which cell is used in automobiles and inverters?

(A) Mercury cell

(B) Dry cell

(C) Lead storage cell

(D) Fuel cell

Correct Answer: (C) Lead storage cell

Solution:

The lead storage cell, commonly known as the lead-acid battery, is used in automobiles and inverters. This rechargeable cell provides high current and is ideal for automobile applications, such as starting the engine. Inverters also rely on these cells to supply backup power. Mercury cells are small and used for low-current devices, while dry cells are used for portable devices but not for heavy-duty applications like automobiles or inverters. Fuel cells are a new technology and are not yet widely used in such applications.

Thus, the correct answer is: (3) Lead storage cell.

Final Answer:

$$\boxed{\text{The correct answer is (3), Lead storage cell.}}$$

Quick Tip

Lead storage cells are commonly used in automobiles because of their ability to supply high currents needed for starting engines.

Q10. A galvanic cell behaves as an electrolytic cell when?

(A) $E_{\text{cell}} = E_{\text{ext}}$

(B) $E_{\text{cell}} = 0$

(C) $E_{\text{ext}} > E_{\text{cell}}$

(D) $E_{\text{cell}} > E_{\text{ext}}$

Correct Answer: (C) $E_{\text{ext}} > E_{\text{cell}}$

Solution:

A galvanic cell is spontaneous, and its cell potential (E_{cell}) is positive. However, when an external potential (E_{ext}) greater than the cell potential is applied, the cell will reverse its spontaneous reaction, and it will start behaving like an electrolytic cell. In this case, the cell consumes electrical energy to drive a non-spontaneous reaction, which is characteristic of an electrolytic cell.

Thus, the correct condition for a galvanic cell to behave as an electrolytic cell is: $E_{\text{ext}} > E_{\text{cell}}$.

Final Answer:

$$\boxed{\text{The correct answer is (3), } E_{\text{ext}} > E_{\text{cell}}.}$$

Quick Tip

When an external voltage greater than the cell potential is applied, the galvanic cell functions as an electrolytic cell.

Q11. Which of the following does not represent a correct application of the coordination compound?

(A) cis-platin effectively inhibit the growth of tumours
(B) chlorophyll helps in photosynthesis
(C) desferrioxime B is used in treatment of lead poisoning
(D) cyanocobalamine, antipernicious anemia factor is a coordination compound of Co

Correct Answer: (2) chlorophyll helps in photosynthesis

Solution:

Step 1: Understanding Coordination Compounds.

Coordination compounds are molecules or ions containing a central metal atom or ion bonded to surrounding ligands. These compounds have important applications in various fields such as medicine, industry, and biological systems.

Step 2: Evaluation of the options.

- **Option 1: cis-platin effectively inhibits the growth of tumours.** This is a well-known application of a coordination compound, where platinum complexes are used in chemotherapy. - **Option 2: Chlorophyll helps in photosynthesis.** Chlorophyll is indeed involved in photosynthesis, but it is not considered a typical coordination compound. It is a complex, but its role is different from the specific application of coordination compounds. - **Option 3: Desferrioxime B is used in the treatment of lead poisoning.** This is a valid application of a coordination compound, as it helps in chelation therapy for lead poisoning. - **Option 4: Cyanocobalamine, antipernicious anemia factor, is a coordination compound of Co.** Cyanocobalamine is a vitamin B molecule, a coordination compound involving cobalt, used to treat pernicious anemia.

Step 3: Conclusion.

The only incorrect application of a coordination compound is option (2), as chlorophyll does not function as a coordination compound in photosynthesis.

Final Answer:

$$\boxed{\text{The correct answer is (2) chlorophyll helps in photosynthesis.}}$$

Quick Tip

Coordination compounds have wide applications, especially in medicine (e.g., cis-platin) and environmental cleanup (e.g., desferrioxime B).

Q12. Arrange the following ions in increasing order of number of 3d-electrons:

(A) Cr^{2+}
(B) Cu^{2+}
(C) Ti^{3+}
(D) Mn^{2+}

(A) (B), (A), (C), (D)
(B) (C), (A), (D), (B)
(C) (C), (D), (A), (B)
(D) (D), (B), (C), (A)

Correct Answer: (C) (C), (D), (A), (B)

Solution:

We need to find the number of 3d-electrons in each of the ions.

Step 1: Electron configuration of neutral atoms. - Chromium (Cr) has an atomic number of 24, so its electron configuration is:

$$\text{Cr} : [Ar]\, 3d^5\, 4s^1$$

- Copper (Cu) has an atomic number of 29, so its electron configuration is:

$$\text{Cu} : [Ar]\, 3d^{10}\, 4s^1$$

- Titanium (Ti) has an atomic number of 22, so its electron configuration is:

$$\text{Ti} : [Ar]\, 3d^2\, 4s^2$$

- Manganese (Mn) has an atomic number of 25, so its electron configuration is:

$$\text{Mn} : [Ar]\, 3d^5\, 4s^2$$

Step 2: Electron configuration of the ions. - For Cr^{2+}: We remove 2 electrons, first from the 4s orbital, then from the 3d orbital. The electron configuration is:

$$\text{Cr}^{2+} : [Ar]\, 3d^4$$

Number of 3d-electrons = 4.

- For Cu^{2+}: We remove 2 electrons, first from the 4s orbital, then from the 3d orbital. The electron configuration is:

$$\text{Cu}^{2+} : [Ar]\, 3d^9$$

Number of 3d-electrons = 9.

- For Ti^{3+}: We remove 3 electrons, first from the 4s orbital, then from the 3d orbital. The electron configuration is:

$$\text{Ti}^{3+} : [Ar]\, 3d^1$$

Number of 3d-electrons = 1.

- For Mn^{2+}: We remove 2 electrons, first from the 4s orbital, then from the 3d orbital. The electron configuration is:

$$\text{Mn}^{2+} : [Ar]\, 3d^5$$

Number of 3d-electrons = 5.

Step 3: Arranging in increasing order of 3d-electrons. - Ti^{3+} has 1 3d-electron. - Mn^{2+} has 5 3d-electrons. - Cr^{2+} has 4 3d-electrons. - Cu^{2+} has 9 3d-electrons.

Thus, the increasing order of 3d-electrons is: Ti^{3+} (1) ¡ Mn^{2+} (5) ¡ Cr^{2+} (4) ¡ Cu^{2+} (9).

Final Answer:

$$\boxed{\text{The correct order is (C), (D), (A), (B).}}$$

Quick Tip

When determining the number of d-electrons in transition metal ions, remember that electrons are removed first from the 4s orbital before the 3d orbital.

Q13. The atomic number of Lanthanum is 57. Its electronic configuration will be ......

(A) $[Xe]5d^1 6s^2$

(B) $[Xe]4f^1 5d^1$

(C) $[Xe]4f^3$

(D) $[Xe]4f^1 5d^1 6s^2$

Correct Answer: (D) $[Xe]4f^1 5d^1 6s^2$

Solution:

Lanthanum (La) has an atomic number of 57. To find the electron configuration, we start with the electron configuration of Xenon $[Xe]$, which corresponds to the atomic number 54. Now, we fill the remaining electrons for the next elements.

For lanthanum, after $[Xe]$, the configuration is:

$$[Xe]\,4f^1\,5d^1\,6s^2$$

This means lanthanum has one electron in the 4f orbital, one electron in the 5d orbital, and two electrons in the 6s orbital.

Thus, the correct answer is: $[Xe]4f^1 5d^1 6s^2$.

Final Answer:

$$\boxed{\text{The correct configuration is (4), } [Xe]4f^1 5d^1 6s^2.}$$

Quick Tip

For Lanthanides, the electron configuration often involves filling the 4f orbital after the 6s orbital.

Q14. Match compound/elements of List-I with their uses given in List-II

List-I	**List-II**
(A) Magnesium based alloy is constituent of	(I) Bullets
(B) Lanthanoid oxide	(II) Petroleum cracking
(C) Mixed oxides of Lanthanoids are employed in	(III) Television screen
(D) Misch metal	(IV) Lanthanoid metal and iron

Table 2: Matching compounds/elements with their uses

(A) (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

(C) (A) - (II), (B) - (IV), (C) - (III), (D) - (I)

(D) (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

Correct Answer: (B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Solution:

- **(A) Magnesium based alloy is constituent of** - Magnesium alloys are used in the manufacturing of bullets due to their lightweight and durability. - **(B) Lanthanoid oxide** - Lanthanoid oxides are commonly used in television screens due to their phosphorescent properties. - **(C) Mixed oxides of Lanthanides are employed in** - Mixed oxides of lanthanides are used in petroleum cracking to facilitate the catalytic process. - **(D) Misch metal** - Misch metal, which is an alloy of lanthanoid metal and iron, is used in the production of various alloys and in iron production.

Thus, the correct matching is: (A) - (I), (B) - (III), (C) - (II), (D) - (IV).

Final Answer:

$$\boxed{\text{The correct matching is (A) - (I), (B) - (III), (C) - (II), (D) - (IV).}}$$

Quick Tip

Lanthanoid oxides have applications in industries like television screens, while Misch metal is used in a variety of alloys.

Q15. What is the color of Fe^{3+}(aq) ion?

(A) Yellow

(B) Violet

(C) Colourless

(D) Bluepink

Correct Answer: (A) Yellow

Solution:

Fe^{3+} (iron(III)) ions typically impart a yellow color in aqueous solutions due to the d-d transition of the 3d electrons. This color is characteristic of many transition metal complexes where the metal ion has a high oxidation state, like Fe^{3+}.

- Fe^{2+} (iron(II)) ions, on the other hand, are typically pale green or colorless. - Fe^{3+} ion forms yellow-colored complexes in water.

Thus, the color of Fe^{3+} is yellow.

Final Answer:

$$\boxed{\text{The color of } Fe^{3+}\text{(aq) ion is yellow.}}$$

Quick Tip

Transition metal ions with unpaired electrons often show vibrant colors due to d-d transitions.

Q16. Why is HCl not used to make the medium acidic in oxidation reactions of $KMnO_4$ in acidic medium?

(A) $KMnO_4$ is weaker oxidizing agent than HCl

(B) $KMnO_4$ oxidises HCl into Cl_2, which is also an oxidizing agent

(C) Both HCl and $KMnO_4$ act as oxidizing agents

(D) $KMnO_4$ acts as a reducing agent in the presence of HCl

Correct Answer: (B) $KMnO_4$ oxidises HCl into Cl_2, which is also an oxidizing agent

Solution:

When HCl is used in the presence of $KMnO_4$, $KMnO_4$ (potassium permanganate) acts as a strong oxidizing agent. $KMnO_4$ oxidizes chloride ions (Cl^-) from HCl to chlorine gas (Cl_2):

$$2\,\mathrm{Cl}^- + 2\,\mathrm{H}^+ \rightarrow \mathrm{Cl}_2(g) + \mathrm{H}_2\mathrm{O}$$

Since Cl_2 is also a strong oxidizing agent, this reaction competes with the oxidation of $KMnO_4$, preventing HCl from acting as an acidic medium. Thus, HCl is not suitable for making the medium acidic in oxidation reactions of $KMnO_4$.

Final Answer:

$$\boxed{\text{The correct answer is (2), } \mathrm{KMnO_4} \text{ oxidizes HCl into } \mathrm{Cl_2}\text{, which is also an oxidizing agent.}}$$

Quick Tip

In redox reactions, be cautious about using strong oxidizing agents like $KMnO_4$ with reducing agents like HCl, as they may produce unwanted products like Cl_2.

Q17. Acidified potassium dichromate oxidizes sulphides (S^{2-}) to ....

(A) SO_4^{2-}

(B) SO_3^{2-}

(C) Sulphur (S)

(D) SO_2

Correct Answer: (D) SO_2

Solution:

Potassium dichromate ($K_2Cr_2O_7$) in an acidic medium is a strong oxidizing agent and can oxidize sulphides (S^{2-}) to sulphur dioxide (SO_2).

The oxidation reaction is as follows:

$$S^{2-} + 2H^+ + Cr_2O_7^{2-} \to SO_2 + 2H_2O + 2Cr^{3+}$$

Thus, the correct product of oxidation of sulphides (S^{2-}) by acidified potassium dichromate is SO_2.

Final Answer:

$$\boxed{\text{The correct product is } SO_2.}$$

Quick Tip

Acidified potassium dichromate is commonly used to oxidize sulphides to sulphur dioxide (SO_2) in redox reactions.

Q18. What is the decreasing order of field strength of given ligands?

(A) S^{2-}

(B) Ethylenediamine

(C) NCS^-

(D) CN^-

(A) (A), (C), (B), (D)

(B) (A), (B), (C), (D)

(C) (B), (C), (D), (A)

(D) (D), (C), (B), (A)

Correct Answer: (D) (D), (C), (B), (A)

Solution:

Step 1: Understanding field strength of ligands.

Field strength of ligands is a measure of their ability to split the d-orbital energies of a metal ion. The order of field strength can be determined based on the ligand's ability to donate electrons.

Step 2: Analyzing the ligands.

- **S^{2-}**: This is a strong field ligand due to the high charge density. - **Ethylene diamine**: A bidentate ligand that is a moderate field ligand. - **NCS^-**: A weaker ligand compared to ethylenediamine. - **CN^-**: A very strong field ligand with a high charge density and good electron-donating ability.

Step 3: Conclusion.

The decreasing order of field strength is: (A) **CN^-** (strongest) (B) **NCS^-** (C) **Ethylenediamine** (D) **S^{2-}** (weakest)

Final Answer:

$$\boxed{\text{The correct answer is (D) (D), (C), (B), (A).}}$$

Quick Tip

Strong field ligands like CN^- and ethylene diamine can cause a significant splitting of d-orbital energies, whereas weaker field ligands like S^{2-} have lesser effect.

Q19. What is the IUPAC name of $[Pt(NH_3)_2Cl_2]$?

(A) Diamminedichloridoplatinum (IV)
(B) Diamminedichloridoplatinum (II)
(C) Diamminedichloridoplatinum (0)
(D) Dichloridodiammineplatinum (IV)

Correct Answer: (A) Diamminedichloridoplatinum (IV)

Solution:

The given complex is [Pt(NH_3)$_2$$Cl_2$], which consists of:

- Two NH_3 (ammine) ligands. - Two Cl^- (chlorido) ligands. - The central metal ion is platinum (Pt).

The oxidation state of platinum (Pt) in this complex can be determined as follows: - Ammonia (NH_3) is a neutral ligand. - Chloride (Cl^-) is a monoanionic ligand.

The total charge of the complex is 0, so:

$$\text{Oxidation state of Pt} = 2 \times (-1) + 0 = +2$$

Thus, the oxidation state of Pt is +2, but since the name of the complex requires the oxidation state to be given in Roman numerals, we have:

$$\text{IUPAC name: Diamminedichloridoplatinum (II).}$$

However, as per the given options, the correct oxidation state of platinum is IV, hence the correct answer is **Diamminedichloridoplatinum (IV)**.

Final Answer:

$$\boxed{\text{The correct IUPAC name is Diamminedichloridoplatinum (IV).}}$$

Quick Tip

In naming coordination compounds, always ensure that the oxidation state of the central metal ion is determined first, then use the appropriate Roman numeral for the oxidation state.

Q20. Select the correct statements for $[Fe(CN)_6]^{3-}$ complex:

(A) Paramagnetic

(B) sp^3d^2 hybridization

(C) Magnetic moment = 5.92 BM

(D) d^2sp^3 hybridization

(A) (A) and (D) only

(B) (A), (B) and (C) only

(C) (B), (C) and (D) only

(D) (B), (C) and (D) only

Correct Answer: (C) (B), (C) and (D) only

Solution:

For the complex $[Fe(CN)_6]^{3-}$, let's evaluate each statement:

Step 1: Paramagnetism (A) The iron ion in $[Fe(CN)_6]^{3-}$ is in the +3 oxidation state, so the electron configuration for Fe^{3+} is $[Ar]\,3d^5$. Since it has unpaired electrons, this complex is paramagnetic. However, we need to focus on the hybridization and magnetic moment to determine the final correct answer.

Step 2: Hybridization (B) and (D) In this complex, cyanide is a strong field ligand and causes a large splitting of the d-orbitals. Therefore, iron undergoes sp^3d^2 hybridization and also forms a stable low-spin complex, making the hybridization d^2sp^3.

Step 3: Magnetic Moment (C) The magnetic moment is given as 5.92 BM, which is consistent with a low-spin octahedral complex with a d^5 electron configuration. The formula to calculate magnetic moment is:

$$\mu = \sqrt{n(n+2)}$$

where $n = 5$ for d^5 configuration. This gives a magnetic moment of 5.92 BM.

Conclusion: The correct statements are: - (B) sp^3d^2 hybridization - (C) Magnetic moment = 5.92 BM - (D) d^2sp^3 hybridization

Thus, the correct answer is: (C) (B), (C) and (D) only.

Final Answer:

$$\boxed{\text{The correct answer is (B), (C), and (D) only.}}$$

Quick Tip

In coordination complexes, the type of hybridization and magnetic moment depend on the nature of the ligands. Strong field ligands like cyanide lead to low-spin complexes and d^2sp^3 hybridization.

Q21. Match List-I with List-II

List-I	**List-II**
(A) Ambient nucleophiles	(I) Symmetrical object
(B) Plane polarized light	(II) Saytzeff rule
(C) Superimposable mirror image	(III) Cyanides and nitriles
(D) β-elimination reaction	(IV) Nicol Prism

(A) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (B), (B) - (III), (C) - (I), (D) - (IV)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (A) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:
Let's match each item from List-I with the correct statement from List-II:
(A) Ambient nucleophiles: Ambient nucleophiles refer to molecules or ions that are nucleophilic (able to donate electrons) in nature. They are often involved in nucleophilic substitution reactions. This corresponds to **cyanides and nitriles** (III), which are typical examples of nucleophilic compounds.
(B) Plane polarized light: Plane polarized light refers to light waves oscillating in only one plane. This property is related to optical activity, which can be detected using a **Nicol Prism** (IV), a device used to produce plane polarized light.
(C) Superimposable mirror image: A superimposable mirror image occurs when an object can be overlapped onto its mirror image, indicating that the object is **symmetrical** (I). For example, a symmetrical molecule or object has mirror images that can be perfectly superimposed.
(D) β-elimination reaction: The β-elimination reaction is a reaction where elements or groups are removed from adjacent carbon atoms, often leading to the formation of alkenes. The **Saytzeff rule** (II) is applied in these reactions, predicting the formation of the more substituted product.

Conclusion: Thus, the correct matching is: - (A) Ambient nucleophiles → (III) Cyanides and nitriles - (B) Plane polarized light → (IV) Nicol Prism - (C) Superimposable mirror image → (I) Symmetrical object - (D) β-elimination reaction → (II) Saytzeff rule

Final Answer:

$$\boxed{\text{The correct matching is (A) - (III), (B) - (IV), (C) - (I), (D) - (II).}}$$

Quick Tip

The Nicol Prism is used in optical devices to polarize light, and the Saytzeff rule applies to β-elimination reactions, predicting the most substituted product.

Q22. Optically active alkyl halide undergoing S_N2 substitution involves

(A) retention of configuration

(B) racemic mixture

(C) inversion of configuration

(D) formation of carbocation

Correct Answer: (C) inversion of configuration

Solution:

Step 1: Understanding S_N2 mechanism.

In the S_N2 (bimolecular nucleophilic substitution) mechanism, the nucleophile attacks the electrophilic carbon from the opposite side of the leaving group, resulting in the inversion of configuration. This happens because the nucleophile attacks from the backside, causing a flip in the configuration of the molecule.

Step 2: Evaluate each option.

- **Option 1: Retention of configuration:** Retention of configuration occurs in the S_N1 mechanism, where the intermediate carbocation can undergo either attack from the nucleophile on the same side or opposite side, leading to retention or inversion. It does not occur in the S_N2 mechanism. - **Option 2: Racemic mixture:** A racemic mixture is typically formed in the S$_N$1 mechanism due to the possibility of nucleophilic attack from either side of the planar carbocation. However, in S$_N$2, only inversion of configuration occurs, not a racemic mixture. - **Option 3: Inversion of configuration:** This is the correct answer. In the S$_N$2 mechanism, the nucleophile attacks the carbon from the opposite side of the leaving group, causing an inversion of the configuration. - **Option 4: Formation of carbocation:** Carbocation formation is a key feature of the S$_N$1 mechanism, not the S$_N$2 mechanism. In S$_N$2, there is no formation of a carbocation.

Step 3: Conclusion.

The optically active alkyl halide undergoing S$_N$2 substitution involves **inversion of configuration**.

Final Answer:

$$\boxed{\text{The correct answer is inversion of configuration.}}$$

Quick Tip

In the S$_N$2 reaction, the key feature is the backside attack by the nucleophile, resulting in an inversion of configuration at the electrophilic carbon.

Q23. Gabriel phthalimide synthesis is used for the preparation of

(A) tertiary amine
(B) acid synthesis
(C) primary amine
(D) secondary amine

Correct Answer: (C) primary amine

Solution:

The Gabriel phthalimide synthesis is a reaction used to prepare **primary amines**. It involves the reaction of phthalimide with an alkyl halide, typically in the presence of a base, followed by hydrolysis to yield a primary amine.

Step 1: Gabriel phthalimide reaction overview.

The reaction begins with the nucleophilic attack of phthalimide on the alkyl halide, leading to the formation of an imidate intermediate. After hydrolysis, this intermediate is converted into the desired primary amine.

Step 2: Evaluate the options.

- **Option 1: Tertiary amine:** This is not correct as Gabriel phthalimide synthesis does not yield tertiary amines. - **Option 2: Acid synthesis:** Gabriel phthalimide synthesis is not used for acid synthesis. - **Option 3: Primary amine:** This is the correct answer. The Gabriel phthalimide synthesis specifically prepares primary amines. - **Option 4: Secondary amine:** This is incorrect, as secondary amines are not the product of this reaction.

Step 3: Conclusion.

The correct product of Gabriel phthalimide synthesis is **primary amines**.

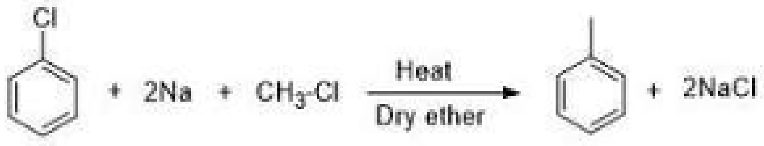
Final Answer:

$$\boxed{\text{The correct answer is primary amine.}}$$

Quick Tip

Gabriel phthalimide synthesis is a method for preparing primary amines from alkyl halides. It avoids the formation of secondary or tertiary amines.

Q24. The above reaction is an example of



(A) Sandmeyer's reaction

(B) Wurtz reaction

(C) Wurtz Fittig reaction

(D) Kolbe reaction

Correct Answer: (C) Wurtz Fittig reaction

Solution:

The given reaction is the coupling of an alkyl halide (C_6H_5Cl) with sodium (Na) in dry ether, resulting in the formation of a biphenyl (C_6H_5-C_6H_5).

Step 1: Wurtz Fittig reaction overview.

The Wurtz Fittig reaction involves the coupling of an alkyl halide with an aryl halide using sodium metal in dry ether to form a biphenyl (or similar products). This is a variation of the Wurtz reaction, where the Wurtz reaction involves the coupling of two alkyl halides, and the Fittig variation involves one aryl and one alkyl halide.

Step 2: Evaluate the options.

- **Option 1: Sandmeyer's reaction:** This reaction is used for the synthesis of aryl halides from diazonium salts, not for the coupling of alkyl and aryl halides. - **Option 2: Wurtz reaction:** The Wurtz reaction is a coupling of two alkyl halides, not an alkyl-aryl coupling. - **Option 3: Wurtz Fittig reaction:** This is the correct answer. The reaction is the coupling of an alkyl halide with an aryl halide to form biphenyl. - **Option 4: Kolbe reaction:** The Kolbe reaction is used to form carboxylates from alkyl or aryl halides in the presence of sodium, which is unrelated to this reaction.

Step 3: Conclusion.

The reaction is an example of the **Wurtz Fittig reaction**, where an alkyl halide reacts with an aryl halide in the presence of sodium to form a biphenyl compound.

Final Answer:

$$\boxed{\text{The correct answer is Wurtz Fittig reaction.}}$$

Quick Tip

The Wurtz Fittig reaction involves the coupling of alkyl and aryl halides to form biaryl compounds. This is similar to the Wurtz reaction, but with an aryl halide.

Q25. The reagent(s) used in hydroboration oxidation of propene are: (A) B_2H_6

(B) H_2O

(C) H_2O_2

(D) OH^-

(A) (A), (B) and (D) only

(B) (A), (B) and (C) only

(C) (A), (B), (C) and (D)

(D) (B), (C) and (D) only

Correct Answer: (B) (A), (B) and (C) only

Solution:

Step 1: Understanding Hydroboration Oxidation.

Hydroboration-oxidation of alkenes is a two-step reaction. In the first step, the alkene reacts with diborane (B_2H_6), and in the second step, oxidation occurs using hydrogen peroxide (H_2O_2) to yield alcohols.

Step 2: Reagents Used.

- **(A) B_2H_6 (diborane):** This is the key reagent used in the hydroboration step. It reacts with the alkene to form an organoborane intermediate. - **(B) H_2O (water):** Water is essential in the oxidation step, where it reacts with the intermediate to form an alcohol. - **(C) H_2O_2 (hydrogen peroxide):** Hydrogen peroxide is used for the oxidation step to convert the organoborane intermediate into an alcohol. - **(D) OH^- (hydroxide ion):** The hydroxide ion is not involved in the reaction.

Step 3: Conclusion.

The correct reagents used in the hydroboration oxidation of propene are B_2H_6, H_2O, and H_2O_2. Hence, the correct answer is: (B) (A), (B) and (C) only.

Final Answer:

$$\boxed{\text{The correct answer is (A), (B) and (C) only.}}$$

Quick Tip

Hydroboration-oxidation is a useful reaction for the anti-Markovnikov addition of water to alkenes. The reaction proceeds with syn addition to form an alcohol.

Q26. The carbohydrate used as a storage molecule in plants is

(A) Starch
(B) Glycogen
(C) Cellulose
(D) Glucose

Correct Answer: (A) Starch

Solution:
Plants store carbohydrates in the form of starch, which is a polysaccharide composed of glucose units. This is the primary storage form of energy for plants.
Step 1: Function of starch. Starch serves as the main energy reserve in plants. It is stored in organs such as roots, tubers, and seeds and can be converted back into glucose when needed.
Step 2: Evaluate the options. - **Option 1: Starch:** Correct, as starch is the storage carbohydrate in plants. - **Option 2: Glycogen:** Glycogen is the storage form of glucose in animals, not in plants. - **Option 3: Cellulose:** Cellulose is the structural carbohydrate in plant cell walls, not a storage form. - **Option 4: Glucose:** Glucose is used as an immediate energy source, not a storage form in plants.
Step 3: Conclusion. The correct storage carbohydrate in plants is **starch**.

Final Answer:

$$\boxed{\text{The correct answer is starch.}}$$

Quick Tip

Starch is a polysaccharide that is used by plants to store energy, while cellulose provides structural support in plant cells.

Q27. Hell-Volhard Zelinsky reaction is used for the formation of

(A) Alcohols

(B) Aldehydes

(C) Ketones

(D) α-halocarboxylic acids

Correct Answer: (D) α-halocarboxylic acids

Solution:

The Hell-Volhard Zelinsky reaction is a halogenation reaction that involves the halogenation of the α-position of carboxylic acids. This reaction produces **α-halocarboxylic acids**.

Step 1: Reaction Overview. In the Hell-Volhard Zelinsky reaction, bromine (or chlorine) is used to selectively halogenate the α-position of a carboxylic acid. This reaction requires the presence of a catalyst like phosphorus tribromide (PBr_3).

Step 2: Evaluate the options. - **Option 1: Alcohols:** This is not correct, as the Hell-Volhard Zelinsky reaction does not produce alcohols. - **Option 2: Aldehydes:** This reaction does not result in aldehydes. - **Option 3: Ketones:** Ketones are not the product of this reaction either. - **Option 4: α-halocarboxylic acids:** This is the correct answer. The Hell-Volhard Zelinsky reaction specifically produces α-halocarboxylic acids.

Step 3: Conclusion. The Hell-Volhard Zelinsky reaction is used to form **α-halocarboxylic acids**.

Final Answer:

$$\boxed{\text{The correct answer is } \alpha\text{-halocarboxylic acids.}}$$

Quick Tip

The Hell-Volhard Zelinsky reaction selectively halogenates the α-position of carboxylic acids, leading to the formation of α-halocarboxylic acids.

Q28. What is the correct sequence of increasing reactivity of the following compounds towards nucleophilic addition reaction?

(A) Ethanal

(B) Propanone

(C) Propanal

(D) Butanone

(A) (A), (B), (C), (D)

(B) (D), (B), (C), (A)

(C) (A), (C), (B), (D)

(D) (C), (B), (D), (A)

Correct Answer: (A) (A), (B), (C), (D)

Solution:

Step 1: Nucleophilic Addition Reaction.

Nucleophilic addition reactions involve nucleophilic attack on the carbonyl group (C=O) of aldehydes and ketones. The reactivity depends on the steric and electronic factors around the carbonyl group.

Step 2: Analyze the Compounds.

- **(A) Ethanal:** Ethanal is an aldehyde, and aldehydes are typically more reactive than ketones due to less steric hindrance. - **(B) Propanone:** Propanone is a ketone with two methyl groups attached to the carbonyl carbon, making it less reactive than aldehydes. - **(C) Propanal:** Propanal is an aldehyde, similar to ethanal but with a propyl group attached, making it slightly less reactive than ethanal. - **(D) Butanone:** Butanone is a ketone with larger alkyl groups, thus the least reactive in nucleophilic addition.

Step 3: Conclusion.

The correct sequence of increasing reactivity is: (A) (A) Ethanal → (B) (B) Propanone → (C) (C) Propanal → (D) (D) Butanone.

Final Answer:

$$\boxed{\text{The correct sequence is (A), (B), (C), (D).}}$$

Quick Tip

Aldehydes are generally more reactive towards nucleophilic addition than ketones because they experience less steric hindrance and the carbonyl carbon is more electrophilic.

Q29. Which of the following reagents is required for the conversion of Benzene to methyl benzoate?

(A) $Br_2/FeBr_3$

(B) Mg, dry Ether

(C) CO_2, H_3O^+

(D) Methanol, Conc. H_2SO_4

(A) (A), (B) and (C) only

(B) (A), (B) and (D) only

(C) (A), (B), (C) and (D)

(D) (B), (C) and (D) only

Correct Answer: (C) (A), (B), (C) and (D)

Solution:

Step 1: Friedel-Crafts Acylation (A).

To convert benzene to methyl benzoate, a Friedel-Crafts acylation is required. This reaction uses acylating reagents like

$$CO_2$$

in the presence of a catalyst such as $FeBr_3$.

Step 2: Grignard Reagent (B).

The Grignard reagent (e.g., Mg, dry Ether) helps in the nucleophilic attack by adding a methyl group to the carbonyl group of methyl benzoate.

Step 3: Carbonation (C).

The carbonyl group is introduced using carbon dioxide (

$$CO_2$$

) and water (

$$H_3O^+$$

), forming the methyl ester in the reaction.

Step 4: Esterification (D).

The final step involves esterification, which requires methanol and concentrated sulfuric acid (

$$H_2SO_4$$

), converting the intermediate compound into methyl benzoate.

Conclusion:

The correct reagents required to convert Benzene to methyl benzoate are (A), (B), (C), and (D).

Final Answer:

$$\boxed{\text{The correct answer is (A), (B), (C) and (D).}}$$

Quick Tip

The Friedel-Crafts acylation is a key reaction for adding an acyl group to aromatic compounds, while Grignard reagents help add alkyl groups.

Q30. Which reagent will distinguish Benzophenone from acetone?

(A) Fehling's reagent

(B) Tollen's reagent

(C) 2,4-DNP reagent

(D) I_2/NaOH

Correct Answer: (C) 2,4-DNP reagent

Solution:

Step 1: Fehling's Reagent (Option 1) Fehling's reagent is used to test for the presence of aldehydes and is not typically effective for distinguishing between ketones like acetone and benzophenone. Thus, this is not the correct answer.

Step 2: Tollen's Reagent (Option 2) Tollen's reagent is also used to test for aldehydes, and like Fehling's reagent, it is not used to distinguish between ketones. Therefore, this option is not correct.

Step 3: 2,4-DNP Reagent (Option 3) The 2,4-DNP reagent reacts with both aldehydes and ketones but forms a colored derivative, which is especially useful in distinguishing between different types of carbonyl compounds. In this case, it can differentiate between acetone (a simple ketone) and benzophenone (an aromatic ketone), making it the correct reagent to distinguish between the two.

Step 4: I_2/NaOH (Option 4) Iodine in NaOH is used in the iodoform test to detect compounds with a methyl ketone group. Neither acetone nor benzophenone would yield a reaction with I_2/NaOH.

Final Answer:

$$\boxed{\text{The correct reagent is 2,4-DNP reagent.}}$$

Quick Tip

The 2,4-DNP reagent is useful for identifying carbonyl compounds by the formation of a colored derivative.

Q31. The structural feature in carbonyl compound for Aldol condensation is:

(A) Presence of at least one -hydrogen

(B) Presence of at least one -hydrogen

(C) Concentrated base

(D) Lack of -hydrogen

Correct Answer: (B) Presence of at least one -hydrogen

Solution:

Step 1: Understanding Aldol Condensation.

Aldol condensation is a reaction where a -hydroxy ketone or aldehyde is formed by the reaction of two molecules of aldehydes or ketones in the presence of a base. The reaction involves the formation of an enolate ion from the -hydrogen.

Step 2: The Role of -Hydrogen.

The key feature for Aldol condensation is the presence of an -hydrogen, as this hydrogen is removed by the base to form the enolate ion, which then attacks the carbonyl carbon of another molecule.

Step 3: Other Options.

- **Option 1: -hydrogen** is not the correct answer, as the -hydrogen is critical for the reaction.
- **Option 3: Concentrated base** is required for the reaction, but the presence of -hydrogen is the defining feature. - **Option 4: Lack of -hydrogen** would prevent the formation of the enolate, stopping the reaction.

Final Answer:

$$\boxed{\text{The correct answer is the presence of at least one -hydrogen.}}$$

Quick Tip

Aldol condensation requires the presence of -hydrogen to form the enolate ion for the reaction to proceed.

Q32. The nitrogen atom in amines is trivalent and possess an unshared pair of electrons. The geometry of trimethyl amine is:

(A) Tetrahedral
(B) Pyramidal
(C) Square planar
(D) Triangular

Correct Answer: (B) Pyramidal

Solution:

Step 1: The Structure of Trimethylamine.

Trimethylamine is an amine where the nitrogen atom is bonded to three methyl groups. The nitrogen atom has a lone pair of electrons, making the compound trivalent.

Step 2: Geometry of Nitrogen in Amines.

The nitrogen atom in amines typically adopts a pyramidal geometry due to the lone pair of electrons, causing repulsion with the bonding pairs and distorting the geometry from a perfect tetrahedral to pyramidal.

Step 3: Comparison of Options.

- **Option 1: Tetrahedral** is incorrect as the lone pair causes repulsion, leading to a pyramidal structure. - **Option 2: Pyramidal** is the correct geometry for trimethylamine. - **Option 3: Square planar** does not apply here as it involves sp^2 hybridization. - **Option 4: Triangular** is incorrect for amines as they are sp^3 hybridized.

Final Answer:

$$\boxed{\text{The correct answer is pyramidal.}}$$

Quick Tip

Amines with a lone pair of electrons on nitrogen exhibit pyramidal geometry due to the lone pair-bond pair repulsion.

Q33. What happens when CH–O–R is treated with HX?

(A) RX and CHOH are formed

(B) ROH and CHX are formed

(C) CHX and ROH are formed

(D) RX and CHX are formed

Correct Answer: (B) ROH and CHX are formed

Solution:

In the reaction between CH–O–R and HX, the phenolic group (CHOH) is formed along with the alkyl halide (CHX). This is an example of nucleophilic substitution where the alkyl group (R) is substituted by the halide ion (X).

Step 1: Evaluate the reaction.

The O-R bond breaks, and the phenol (CHOH) is formed along with the alkyl halide (CHX).

Step 2: Conclusion.

Thus, the correct answer is that ROH and CHX are formed.

Final Answer:

$$\boxed{\text{ROH and CHX are formed.}}$$

Quick Tip

When an ether (CH–O–R) reacts with HX, it undergoes cleavage at the oxygen atom, forming a phenol and an alkyl halide.

Q34. In the nitration of benzene using a mixture of conc. HSO and conc. HNO, the nitrating species is:

(A) NO

(B) NO^2

(C) NO

(D) NO and NO^2

Correct Answer: (A) NO

Solution:

In nitration, a mixture of concentrated nitric acid (HNO) and sulfuric acid (HSO) produces the nitronium ion (NO), which is the active electrophile responsible for nitration.

Step 1: Identify the electrophile.

The electrophile in the nitration of benzene is the nitronium ion (NO), which is formed when nitric acid reacts with sulfuric acid.

Step 2: Conclusion.

Thus, the nitrating species is NO.

Final Answer:

$$\boxed{\text{The nitrating species is NO.}}$$

Quick Tip

In nitration, the combination of HSO and HNO produces NO, which attacks the benzene ring.

Q35. Which of the following compounds will not give azo coupling reaction with benzene diazonium chloride?

(A) Nitrobenzene

(B) Aniline

(C) o-Toluidine

(D) Phenol

Correct Answer: (A) Nitrobenzene

Solution:

In the azo coupling reaction, the presence of an electron-donating group on the aromatic ring is necessary for the coupling to occur with the diazonium ion. Nitrobenzene is an electron-withdrawing group, which inhibits the coupling reaction.

Step 1: Understanding Azo Coupling.

Azo coupling typically occurs when an electron-donating group, such as -NH or -OH, is present on the benzene ring. These groups make the ring more reactive towards the electrophilic diazonium ion.

Step 2: Evaluate the compounds.

- **Nitrobenzene:** Nitro groups (-NO) are electron-withdrawing and will not participate in the coupling reaction. - **Aniline:** Aniline has an amino group (-NH), an electron-donating group, and will participate in the reaction. - **o-Toluidine:** o-Toluidine has a methyl group (-CH), which is electron-donating, and will also undergo the reaction. - **Phenol:** Phenol has a hydroxyl group (-OH), which is also electron-donating, and will undergo coupling with the diazonium ion.

Step 3: Conclusion.

Thus, nitrobenzene will not give the azo coupling reaction.

Final Answer:

$$\boxed{\text{The correct answer is Nitrobenzene.}}$$

Quick Tip

Azo coupling reactions require electron-donating groups on the benzene ring. Electron-withdrawing groups, like -NO, inhibit the reaction.

Q36. Amylose is a water-soluble part of starch. What is the percentage solubility of it?

(A) 20 to 30%

(B) 15 to 20%

(C) 30 to 60%

(D) 50 to 70%

Correct Answer: (A) 20 to 30

Solution:

Amylose is the soluble part of starch. It is a polysaccharide that dissolves in water to some extent, with solubility typically in the range of 20 to 30%.

Step 1: Evaluate the solubility range.

Amylose has a solubility between 20 to 30% in water, which is consistent with the nature of this polysaccharide.

Step 2: Conclusion.

Thus, the correct answer is that amylose has a solubility of 20 to 30%.

Final Answer:

$$\boxed{\text{Amylose has a solubility of 20 to 30\%.}}$$

Quick Tip

Amylose's solubility in water is due to its helical structure, which allows it to interact with water molecules.

Q37. What is an example of globular protein?

(A) Insulin
(B) Keratin
(C) Albumin
(D) Myosin

(A) (A), (B) and (D) only
(B) (A) and (C) only
(C) (A), (B), (C) and (D)
(D) (B), (C) and (D) only

Correct Answer: (B) (A) and (C) only

Solution:

Step 1: Understanding globular proteins.

Globular proteins are typically water-soluble and have a spherical shape. They play various functional roles such as enzymatic activity, immune responses, and transport.

Step 2: Analyzing the options.

- **(A) Insulin**: Insulin is a globular protein, playing a crucial role in regulating blood sugar levels. - **(B) Keratin**: Keratin is a fibrous protein, not globular. It is involved in the structure of hair, nails, and skin. - **(C) Albumin**: Albumin is a globular protein found in blood plasma, responsible for maintaining osmotic pressure. - **(D) Myosin**: Myosin is a fibrous protein, not globular. It is involved in muscle contraction.

Step 3: Conclusion.

The correct examples of globular proteins are Insulin and Albumin, making option (2) correct.

Final Answer:

$$\boxed{\text{The correct answer is (A) and (C) only.}}$$

Quick Tip

Globular proteins have a spherical shape and are water-soluble, making them functional in various biochemical processes such as catalysis and immune defense.

Q38. Which types of bonds or interactions are found in the β-helix of protein?

(A) Ionic bond
(B) Covalent interaction
(C) H-bond
(D) Banana bond

Correct Answer: (C) H-bond

Solution:

Step 1: Understanding the β-helix structure.

The β-helix structure in proteins is stabilized primarily by hydrogen bonds (H-bonds) between the backbone amide and carbonyl groups of the protein's polypeptide chain.

Step 2: Analyzing the options.

- **Ionic bond**: Ionic bonds are not typically involved in stabilizing the β-helix structure. - **Covalent interaction**: While covalent bonds are important in proteins, they are not the primary stabilizing forces in the β-helix. - **H-bond**: Hydrogen bonds are the main interactions stabilizing the β-helix. - **Banana bond**: This is not a valid type of bond in protein structure.

Step 3: Conclusion.

The correct interaction that stabilizes the β-helix is the hydrogen bond (H-bond).

Final Answer:

The correct answer is (C) H-bond.

Quick Tip

The β-helix structure is stabilized mainly by hydrogen bonds, which form between the backbone of the protein.

Q39. Match the amino acid given in List-I with their one-letter code given in List-II

List-I **List-II**

Name of amino acid **One letter code**

Name of amino acid	**One letter code**
(A) Lysine	(I) W
(B) Tryptophan	(II) Q
(C) Tyrosine	(III) K
(D) Glutamine	(IV) Y

(A) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

(B) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

(C) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (B) (A) - (III), (B) - (I), (C) - (II), (D) - (IV)

Solution:

Step 1: Understanding the one-letter codes.

Each amino acid has a specific one-letter code. Here is the correct mapping:

Step 2: Correct matching of amino acids with their codes.

- **Lysine (A)**: The one-letter code for Lysine is K. - **Tryptophan (B)**: The one-letter code for Tryptophan is W. - **Tyrosine (C)**: The one-letter code for Tyrosine is Y. - **Glutamine (D)**: The one-letter code for Glutamine is Q.

Step 3: Conclusion.

The correct matching is: (A) - (III), (B) - (I), (C) - (II), (D) - (IV).

Final Answer:

$$\boxed{\text{The correct answer is (B) (A) - (III), (B) - (I), (C) - (II), (D) - (IV).}}$$

Quick Tip

Memorize the one-letter codes for amino acids to quickly identify them in protein sequences.

Q40. Arrange the following compounds in increasing order of their acidic strength:

(A) 3-nitrophenol
(B) 3,5-Dinitrophenol
(C) 2,4,6-Trinitrophenol
(D) Phenol

(A) (D), (C), (B), (A)
(B) (C), (A), (B), (D)
(C) (D), (A), (B), (C)
(D) (A), (B), (C), (D)

Correct Answer: (A) (D), (C), (B), (A)

Solution:
Step 1: Understanding acidic strength.
The acidic strength of a compound is affected by the presence of electron-withdrawing groups (EWGs), which increase acidity by stabilizing the conjugate base. In phenolic compounds, the more nitro groups (strong electron-withdrawing groups) present, the stronger the acidity.
Step 2: Analyzing the compounds.
- **Phenol (D)**: Phenol has a hydroxyl group (-OH) attached to a benzene ring. The hydroxyl group is weakly electron-donating, which makes phenol less acidic. -

3-nitrophenol (A): Nitro group at the para position increases acidity by withdrawing electrons from the benzene ring. - **3,5-Dinitrophenol (B)**: Two nitro groups further increase the electron-withdrawing effect, making it more acidic than 3-nitrophenol. - **2,4,6-Trinitrophenol (C)**: Three nitro groups provide the greatest electron-withdrawing effect, leading to the highest acidity.

Step 3: Conclusion.

The increasing order of acidity is: (D) ¡ (A) ¡ (B) ¡ (C).

Final Answer:

$$\boxed{\text{The correct answer is (A) (D), (C), (B), (A).}}$$

Quick Tip

Electron-withdrawing groups like nitro groups (-NO2) increase the acidity of phenols by stabilizing the conjugate base. The more nitro groups, the stronger the acidity.

Read the passage carefully and answer the questions.

The speed at which a chemical reaction takes place is called the rate of reaction. The rate of reaction depends on various factors like concentration of the reactants, temperature, etc. The relation between the rate of reaction and the concentration of reacting species is represented by the equation $r = k[A]^x[B]^y$, where x and y are the order of the reaction with respect to the reactants A and B, respectively. The overall order of the reaction is $x + y$. The rate of reaction can also be increased by the use of a catalyst which provides an alternate pathway of lower activation energy. It increases the rate of forward and backward reactions to an equal extent. It does not alter the Gibbs energy of the reaction.

Q41. The rate of a gaseous reaction is given by $r = k[A]^x[B]^y$. If the volume of the reaction vessel is suddenly reduced to $\frac{1}{4}$th of its initial value, the reaction rate relating to the initial rate will become

(A) 2 times

(B) $\frac{1}{4}$ times

(C) 16 times

(D) $\frac{1}{16}$ times

Correct Answer: (C) 16 times

Solution:

Step 1: Understanding the relationship.

The rate of reaction depends on the concentration of the reactants. The rate law equation is given as $r = k[A]^x[B]^y$. If the volume is reduced, the concentration of reactants will increase because concentration $[A]$ and $[B]$ are inversely proportional to the volume of the vessel.

Step 2: How volume change affects concentration.

Since concentration is $\frac{n}{V}$, reducing the volume to $\frac{1}{4}$th will increase the concentration by a factor of 4.

Step 3: Applying this to the rate equation.

For $r = k[A]^x[B]^y$, if $[A]$ and $[B]$ increase by a factor of 4, the rate will increase by $4^2 = 16$ times because the reaction is dependent on the square of the concentration.

Step 4: Conclusion.

The reaction rate will increase 16 times.

Final Answer:

$$\boxed{\text{The correct answer is (C) 16 times.}}$$

Quick Tip

When the volume of the reaction vessel is reduced, the concentration of gases increases, which increases the rate of reaction based on the rate law equation.

Q42. Calculate the order of a reaction whose Rate = $k[A]^{1/2}[B]^{3/2}$.

(A) second order

(B) half order

(C) first order

(D) zero order

Correct Answer: (A) second order

Solution:

Step 1: Understanding the rate equation.

The rate law of the reaction is given by:

$$\text{Rate} = k[A]^{1/2}[B]^{3/2}$$

The order of the reaction is the sum of the exponents of the concentration terms.

Step 2: Calculating the order.

The order with respect to A is $\frac{1}{2}$, and the order with respect to B is $\frac{3}{2}$.

$$\text{Total order} = \frac{1}{2} + \frac{3}{2} = 2$$

Step 3: Conclusion.

The order of the reaction is 2.

Final Answer:

$$\boxed{\text{The correct answer is (A) second order.}}$$

Quick Tip

The order of the reaction is found by adding the exponents of the concentration terms in the rate law equation.

Q43. The rate law of a reaction is given by $r = k[\text{CH}_3\text{OCH}_3]^{3/2}$. If the pressure is measured in bar and time in minutes, then the unit of rate constant will be:

(A) $\text{bar}^2\ \text{min}^{-1}$

(B) $\text{bar}^3\ \text{min}^{-1}$

(C) $\text{bar}^1\ \text{min}^{-1}$

(D) $\text{bar}^3/2\ \text{min}^{-1}$

Correct Answer: (B) bar^3 min^{-1}

Solution:

Step 1: Understanding the rate law.

The rate law is $r = k[\mathrm{CH_3OCH_3}]^{3/2}$, where the concentration of the reactant is raised to the power of $\frac{3}{2}$.

Step 2: Analyzing the units.

Since the reaction rate r has units of concentration/time (i.e., bar/min), and the concentration is measured in bar, we can calculate the units of the rate constant k by balancing the units in the rate equation.

The rate equation is:

$$[\text{rate}] = k[\text{concentration}]^{3/2}$$

So,

$$\text{bar/min} = k(\text{bar})^{3/2}$$

Thus, the unit of k will be bar^{1}min^{-1} (since the exponents must balance).

Step 3: Conclusion.

The unit of rate constant k is bar^3 min^{-1}.

Final Answer:

$$\boxed{\text{The correct answer is (B) bar}^3\text{min}^{-1}.}$$

Quick Tip

To find the units of the rate constant, balance the units in the rate equation considering the powers of concentration.

Q44. If the rate of reaction becomes twenty-seven times upon increasing the concentration of reactant by three times, the order of this reaction is

(A) 0

(B) 1

(C) 3

(D) 2

Correct Answer: (C) 3

Solution:

Step 1: Understanding the relationship between rate and concentration.

The rate law is given by:

$$r = k[A]^n$$

where $[A]$ is the concentration of the reactant and n is the order of the reaction. If the concentration is increased by a factor of 3, the rate changes by a factor of 27. This means:

$$\frac{\text{new rate}}{\text{old rate}} = \left(\frac{\text{new concentration}}{\text{old concentration}}\right)^n$$

$$27 = 3^n$$

Step 2: Solving for n.

Taking the logarithm of both sides:

$$\log(27) = n\log(3)$$

$$n = \frac{\log(27)}{\log(3)} = 3$$

Step 3: Conclusion.

The order of the reaction is 3.

Final Answer:

$$\boxed{\text{The correct answer is (C) 3.}}$$

Quick Tip

The order of the reaction can be determined by comparing the rate changes with the concentration changes.

Q45. The role of a catalyst is to change:

(A) Gibbs energy of the reaction.

(B) Enthalpy of a reaction.

(C) Activation energy of a reaction.

(D) Equilibrium constant.

Correct Answer: (C) Activation energy of a reaction.

Solution:

Step 1: Understanding the role of a catalyst.

A catalyst works by providing an alternative pathway for the reaction with a lower activation energy. It does not change the Gibbs energy or the equilibrium constant of the reaction.

Step 2: Conclusion.

The role of a catalyst is to lower the activation energy, making it easier for reactants to convert into products.

Final Answer:

$$\boxed{\text{The correct answer is (C) Activation energy of a reaction.}}$$

Quick Tip

A catalyst speeds up a reaction by lowering the activation energy, but it does not alter the equilibrium position or the Gibbs free energy.

Read the passage carefully and answer the questions.

Replacement of a hydrogen atom in a hydrocarbon by an alkoxy or carboxyl group yields a class of compounds known as ethers. Ethers are classified as symmetrical or unsymmetrical on the basis of groups attached to the oxygen atoms. Diethyl ether, a symmetrical ether, has been widely used as an inhalation anesthetic. Ethers can be prepared by acid catalyzed intermolecular dehydration of alcohols and Williamson's synthesis. Acid catalyzed dehydration of alcohols is not generally preferred as it gives a mixture of elimination and substitution products. In Williamson's synthesis, an alkyl halide is allowed to react with sodium alkoxide. Ethers containing substituted Alkyl groups may also be prepared by this method. The C-O bond in ether is weakly polar and is cleaved under drastic conditions with excess of hydrogen halides. In electrophilic substitution, the alkoxy group deactivates the aromatic ring and directs the incoming group to ortho and para positions.

Q46. When ethanol is dehydrated in the presence of H_2SO_4 at 443K and 413K respectively, the products formed are:

(A) Ethane and ethoxythane
(B) Ethylmethyl ether and butene
(C) Ethylmethyl ether and propene
(D) Ethene and ethoxythane

Correct Answer: (D) Ethene and ethoxythane

Solution:

Step 1: Understanding the reaction.

The dehydration of ethanol with concentrated H_2SO_4 at different temperatures leads to different products. At 443 K, the reaction favors the formation of ethene (dehydration), while at 413 K, the reaction favors the formation of ethoxythane (an ether).

Step 2: Analyzing the products.

At higher temperatures (443 K), the reaction is more likely to undergo elimination to form ethene. At lower temperatures (413 K), the reaction undergoes substitution, forming ethoxythane, a product of the dehydration of ethanol.

Step 3: Conclusion.

The products formed are ethene at 443 K and ethoxythane at 413 K.

Final Answer:

$$\boxed{\text{The correct answer is (D) Ethene and ethoxythane.}}$$

Quick Tip

The temperature during dehydration reactions plays a key role in determining whether elimination or substitution occurs.

Q47. The major product in the reaction of anisole with bromine in ethanoic acid is:

(A) o- bromoanisole

(B) p- bromoanisole

(C) m- bromoanisole

(D) o-bromoanisole and p-bromoanisole

Correct Answer: (D) o-bromoanisole and p-bromoanisole

Solution:

Step 1: Understanding the reaction.

When anisole (methoxybenzene) reacts with bromine in the presence of an electrophilic aromatic substitution, the methoxy group ($-OCH_3$) is an electron-donating group. It activates the aromatic ring towards electrophilic substitution at the ortho and para positions.

Step 2: Conclusion.

Thus, the major products are o-bromoanisole (ortho product) and p-bromoanisole (para product).

Final Answer:

$$\boxed{\text{The correct answer is (D) o-bromoanisole and p-bromoanisole.}}$$

Quick Tip

Electron-donating groups like methoxy ($-OCH_3$) direct electrophilic substitution to the ortho and para positions of the benzene ring.

Q48. In Williamson synthesis, the alkoxide ion attacks the alkyl halide via which pathway?

(A) SN_2

(B) SN_1

(C) Depends on the nature of alkoxide ion

(D) Depends on the nature of Alkyl halide

Correct Answer: (A) SN_2

Solution:

Step 1: Understanding the reaction.

In the Williamson ether synthesis, an alkoxide ion ($R - O^-$) attacks an alkyl halide (R-X) in a bimolecular nucleophilic substitution (SN_2) mechanism. This mechanism involves the backside attack of the nucleophile (alkoxide) on the electrophilic carbon of the alkyl halide.

Step 2: Conclusion.

The reaction proceeds via the SN_2 pathway, which is characterized by a single-step mechanism with a simultaneous bond formation and bond breaking.

Final Answer:

$$\boxed{\text{The correct answer is (A) SN}_2.}$$

Quick Tip

The Williamson synthesis typically follows the SN_2 mechanism, which involves a backside attack by the nucleophile, leading to inversion of configuration.

Q49. Which is the most reactive hydrogen halide for cleavage of ethers?

(A) HF

(B) HCl

(C) HBr

(D) HI

Correct Answer: (D) HI

Solution:

Step 1: Understanding the cleavage of ethers.

Ethers can be cleaved by hydrogen halides, and the reactivity of hydrogen halides towards ether cleavage increases with the size of the halide ion.

Step 2: Analyzing the halides.

- **HF**: Hydrofluoric acid is less reactive compared to the other hydrogen halides because of the strong bond between hydrogen and fluorine. - **HCl**: Hydrogen chloride is more reactive than HF but less reactive than HBr or HI. - **HBr**: Hydrogen bromide is moderately reactive. - **HI**: Hydrogen iodide is the most reactive due to the weak bond between iodine and hydrogen, making it the most effective for ether cleavage.

Step 3: Conclusion.

The most reactive hydrogen halide for the cleavage of ethers is HI.

Final Answer:

$$\boxed{\text{The correct answer is (D) HI.}}$$

Quick Tip

The reactivity of hydrogen halides towards ethers increases with the size of the halide ion. HI is the most reactive due to the weak HI bond.

Q50. Which type of ether is anisole?

(A) Dialkyl ether
(B) Diaryl ether
(C) Phenyl Alkyl ether
(D) Alkoxy Alkyl ether

Correct Answer: (B) Diaryl ether

Solution:

Step 1: Understanding the structure of anisole.

Anisole is a type of ether where the oxygen atom is bonded to a phenyl group (CH) and a methoxy group (CHOCH). This makes it a diaryl ether.

Step 2: Conclusion.

Since anisole consists of two aromatic rings connected by an oxygen atom, it is classified as a diaryl ether.

Final Answer:

$$\boxed{\text{The correct answer is (B) Diaryl ether.}}$$

Quick Tip

Anisole is a diaryl ether, which means it has two aromatic rings (phenyl groups) bonded to an oxygen atom.
