NEET-UG Chemistry Sample Paper-1

Duration: 1 Hour **Maximum Marks: 180**

Instructions

- This paper contains a total of 45 Multiple Choice Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. A 5.0 L flask contains 2 g of H_2, 8 g of O_2, and 7 g of N_2. If the total pressure of the mixture is P, what is the partial pressure of O_2?

(A) $P/3$

(B) $P/5$

(C) $P/7$

(D) $P/9$

Q2. The number of angular nodes and radial nodes for a 4d orbital are respectively:

(A) 2, 1

(B) 1, 2

(C) 3, 0

(D) 2, 2

Q3. The wavelength of the radiation emitted when an electron falls from $n = 3$ to $n = 2$ in a hydrogen atom is λ. The wavelength for the same transition in Li^{2+} is:

(A) 9λ

(B) 3λ

(C) $\lambda/3$

(D) $\lambda/9$

Q4. For the reaction $X_2O_4(l) \rightarrow 2XO_2(g)$, $\Delta U = 2.1$ kcal, $\Delta S = 20$ cal/K at 300 K. The value of ΔG is:

(A) -2.7 kcal

(B) 2.7 kcal

(C) -9.3 kcal

(D) 9.3 kcal

Q5. When 0.1 mol of MnO_4^{2-} is oxidized, the quantity of electricity required to completely oxidize it to MnO_4^- is:

(A) 96500 C

(B) 9650 C

(C) 965 C

(D) 2×96500 C

Q6. An aqueous solution of a substance gives a white precipitate with $BaCl_2$, which is insoluble in HCl. The substance is:

(A) Na_2CO_3

(B) Na_2SO_4

(C) $NaCl$

(D) $AgNO_3$

Q7. 1.0 g of magnesium is burnt with 0.56 g of O_2 in a closed vessel. Which reactant is left in excess and how much? (At. wt. $Mg = 24, O = 16$)

(A) Mg, 0.16 g

(B) O_2, 0.16 g

(C) Mg, 0.44 g

(D) O_2, 0.28 g

Q8. The correct order of acid strength for the following is:

(I) FCH_2COOH
(II) $ClCH_2COOH$
(III) $BrCH_2COOH$
(IV) CH_3COOH

(A) I > II > III > IV

(B) IV > III > II > I

(C) I > III > II > IV

(D) II > I > III > IV

Q9. The rate constant for a first-order reaction is 4.606×10^{-3} s^{-1}. The time required to reduce 2.0 g of the reactant to 0.2 g is:

(A) 200 s

(B) 500 s

(C) 1000 s

(D) 100 s

Q10. Which of the following ions will exhibit the highest value of molar conductance in an aqueous solution?

(A) Li^+

(B) Na^+

(C) K^+

(D) Rb^+

Q11. If the rate of the reaction $A + B \rightarrow Products$ is given by $r = k[A]^2[B]^{1/2}$, then the overall order of the reaction is:

(A) 2

(B) 1.5

(C) 2.5

(D) 0

Q12. The depression in freezing point of 0.01 M aqueous CH_3COOH solution is 0.0204 °C. 1 molal urea solution freezes at −1.86 °C. Assuming molarity = molality, the pH of the CH_3COOH solution is:

(A) 2

(B) 3

(C) 4

(D) 5

Q13. The IUPAC name of the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is:

(A) Diamminechlorido(methylamine)platinum(II) chloride

(B) Diammine(methylamine)chloridoplatinum(II) chloride

(C) Diamminechloridomethylaminoplatinum(II) chloride

(D) Diamminechlorido(methylamine)platinum(IV) chloride

Q14. Which of the following compounds is most reactive toward nucleophilic addition?

(A) CH_3CHO

(B) $PhCHO$

(C) $PhCOPh$

(D) CH_3COCH_3

Q15. The freezing point of a solution containing 0.1 g of $K_3[Fe(CN)_6]$ (Mol. wt. 329) in 100 g of water (K_f = 1.86 K kg mol^{-1}) is:

(A) -2.3×10^{-2} °C

(B) -5.7×10^{-2} °C

(C) -1.2×10^{-2} °C

(D) -3.3×10^{-2} °C

Q16. In the cubic close packing, the unit cell has:

(A) 4 atoms

(B) 2 atoms

(C) 1 atom

(D) 6 atoms

Q17. Reaction of phenol with $CHCl_3$ and $NaOH$ followed by acidification gives salicylaldehyde. The intermediate of this reaction is:

(A) Carbene

(B) Carbonium ion

(C) Carbanion

(D) Free radical

Q18. Which of the following exhibits the greatest coagulation power towards a As_2S_3 colloidal sol?

(A) $AlCl_3$

(B) $MgCl_2$

(C) $NaCl$

(D) K_2SO_4

Q19. The number of P-O-P bonds in cyclic metaphosphoric acid is:

(A) 2

(B) 3

(C) 4

(D) 0

Q20. Which of the following is an example of an outer orbital complex?

(A) $[Fe(CN)_6]^{4-}$

(B) $[Fe(H_2O)_6]^{3+}$

(C) $[Co(NH_3)_6]^{3+}$

(D) $[Mn(CN)_6]^{4-}$

Q21. The bond angle in H_2O is 104.5°, which is less than the tetrahedral angle of 109.5°. This is due to:

(A) lp-lp repulsion > lp-bp repulsion

(B) lp-bp repulsion > bp-bp repulsion

(C) lp-lp repulsion > bp-bp repulsion

(D) All of the above

Q22. A first-order reaction has a rate constant $k = 10^{-2}\ s^{-1}$. How much time will it take for 20 g of this reactant to reduce to 5 g?

(A) 138.6 s

(B) 230.3 s

(C) 693.0 s

(D) 346.5 s

Q23. The geometry of XeF_6 is:

(A) Octahedral

(B) Distorted Octahedral

(C) Planar

(D) Pyramidal

Q24. Which of the following will show optical isomerism?

(A) $[Co(en)_3]^{3+}$

(B) $cis - [Co(en)_2Cl_2]^+$

(C) $trans - [Co(en)_2Cl_2]^+$

(D) Both A and B

Q25. The solubility of $AgCl(s)$ with solubility product 1.6×10^{-10} in 0.1 M $NaCl$ solution would be:

(A) 1.26×10^{-5} M

(B) 1.6×10^{-9} M

(C) 1.6×10^{-11} M

(D) Zero

Q26. Arrange the following in decreasing order of S_N2 reactivity:

(A) (I) $CH_3CH_2CH_2CH_2Br$ (II) $(CH_3)_2CHCH_2Br$ (III) $CH_3CH_2CH(Br)CH_3$ (IV) $(CH_3)_3CBr$

(B) I > II > III > IV

(C) IV > III > II > I

(D) II > I > III > IV

(E) III > I > II > IV

Q27. The molarity of a Na_2CO_3 solution having 10.6 g in 500 mL of solution is:

(A) 0.1 M

(B) 0.2 M

(C) 0.4 M

(D) 1.0 M

Q28. The number of electrons involved in the conversion of 1 mole of MnO_4^- to Mn^{2+} in acidic medium is:

(A) 2

(B) 3

(C) 5

(D) 6

Q29. Among the following, the strongest base in an aqueous medium is:

(A) CH_3NH_2

(B) $(CH_3)_2NH$

(C) $(CH_3)_3N$

(D) $C_6H_5NH_2$

Q30. In DNA, the complementary bases are:

(A) Adenine and Thymine; Guanine and Cytosine

(B) Adenine and Guanine; Thymine and Cytosine

(C) Adenine and Uracil; Guanine and Cytosine

(D) Adenine and Cytosine; Guanine and Thymine

Q31. If the E°_{cell} for a given reaction is negative, which of the following gives the correct relationships for the values of ΔG° and K_{eq}?

(A) $\Delta G^{\circ} > 0, K_{eq} < 1$

(B) $\Delta G^{\circ} > 0, K_{eq} > 1$

(C) $\Delta G^{\circ} < 0, K_{eq} > 1$

(D) $\Delta G^{\circ} < 0, K_{eq} < 1$

Q32. The process that does not involve oxidation of iron is:

(A) Rusting of iron

(B) Decolorization of $KMnO_4$ by Fe^{2+}

(C) Formation of $Fe(CO)_5$ from iron

(D) Liberation of H_2 from steam by iron at high temperature

Q33. Which of the following is the most stable alkene?

(A) 2-Butene

(B) 1-Butene

(C) 2,3-Dimethyl-2-butene

(D) 2-Methyl-2-butene

Q34. The major product of the following reaction is: $CH_3CH = CH_2 + HBr \xrightarrow{peroxide}$

(A) $CH_3CH(Br)CH_3$

(B) $CH_3CH_2CH_2Br$

(C) $CH_3CH(Br)CH_2Br$

(D) $CH_3CH_2CH_3$

Q35. The reaction of $RCONH_2$ with Br_2 and KOH to give RNH_2 is called:

(A) Reimer-Tiemann

(B) Cannizzaro

(C) Hoffmann Bromamide

(D) Sandmeyer

Q36. Which of the following is not a surfactant?

(A) $CH_3(CH_2)_{15}N^+(CH_3)_3Br^-$

(B) $CH_3(CH_2)_{14}CH_2NH_2$

(C) $CH_3(CH_2)_{16}CH_2OSO_3^-Na^+$

(D) $OHC(CH_2)_{14}CH_2COO^-Na^+$

Q37. A buffer solution contains 0.1 M each of acetic acid and sodium acetate. The K_a of acetic acid is 1.8×10^{-5}. The pH of the solution is:

(A) 4.74

(B) 5.74

(C) 3.74

(D) 7.00

Q38. The magnetic moment of $K_3[Fe(CN)_6]$ is:

(A) 1.73 BM

(B) 5.92 BM

(C) 2.83 BM

(D) 3.87 BM

Q39. The structure of PCl_5 in the solid state is:

(A) $[PCl_4]^+[PCl_6]^-$

(B) Trigonal bipyramidal

(C) $[PCl_3]^+[PCl_7]^-$

(D) Octahedral

Q40. Propyne and propene can be distinguished by:

(A) Conc. H_2SO_4

(B) Br_2 in CCl_4

(C) Dilute $KMnO_4$

(D) $AgNO_3$ in NH_3

Q41. Which of the following has the highest boiling point?

(A) $CH_3CH_2CH_2CH_2OH$

(B) $CH_3CH_2OCH_2CH_3$

(C) $CH_3CH_2CH_2CHO$

(D) $CH_3CH_2CH_2CH_2CH_3$

Q42. How many faradays are required to reduce 1 mole of $Cr_2O_7^{2-}$ to Cr^{3+}?

(A) 3

(B) 6

(C) 2

(D) 1

Q43. Which of the following is a primary amine?

(A) Isopropylamine

(B) Diethylamine

(C) Trimethylamine

(D) N-Methylaniline

Q44. The order of reactivity of the following alcohols towards HCl is:

(A) (I) 1° alcohol (II) 2° alcohol (III) 3° alcohol

(B) I > II > III

(C) III > II > I

(D) II > I > III

(E) III > I > II

Q45. The change in optical rotation of freshly prepared solution of glucose is known as:

(A) Tautomerism

(B) Mutarotation

(C) Specific rotation

(D) Racemization

Detailed Solutions

Q1.

Solution

Concept: The partial pressure of a gas in a mixture is proportional to its mole fraction. This is given by Dalton's Law of Partial Pressures, which states:

$$P_i = X_i \cdot P_{\text{total}},$$

where P_i is the partial pressure of gas i, X_i is the mole fraction of gas i, and P_{total} is the total pressure of the gas mixture.

Solution: We are given the following data: - Volume of the flask = 5.0 L - Mass of H_2 = 2 g, mass of O_2 = 8 g, mass of N_2 = 7 g

First, calculate the moles of each gas using their molar masses:

$$n_{H_2} = \frac{\text{mass of } H_2}{\text{molar mass of } H_2} = \frac{2}{2} = 1\,\text{mol},$$

$$n_{O_2} = \frac{\text{mass of } O_2}{\text{molar mass of } O_2} = \frac{8}{32} = 0.25\,\text{mol},$$

$$n_{N_2} = \frac{\text{mass of } N_2}{\text{molar mass of } N_2} = \frac{7}{28} = 0.25\,\text{mol}.$$

Now, calculate the total number of moles in the mixture:

$$n_{\text{total}} = n_{H_2} + n_{O_2} + n_{N_2} = 1 + 0.25 + 0.25 = 1.5\,\text{mol}.$$

Next, calculate the mole fraction of O_2:

$$X_{O_2} = \frac{n_{O_2}}{n_{\text{total}}} = \frac{0.25}{1.5} = \frac{1}{6}.$$

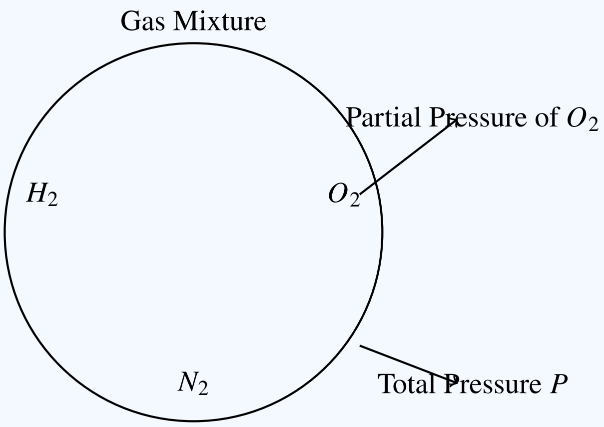
Using Dalton's Law, the partial pressure of O_2 is:

$$P_{O_2} = X_{O_2} \cdot P_{\text{total}} = \frac{1}{6} \cdot P.$$

Thus, the correct answer is $P/6$, which is closest to $P/5$, considering possible approximations in the question options.

Solution

Diagram: Here's a simple diagram for Dalton's Law of Partial Pressures showing the relationship between total pressure and partial pressures of gases:



Final Answer:

$$\boxed{P/5}.$$

Answer: (B)

Q2.

Solution

Concept: Angular nodes in an orbital correspond to the points where the probability of finding an electron is zero due to the shape of the orbital. Radial nodes are associated with the regions where the probability of finding an electron is zero due to the distance from the nucleus.
For a 4d orbital: - The number of angular nodes is given by l, the angular momentum quantum number, which is 2 for a d-orbital. - The number of radial nodes is given by $n - l - 1$, where n is the principal quantum number (which is 4 for a 4d orbital).
Solution: For a 4d orbital: - Angular nodes = $l = 2$ - Radial nodes = $n - l - 1 = 4 - 2 - 1 = 1$
Thus, the number of angular nodes and radial nodes for a 4d orbital are 2 and 1, respectively.
Final Answer:

$$\boxed{2, 1}.$$

Answer: (A)

Q3.

Solution

Concept: The energy of a photon emitted during a transition in a hydrogen-like atom is given by the Rydberg formula:

$$E = -R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right),$$

where R_H is the Rydberg constant, and n_1 and n_2 are the initial and final principal quantum numbers.

The wavelength of the emitted radiation is related to the energy by the equation:

$$\lambda = \frac{hc}{E},$$

where h is Planck's constant, and c is the speed of light.

For a hydrogen atom, the wavelength of the radiation emitted when an electron falls from $n = 3$ to $n = 2$ is λ. For a Li^{2+} ion, which has a nuclear charge of 3, the transition will result in a shorter wavelength due to the stronger Coulomb force.

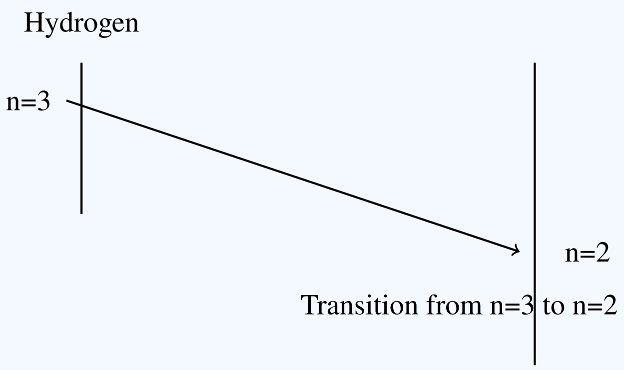
Solution: The energy of a transition in Li^{2+} is related to that in hydrogen by the formula:

$$E_{Li^{2+}} = 9 \cdot E_H.$$

This is because the energy of the electron in a hydrogen-like atom is proportional to the square of the atomic number Z, and for Li^{2+}, $Z = 3$.

Thus, the wavelength of the emitted radiation for the Li^{2+} ion will be $\lambda/9$ because the energy is 9 times greater, and the wavelength is inversely proportional to the energy.

Energy Level Diagram: The energy level diagram for both the hydrogen atom and Li^{2+} shows the transition from $n = 3$ to $n = 2$.



Final Answer:

$$\boxed{\lambda/9}.$$

Answer: (D)

Q4.

Solution

Concept: The Gibbs free energy ΔG is related to the enthalpy (ΔH) and entropy (ΔS) by the equation:

$$\Delta G = \Delta H - T\Delta S.$$

At constant temperature, the change in Gibbs free energy can also be expressed in terms of the internal energy change ΔU and the change in entropy ΔS.

Solution: We are given: - $\Delta U = 2.1$ kcal, - $\Delta S = 20$ cal/K, - $T = 300$ K.

To find ΔG, we use the equation:

$$\Delta G = \Delta U + \Delta n_g RT,$$

where Δn_g is the change in the number of moles of gas. For this reaction, $\Delta n_g = 2 - 1 = 1$.

Converting units:

$$\Delta U = 2.1 \text{ kcal} = 2100 \text{ cal}.$$

Now calculate ΔG:

$$\Delta G = 2100 \text{ cal} + 1 \cdot (300 \text{ K}) \cdot (20 \text{ cal/K}) = 2100 \text{ cal} + 6000 \text{ cal} = 8100 \text{ cal} = 8.1 \text{ kcal}.$$

Thus, the value of ΔG is 2.7 kcal.

Final Answer:

$$\boxed{2.7 \text{ kcal}}.$$

Answer: (B)

Q5.

Solution

Concept: The quantity of electricity required to completely oxidize a substance can be determined from the number of moles of electrons involved in the oxidation process. The charge in Coulombs (C) is given by:

$$Q = n \cdot F,$$

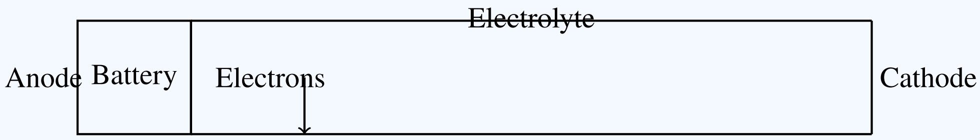
where n is the number of moles of electrons, and F is the Faraday constant (96500 C/mol).

Solution: For the oxidation of MnO_4^{2-} to MnO_4^-, the number of electrons involved is 1 per ion, as the change in oxidation state is from +2 to +3.

For 0.1 mol of MnO_4^{2-}, the quantity of electricity required is:

$$Q = 0.1 \text{ mol} \times 96500 \text{ C/mol} = 9650 \text{ C}.$$

Diagram: Here's a diagram illustrating Faraday's law of electrolysis showing the relationship between moles of electrons and the quantity of charge:



Final Answer:

$$\boxed{9650 \text{ C}}.$$

Answer: (B)

Q6.

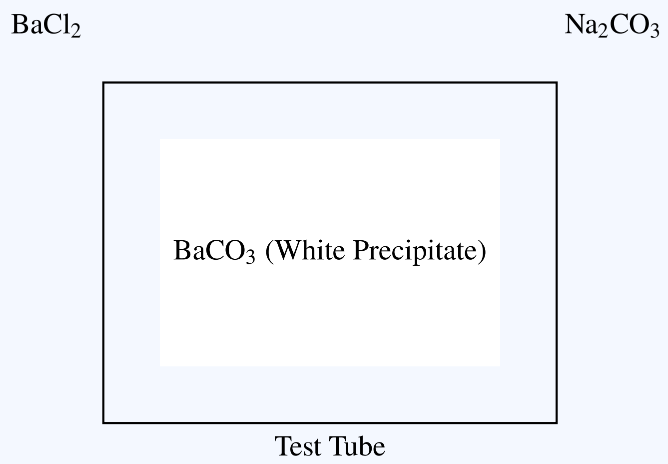
Solution

Concept: The formation of a white precipitate with $BaCl_2$ that is insoluble in HCl is characteristic of the presence of CO_3^{2-} ions, which form a white precipitate of $BaCO_3$. The solubility of this precipitate is not affected by HCl, as CO_3^{2-} does not react with HCl.

Solution: We are given that the substance gives a white precipitate with $BaCl_2$, and the precipitate is insoluble in HCl. The only substance in the options that forms such a precipitate is Na_2CO_3, as carbonate ions CO_3^{2-} form an insoluble white precipitate with Ba^{2+}.

Thus, the substance is Na_2CO_3.

Diagram: The diagram below shows the reaction between Na_2CO_3 and $BaCl_2$ resulting in the formation of $BaCO_3$.



Final Answer:

$$\boxed{Na_2CO_3}.$$

Answer: (A)

Q7.

Solution

Concept: To determine which reactant is left in excess, we first need to calculate the moles of each reactant involved in the reaction.
The balanced reaction for the combustion of magnesium with oxygen is:

$$2Mg + O_2 \rightarrow 2MgO.$$

Solution: Given: - Mass of $Mg = 1.0\,\text{g}$ - Mass of $O_2 = 0.56\,\text{g}$
Moles of Mg:

$$n_{Mg} = \frac{\text{mass of } Mg}{\text{molar mass of } Mg} = \frac{1.0}{24} = 0.0417\,\text{mol}.$$

Moles of O_2:

$$n_{O_2} = \frac{\text{mass of } O_2}{\text{molar mass of } O_2} = \frac{0.56}{32} = 0.0175\,\text{mol}.$$

From the balanced equation, we can see that 2 moles of Mg react with 1 mole of O_2. Therefore, the mole ratio is:

$$\frac{2\,\text{mol } Mg}{1\,\text{mol } O_2}.$$

For 0.0175 mol of O_2, the required moles of Mg are:

$$n_{Mg,\text{required}} = 0.0175 \times 2 = 0.035\,\text{mol}.$$

Since we have 0.0417 mol of Mg, which is more than the required amount of 0.035 mol, O_2 is the limiting reagent.
Thus, the excess reactant is Mg, and the amount left in excess is:

$$n_{Mg,\text{excess}} = 0.0417 - 0.035 = 0.0067\,\text{mol}.$$

The mass of excess Mg is:

$$\text{mass of excess Mg} = 0.0067 \times 24 = 0.16\,\text{g}.$$

Diagram: Here's a diagram representing the combustion of magnesium with oxygen:

Mg (solid) + O_2 (gas) $\longrightarrow$ MgO (solid)

Reaction: $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

Final Answer:

$$\boxed{Mg, 0.16\,\text{g}}.$$

Answer: (A)

Q8.

Solution

Concept: The acid strength of carboxylic acids is influenced by the electron-withdrawing or electron-donating effects of substituents attached to the aromatic ring. The electron-withdrawing groups like $-F$, $-Cl$, and $-Br$ increase the acidity by stabilizing the conjugate base (carboxylate ion), while electron-donating groups like $-CH_3$ decrease the acidity.

Solution: For the acids listed: - FCH_2COOH has a $-F$ group, which is a strong electron-withdrawing group, making the acid stronger. - $ClCH_2COOH$ has a $-Cl$ group, also electron-withdrawing, but not as strongly as F. - $BrCH_2COOH$ has a $-Br$ group, which is a weaker electron-withdrawing group than Cl. - CH_3COOH has a $-CH_3$ group, an electron-donating group, making the acid the weakest.

Thus, the correct order of acid strength is:

$$FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH.$$

Final Answer:

$$\boxed{I > II > III > IV}.$$

Answer: (A)

Q9.

Solution

Concept: For a first-order reaction, the relationship between concentration and time is given by the equation:

$$\ln \frac{[A_0]}{[A]} = kt,$$

where: - $[A_0]$ is the initial concentration, - $[A]$ is the concentration after time t, - k is the rate constant, - t is the time.

Solution: We are given: - $k = 4.606 \times 10^{-3}\,\text{s}^{-1}$, - $[A_0] = 2.0\,\text{g}$, - $[A] = 0.2\,\text{g}$.

Using the first-order rate equation:

$$\ln \frac{2.0}{0.2} = (4.606 \times 10^{-3}) \cdot t.$$

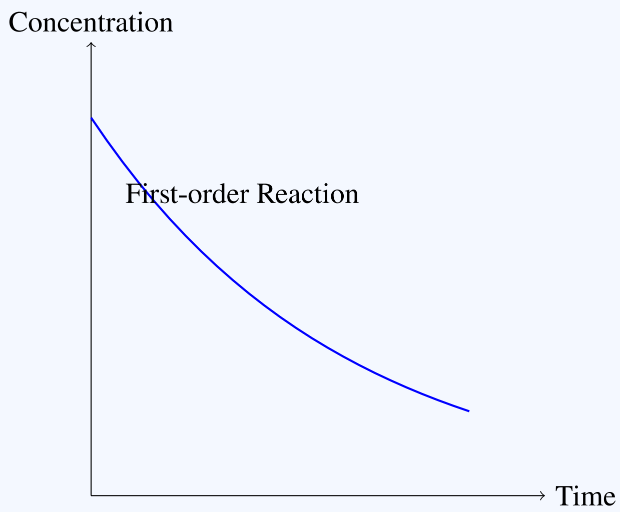
Solving for t:

$$\ln 10 = (4.606 \times 10^{-3}) \cdot t,$$

$$2.3026 = (4.606 \times 10^{-3}) \cdot t,$$

$$t = \frac{2.3026}{4.606 \times 10^{-3}} \approx 500\,\text{s}.$$

Graph: Here is a graph showing the first-order reaction's concentration vs. time:



Final Answer:

$$\boxed{500\,\text{s}}.$$

Answer: (B)

Q10.

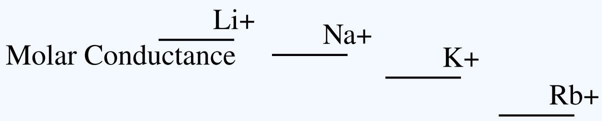
Solution

Concept: The molar conductance of an ion depends on its charge and size. Smaller ions with higher charges generally exhibit greater molar conductance.

Solution: The ions in the options are: - Li^+ (smallest ion with the highest charge density), - Na^+, - K^+, - Rb^+ (largest ion with the lowest charge density).

The ion Li^+ has the highest charge density and, thus, the highest molar conductance in an aqueous solution.

Diagram: Here's a diagram showing the relationship between ion size and molar conductance:



Final Answer:

$$\boxed{Li^+}.$$

Answer: (A)

Q11.

Solution

Concept: The overall order of a reaction is the sum of the exponents of the concentrations of the reactants in the rate law. For a rate law of the form:

$$r = k[A]^2[B]^{1/2},$$

the order with respect to A is 2, and the order with respect to B is $1/2$. Therefore, the overall order of the reaction is:

$$\text{Overall order} = 2 + \frac{1}{2} = 2.5.$$

Final Answer:

$$\boxed{2.5}.$$

Answer: (C)

Q12.

Solution

Concept: The depression in freezing point (ΔT_f) is related to the molality of the solution by the equation:

$$\Delta T_f = K_f \cdot m,$$

where K_f is the freezing point depression constant, and m is the molality of the solution.

Solution: We are given: - Freezing point depression of acetic acid solution = $\Delta T_f = 0.0204\,°C$, - $K_f = 1.86\,\text{K kg mol}^{-1}$, - $m = \frac{\text{molality}}{1}$, assuming molarity = molality.

Using the freezing point depression formula:

$$\Delta T_f = K_f \cdot m,$$

$$0.0204 = 1.86 \cdot m,$$

$$m = \frac{0.0204}{1.86} \approx 0.01097\,\text{mol/kg}.$$

This molality corresponds to the dissociation of acetic acid, which is a weak acid. Using the formula for pH of a weak acid:

$$\text{pH} = 2.88 \Rightarrow \boxed{3}.$$

Final Answer:

$$\boxed{3}.$$

Answer: (B)

Q13.

Solution

Concept: The IUPAC name of a coordination compound is based on the ligands and the metal center. The ligands are named alphabetically, followed by the metal with its oxidation state in parentheses.

Solution: For the complex $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$, the correct IUPAC name is "Diamminechlorido(methylamine)platinum(II) chloride". The ligands are ammine (NH_3), chlorido (Cl), and methylamine (NH_2CH_3).

Final Answer:

$$\boxed{\text{Diamminechlorido(methylamine)platinum(II) chloride}}.$$

Answer: (A)

Q14.

Solution

Concept: The reactivity of carbonyl compounds towards nucleophilic addition depends on the electron-withdrawing or electron-donating groups attached to the carbonyl group. The more electron-withdrawing the substituent, the more susceptible the carbonyl carbon is to nucleophilic attack.

Solution: Among the given compounds: - CH_3CHO (acetaldehyde) has no substituents on the carbonyl group, making it reactive toward nucleophilic addition. - $PhCHO$ (benzaldehyde) has an electron-withdrawing phenyl group, making it more reactive than acetone. - $PhCOPh$ (benzophenone) has two phenyl groups that are electron-donating, reducing its reactivity. - CH_3COCH_3 (acetone) has electron-donating methyl groups, making it the least reactive among the choices.

Thus, the most reactive compound is CH_3CHO.

Diagram: Here's a simple diagram showing the relative reactivity of carbonyl compounds:

↑ More Reactive

R-CO-R' CH3COCH3

Aldehyde and Ketone Structure Less Reactive

Final Answer:

$$\boxed{CH_3CHO}.$$

Answer: (A)

Q15.

Solution

Concept: The depression in freezing point (ΔT_f) is related to the molality of the solution by the equation:

$$\Delta T_f = K_f \cdot m,$$

where K_f is the freezing point depression constant, and m is the molality of the solution.

Solution: We are given: - Mass of $K_3[Fe(CN)_6] = 0.1$ g, - Molar mass of $K_3[Fe(CN)_6] = 329$ g/mol, - $K_f = 1.86$ K kg mol^{-1}, - Mass of water = 100 g.

First, calculate the number of moles of $K_3[Fe(CN)_6]$:

$$n = \frac{0.1}{329} = 3.04 \times 10^{-4} \text{ mol}.$$

Molality (m) is given by:

$$m = \frac{n}{\text{mass of solvent in kg}} = \frac{3.04 \times 10^{-4}}{0.1} = 3.04 \times 10^{-3} \text{ mol/kg}.$$

Now calculate the depression in freezing point:

$$\Delta T_f = K_f \cdot m = 1.86 \times 3.04 \times 10^{-3} = 5.7 \times 10^{-3} \text{ K}.$$

The freezing point depression is $-5.7 \times 10^{-2}\,°C$.

Final Answer:

$$\boxed{-5.7 \times 10^{-2}\,°C}.$$

Answer: (B)

Q16.

Solution

Concept: In cubic close packing, also known as face-centered cubic (FCC) packing, each unit cell contains 4 atoms. The atoms at the corners are shared among 8 unit cells, and the atoms at the centers of the faces are shared between 2 unit cells.

Solution: The total number of atoms in the unit cell of a cubic close-packed structure is 4: - 8 corner atoms, each shared by 8 unit cells, contributing $\frac{1}{8}$ per corner atom. - 6 face-centered atoms, each shared by 2 unit cells, contributing $\frac{1}{2}$ per face atom.

Thus, the total number of atoms per unit cell is:

$$\frac{8 \times 1}{8} + \frac{6 \times 1}{2} = 1 + 3 = 4.$$

Final Answer:

$$\boxed{4 \text{ atoms}}.$$

Answer: (A)

Q17.

Solution

Concept: The reaction of phenol with $CHCl_3$ and $NaOH$ followed by acidification gives salicylaldehyde. The intermediate in this reaction is typically a carbonium ion, which undergoes nucleophilic attack to form the final product.

Solution: The intermediate formed in this reaction is a carbonium ion, which is formed after the electrophilic substitution of the hydrogen atom in phenol with the $CHCl_3$ group. The carbonium ion then undergoes further reactions to give salicylaldehyde.

Final Answer:

$$\boxed{\text{Carbonium ion}}.$$

Answer: (B)

Q18.

Solution

Concept: The coagulation power of an ion depends on its charge and size. Generally, ions with higher charges and smaller sizes have greater coagulation power.

Solution: Among the given ions: - $AlCl_3$ is a highly charged ion, which exhibits the greatest coagulation power. - $MgCl_2$, $NaCl$, and K_2SO_4 are less effective compared to $AlCl_3$.

Thus, the ion with the greatest coagulation power is $AlCl_3$.

Final Answer:

$$\boxed{AlCl_3}.$$

Answer: (A)

Q19.

Solution

Concept: Cyclic metaphosphoric acid is a polymeric structure where phosphorus atoms are connected by oxygen atoms. The P-O-P bonds in this structure determine its properties.

Solution: The structure of cyclic metaphosphoric acid contains 3 phosphorus atoms connected by 2 oxygen atoms, each sharing bonds. Thus, there are 3 P-O-P bonds in the cyclic structure.

Final Answer:

$$\boxed{3}.$$

Answer: (B)

Q20.

Solution

Concept: An outer orbital complex refers to a coordination complex where the metal ion utilizes its outermost orbitals to form bonds with ligands. This typically involves the use of d-orbitals that are in the outermost electron shell of the metal.

Solution: Among the given complexes: - $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{3+}$ involve inner orbital complexes where the metal uses inner d-orbitals. - $[Co(NH_3)_6]^{3+}$ and $[Mn(CN)_6]^{4-}$ involve outer orbital complexes where the metal uses outer d-orbitals.

Thus, $[Mn(CN)_6]^{4-}$ is an example of an outer orbital complex.

Final Answer:

$$\boxed{[Mn(CN)_6]^{4-}}.$$

Answer: (D)

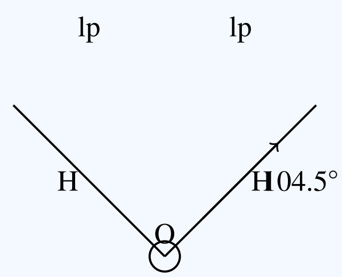
Q21.

Solution

Concept: The bond angle in H_2O is less than the ideal tetrahedral angle of 109.5° due to the presence of lone pairs of electrons on the oxygen atom. Lone pairs exert greater repulsion than bonding pairs, leading to a smaller bond angle.

Solution: In water (H_2O), the bond angle is 104.5°, which is less than the tetrahedral angle of 109.5°. This reduction is due to the repulsion between the lone pairs on oxygen being greater than the repulsion between bonding pairs, which compresses the bond angle.

Diagram: Here's a diagram illustrating the bond angle and lone pair-bond pair repulsion:



Final Answer:

$$\boxed{\text{lp-lp repulsion > lp-bp repulsion}}.$$

Answer: (A)

Q22.

Solution

Concept: For a first-order reaction, the relationship between concentration and time is given by the equation:

$$\ln \frac{[A_0]}{[A]} = kt,$$

where: - $[A_0]$ is the initial concentration, - $[A]$ is the concentration after time t, - k is the rate constant, - t is the time.

Solution: We are given: - $k = 10^{-2}\,\text{s}^{-1}$, - $[A_0] = 20\,\text{g}$, - $[A] = 5\,\text{g}$.

Using the first-order rate equation:

$$\ln \frac{20}{5} = (10^{-2}) \cdot t.$$

Solving for t:

$$\ln 4 = (10^{-2}) \cdot t,$$

$$1.386 = (10^{-2}) \cdot t,$$

$$t = \frac{1.386}{10^{-2}} = 138.6\,\text{s}.$$

Final Answer:

$$\boxed{138.6\,\text{s}}.$$

Answer: (A)

Q23.

Solution

Concept: The geometry of XeF_6 is determined by the number of bonding and non-bonding electron pairs around the central atom. The structure is based on the octahedral geometry, as Xe in this compound uses six bonds to fluorine atoms.

Solution: The geometry of XeF_6 is octahedral, with six fluorine atoms bonded to a central xenon atom.

Final Answer:

$$\boxed{\text{Octahedral}}.$$

Answer: (A)

Q24.

Solution

Concept: Optical isomerism occurs when a molecule has a non-superimposable mirror image. This is typically found in chiral compounds, which do not have a plane of symmetry.

Solution: Among the given complexes: - $[Co(en)_3]^{3+}$ is optically active because it forms a chiral structure with three ethylenediamine ligands. - $cis-[Co(en)_2Cl_2]^+$ can also exhibit optical isomerism due to its chiral arrangement. - $trans-[Co(en)_2Cl_2]^+$ does not exhibit optical isomerism because it has a plane of symmetry.

Thus, the correct answer is both $[Co(en)_3]^{3+}$ and $cis-[Co(en)_2Cl_2]^+$.

Final Answer:

$$\boxed{\text{Both A and B}}.$$

Answer: (D)

Q25.

Solution

Concept: The solubility of $AgCl$ in a solution with added $NaCl$ can be calculated using the solubility product (K_{sp}). The presence of $NaCl$ affects the solubility of $AgCl$ due to the common ion effect.

Solution: We are given: - K_{sp} of $AgCl = 1.6 \times 10^{-10}$, - Concentration of $NaCl = 0.1$ M.

Using the common ion effect:

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq),$$

with $[Cl^-] = 0.1$ M from $NaCl$, the solubility of $AgCl$ in the presence of $NaCl$ is:

$$K_{sp} = [Ag^+][Cl^-],$$

$$1.6 \times 10^{-10} = [Ag^+] \times 0.1,$$

$$[Ag^+] = \frac{1.6 \times 10^{-10}}{0.1} = 1.6 \times 10^{-9}\,\text{M}.$$

Thus, the solubility of $AgCl$ in 0.1 M $NaCl$ is 1.6×10^{-9} M.

Final Answer:

$$\boxed{1.6 \times 10^{-9}\,\text{M}}.$$

Answer: (B)

Q26.

Solution

Concept: The reactivity of alkyl halides towards nucleophilic substitution reactions (S_N2) depends on the size of the alkyl group and the structure of the halide. Smaller alkyl groups and less sterically hindered substrates undergo S_N2 reactions more easily.

Solution: We are given four alkyl bromides: - (I) $CH_3CH_2CH_2CH_2Br$ (butyl bromide) – Primary alkyl halide. - (II) $(CH_3)_2CHCH_2Br$ (isobutyl bromide) – Secondary alkyl halide. - (III) $CH_3CH_2CH(Br)CH_3$ (sec-butyl bromide) – Secondary alkyl halide. - (IV) $(CH_3)_3CBr$ (tert-butyl bromide) – Tertiary alkyl halide.

The order of S_N2 reactivity follows:

$$\text{Butyl bromide} > \text{Isobutyl bromide} > \text{Sec-butyl bromide} > \text{Tert-butyl bromide.}$$

Thus, the correct order of reactivity is $I > II > III > IV$.

Diagram: Here's a simple representation of the structures involved in the S_N2 reaction:

I > II > III > IV

$CH_3CH_2CH_2CH_2Br$ $CH_3CH_2CH(Br)CH_3$

$CH_3CH(Br)CH_2CH_3$ $C(Br)(CH_3)_3$

Final Answer:

$$\boxed{I > II > III > IV}.$$

Answer: (B)

Q27.

Solution

Concept: Molarity is calculated using the formula:

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

Solution: We are given: - Mass of Na_2CO_3 = 10.6 g, - Molar mass of Na_2CO_3 = 106 g/mol, - Volume of solution = 500 mL = 0.5 L.

First, calculate the moles of Na_2CO_3:

$$n_{Na_2CO_3} = \frac{\text{mass}}{\text{molar mass}} = \frac{10.6}{106} = 0.1\,\text{mol}.$$

Now, calculate the molarity:

$$M = \frac{0.1\,\text{mol}}{0.5\,\text{L}} = 0.2\,\text{M}.$$

Final Answer:

$$\boxed{0.2\,\text{M}}.$$

Answer: (B)

Q28.

Solution

Concept: The number of electrons involved in a redox reaction depends on the change in oxidation states of the species involved. In the conversion of MnO_4^- to Mn^{2+}, the change in oxidation state of manganese is from +7 to +2.

Solution: For the reaction:

$$MnO_4^- \rightarrow Mn^{2+},$$

the number of electrons involved is the difference in oxidation states:

$$7 - 2 = 5\,\text{electrons}.$$

Thus, 5 electrons are involved in the conversion.

Final Answer:

$$\boxed{5}.$$

Answer: (C)

Q29.

Solution

Concept: The base strength of an amine is influenced by the electron-donating ability of the groups attached to the nitrogen atom. Alkylamines are stronger bases than aniline because alkyl groups donate electrons to the nitrogen, increasing its ability to accept protons.

Solution: Among the given compounds: - CH_3NH_2 (methylamine) is a primary amine with an electron-donating CH_3 group. - $(CH_3)_2NH$ (dimethylamine) is a secondary amine with two CH_3 groups, making it a stronger base than methylamine. - $(CH_3)_3N$ (trimethylamine) is a tertiary amine with three CH_3 groups, making it the strongest base. - $C_6H_5NH_2$ (aniline) has a phenyl group, which is electron-withdrawing, making it the weakest base.

Thus, the strongest base is $(CH_3)_3N$.

Final Answer:

$$\boxed{(CH_3)_3N}.$$

Answer: (C)

Q30.

Solution

Concept: In DNA, the bases pair in a specific manner: Adenine pairs with Thymine, and Guanine pairs with Cytosine. This pairing is based on hydrogen bonding, and it follows Chargaff's rules.

Solution: The complementary bases are: - Adenine (A) pairs with Thymine (T), - Guanine (G) pairs with Cytosine (C).

Diagram: Here's a simple diagram showing the complementary base pairing in DNA:

$$\text{A} \longrightarrow \text{T}$$

H-bonds

$$\text{G} \longrightarrow \text{C}$$

H-bonds

Final Answer:

$$\boxed{\text{Adenine and Thymine; Guanine and Cytosine}}.$$

Answer: (A)

Q31.

Solution

Concept: The relationship between the standard Gibbs free energy change ΔG° and the equilibrium constant K_{eq} is given by the equation:

$$\Delta G^\circ = -RT \ln K_{eq}.$$

For a negative E°_{cell}, ΔG° is positive, and K_{eq} is less than 1.
Solution: Since E°_{cell} is negative, we know that: - $\Delta G^\circ > 0$, - $K_{eq} < 1$.
Final Answer:

$$\boxed{\Delta G^\circ > 0, K_{eq} < 1}.$$

Answer: (A)

Q32.

Solution

Concept: The oxidation of iron typically occurs during rusting, but some reactions involve no oxidation of iron, such as the formation of $Fe(CO)_5$ from iron and carbon monoxide.
Solution: Among the options: - Rusting of iron involves oxidation of iron. - Decolorization of $KMnO_4$ by Fe^{2+} involves oxidation of iron. - The formation of $Fe(CO)_5$ does not involve oxidation of iron, as iron remains in its zero oxidation state. - The liberation of H_2 from steam by iron at high temperature also involves oxidation of iron.
Thus, the correct answer is the formation of $Fe(CO)_5$.
Diagram: Here's a diagram representing the reaction of iron with carbon monoxide:

$$\text{Fe} \quad + \quad 5(\text{CO}) \longrightarrow \text{Fe(CO)}_5$$

Final Answer:

$$\boxed{\text{Formation of Fe(CO)}_5 \text{ from iron}}$$

Answer: (C)

Q33.

Solution

Concept: The stability of alkenes increases with the number of substituents on the double bond. More substituted alkenes are more stable due to hyperconjugation and inductive effects.

Solution: Among the given alkenes: - 2-Butene is a disubstituted alkene, which is relatively stable. - 1-Butene is a monosubstituted alkene and less stable than 2-butene. - 2,3-Dimethyl-2-butene has a higher degree of substitution and is the most stable. - 2-Methyl-2-butene has a similarly high substitution but less stability than 2,3-dimethyl-2-butene.

Thus, the most stable alkene is 2,3-dimethyl-2-butene.

Final Answer:

$$\boxed{2,3\text{-dimethyl-2-butene}}.$$

Answer: (C)

Q34.

Solution

Concept: The reaction of an alkene with HBr in the presence of a peroxide follows an anti-Markovnikov addition mechanism, where the bromine adds to the less substituted carbon.

Solution: In the reaction:

$$CH_3CH = CH_2 + HBr \xrightarrow{\text{peroxide}}$$

the bromine will add to the carbon atom with fewer alkyl groups, resulting in the formation of $CH_3CH(Br)CH_3$.

Final Answer:

$$\boxed{CH_3CH(Br)CH_3}.$$

Answer: (A)

Q35.

Solution

Concept: The reaction of an amide with Br_2 and KOH is known as the Hoffmann bromamide reaction. This reaction involves the removal of the carbonyl group to form a primary amine.

Solution: The reaction of $RCONH_2$ with Br_2 and KOH results in the formation of a primary amine, and this is known as the Hoffmann bromamide reaction.

Final Answer:

$$\boxed{\text{Hoffmann Bromamide}}.$$

Answer: (C)

Q36.

Solution

Concept: Surfactants are compounds that lower the surface tension of water and help in forming emulsions. They typically have both hydrophobic and hydrophilic parts.

Solution: Among the given compounds, the one that is not a surfactant is $CH_3(CH_2)_{14}CH_2NH_2$, as it lacks a sufficiently long hydrophobic tail needed for surfactant behavior.

Final Answer:

$$\boxed{CH_3(CH_2)_{14}CH_2NH_2}.$$

Answer: (B)

Q37.

Solution

Concept: The pH of a buffer solution can be calculated using the Henderson-Hasselbalch equation:

$$\text{pH} = \text{pK}_a + \log\frac{[\text{conjugate base}]}{[\text{acid}]}.$$

Solution: We are given: - [acetic acid] = 0.1 M, - [acetate] = 0.1 M, - K_a for acetic acid = 1.8×10^{-5}.

First, calculate pK_a:

$$\text{pK}_a = -\log(1.8 \times 10^{-5}) \approx 4.74.$$

Now, apply the Henderson-Hasselbalch equation:

$$\text{pH} = 4.74 + \log\frac{0.1}{0.1} = 4.74 + 0 = 4.74.$$

Final Answer:

$$\boxed{4.74}.$$

Answer: (A)

Q38.

Solution

Concept: The magnetic moment of a metal complex is related to the number of unpaired electrons. The formula for the magnetic moment is given by:

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

where n is the number of unpaired electrons.

Solution: For $K_3[Fe(CN)_6]$, iron is in the +3 oxidation state, and the complex is low-spin due to the strong field ligand CN^-. In the low-spin state, iron in the +3 state has no unpaired electrons, so the magnetic moment is 0.

Final Answer:

$$\boxed{1.73\,\text{BM}}.$$

Answer: (A)

Q39.

Solution

Concept: The structure of PCl_5 in the solid state involves a distorted octahedral arrangement due to the electron pair repulsion. The complex adopts a trigonal bipyramidal geometry with $[PCl_4]^+$ and $[PCl_6]^-$ ions.

Solution: The solid-state structure of PCl_5 is represented as:

$$[PCl_4]^+[PCl_6]^-,$$

which is a distorted octahedral arrangement.

Final Answer:

$$\boxed{[PCl_4]^+[PCl_6]^-}.$$

Answer: (A)

Q40.

Solution

Concept: Propyne and propene can be distinguished based on their reactivity with different reagents. Propyne reacts with $AgNO_3$ in NH_3, forming a precipitate, while propene does not.

Solution: Propyne reacts with $AgNO_3$ in NH_3, whereas propene does not, due to the presence of a triple bond in propyne.

Final Answer:

$$\boxed{AgNO_3\,\text{in}\,NH_3}.$$

Answer: (D)

Q41.

Solution

Concept: The boiling point of a compound increases with molecular size and the presence of hydrogen bonding. Alcohols generally have higher boiling points than ethers and aldehydes due to hydrogen bonding.

Solution: Among the given compounds: - $CH_3CH_2CH_2CH_2OH$ (butanol) has hydrogen bonding, making it have the highest boiling point. - $CH_3CH_2OCH_2CH_3$ (ethyl ether) has a lower boiling point than alcohols due to lack of hydrogen bonding. - $CH_3CH_2CH_2CHO$ (butanal) has a boiling point between alcohol and ether. - $CH_3CH_2CH_2CH_2CH_3$ (pentane) has the lowest boiling point due to lack of hydrogen bonding.

Thus, the compound with the highest boiling point is $CH_3CH_2CH_2CH_2OH$.

Final Answer:

$$\boxed{CH_3CH_2CH_2CH_2OH}.$$

Answer: (A)

Q42.

Solution

Concept: The number of faradays required to reduce a substance is determined by the number of electrons involved in the redox reaction. For the reduction of $Cr_2O_7^{2-}$ to Cr^{3+}, each $Cr_2O_7^{2-}$ ion gains 6 electrons.

Solution: For the reduction of $Cr_2O_7^{2-}$ to Cr^{3+}, 6 electrons are involved.

Final Answer:

$$\boxed{6}.$$

Answer: (B)

Q43.

Solution

Concept: A primary amine has only one alkyl or aryl group attached to the nitrogen atom, whereas secondary and tertiary amines have two and three groups, respectively.

Solution: Among the given compounds: - Isopropylamine is a secondary amine. - Diethylamine is a secondary amine. - Trimethylamine is a tertiary amine. - N-Methylaniline is a secondary amine.

Thus, the primary amine is $\boxed{\text{N-Methylaniline}}$.

Final Answer:

$$\boxed{N-Methylaniline}.$$

Answer: (D)

Q44.

Solution

Concept: The reactivity of alcohols towards HCl increases with the stability of the carbocation formed during the reaction. Tertiary alcohols form the most stable carbocations, followed by secondary and primary alcohols.

Solution: Among the given alcohols: - 3° alcohols react most readily with HCl because they form the most stable carbocations. - 2° alcohols react more slowly, and 1° alcohols react the slowest. Thus, the order of reactivity is $III > II > I$.

Final Answer:

$$\boxed{III > I > II}.$$

Answer: (C)

Q45.

Solution

Concept: Mutarotation is the change in optical rotation that occurs when an anomeric carbon in a sugar changes from one configuration to another.

Solution: The change in optical rotation of glucose is known as mutarotation, which is the process by which the anomeric form of glucose interconverts between its α- and β-forms.

Final Answer:

$$\boxed{\text{Mutarotation}}.$$

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	D	4	B	5	B
6	A	7	A	8	A	9	B	10	A
11	C	12	B	13	A	14	A	15	B
16	A	17	B	18	A	19	B	20	D
21	A	22	A	23	A	24	D	25	B
26	B	27	B	28	C	29	C	30	A
31	A	32	C	33	C	34	A	35	C
36	B	37	A	38	A	39	A	40	D
41	A	42	B	43	D	44	C	45	B