NEET-UG Chemistry Sample Paper-18

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 mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with concentrated H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. The weight (in g) of the remaining product at STP will be:

(A) 1.4

(B) 3.0

(C) 2.8

(D) 4.4

Q2. The angular momentum of an electron in a particular orbit of Li^{2+} ion is J. If the de-Broglie wavelength of this electron is λ, then the radius of this orbit is given by:

(A) $\frac{J\lambda}{2\pi}$

(B) $\frac{J\lambda}{2\pi h}$

(C) $\frac{J\lambda}{h}$

(D) $\frac{h\lambda}{2\pi J}$

Q3. Which of the following transitions in a Hydrogen atom will emit a photon of the highest frequency?

(A) $n = 2$ to $n = 1$

(B) $n = 6$ to $n = 2$

(C) $n = 2$ to $n = 6$

(D) $n = 1$ to $n = 2$

Q4. Which of the following species is paramagnetic and has a fractional bond order?

(A) O_2

(B) B_2

(C) O_2^-

(D) N_2

Q5. The dipole moment of NF_3 is smaller than that of NH_3 because:

(A) F is more electronegative than H

(B) The lone pair dipole in NF_3 opposes the bond pair dipoles

(C) $N - F$ bond is less polar than $N - H$ bond

(D) NF_3 has a planar geometry while NH_3 is pyramidal

Q6. The total number of moles at equilibrium for the dissociation of 'a' moles of PCl_5 into PCl_3 and Cl_2 (where x is the degree of dissociation) is:

(A) $a(1 + x)$

(B) $a(1 - x)$

(C) $a(1 + 2x)$

(D) $a/(1 + x)$

Q7. A gas expands from 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm. The work done is: (1 L atm = 101.32 J)

(A) −607.9 J

(B) +607.9 J

(C) −6.0 J

(D) +6.0 J

Q8. The enthalpy of combustion of C, H_2, and CH_4 are −393.5, −285.8, and −890.3 kJ mol^{-1} respectively. The enthalpy of formation of CH_4 is:

(A) −74.8 kJ mol^{-1}
(B) +74.8 kJ mol^{-1}
(C) −52.6 kJ mol^{-1}
(D) +52.6 kJ mol^{-1}

Q9. The vapor pressures of pure liquids A and B are 400 and 600 mm Hg respectively. If a mixture of A and B behaves ideally and has a total vapor pressure of 550 mm Hg, the mole fraction of A in the liquid phase is:

(A) 0.25
(B) 0.50
(C) 0.75
(D) 0.35

Q10. Two solutions X and Y are prepared by dissolving 0.2 mol of a non-volatile solute in 1 kg of water. If the boiling point of X is higher than that of Y, it can be concluded that:

(A) X is undergoing dissociation in water
(B) X is undergoing association in water
(C) Y is undergoing dissociation in water
(D) Molar mass of solute in X is greater than in Y

Q11. Which of the following is the correct order of increasing basic strength of the hydrides of Group 15 elements?

(A) $NH_3 < PH_3 < AsH_3 < SbH_3$

(B) $SbH_3 < AsH_3 < PH_3 < NH_3$

(C) $PH_3 < NH_3 < SbH_3 < AsH_3$

(D) $AsH_3 < SbH_3 < NH_3 < PH_3$

Q12. Number of moles of $KMnO_4$ required to oxidize one mole of KI in alkaline medium to KIO_3 is:

(A) 1

(B) 2

(C) 5/3

(D) 2/3

Q13. The molar conductivity of 0.007 M acetic acid is 20 S cm^2 mol^{-1}. What is its dissociation constant? (Given $\Lambda_m^\circ = 400$ S cm^2 mol^{-1})

(A) 1.75×10^{-5} mol L^{-1}

(B) 2.50×10^{-5} mol L^{-1}

(C) 1.75×10^{-4} mol L^{-1}

(D) 2.50×10^{-4} mol L^{-1}

Q14. For a first-order reaction, the time required for 99.9% completion is approximately how many times the half-life of the reaction?

(A) 10

(B) 100

(C) 5

(D) 2

Q15. The rate constant of a reaction is 1.2×10^{-3} s^{-1} at 300 K and 2.4×10^{-3} s^{-1} at 310 K. The activation energy (E_a) of the reaction is: (Given $R = 8.314$ J K^{-1} mol^{-1})

(A) 53.6 kJ mol^{-1}

(B) 48.2 kJ mol^{-1}

(C) 58.4 kJ mol^{-1}

(D) 62.1 kJ mol^{-1}

Q16. An element has a face-centered cubic (fcc) structure with a cell edge of 200 pm. The atomic radius is:

(A) $100\sqrt{2}$ pm

(B) $50\sqrt{2}$ pm

(C) 100 pm

(D) $200/\sqrt{2}$ pm

Q17. Which of the following aqueous solutions will have the highest boiling point?

(A) 1.0 M KNO_3

(B) 1.0 M Na_2SO_4

(C) 1.0 M Glucose

(D) 1.0 M $AlCl_3$

Q18. The standard reduction potentials of three metals A, B, and C are +0.5 V, −3.0 V, and −1.2 V respectively. The reducing power of these metals are in the order:

(A) $A > B > C$

(B) $C > B > A$

(C) $A > C > B$

(D) $B > C > A$

Q19. For a zero-order reaction, the plot of concentration of reactant $[A]$ vs time (t) yields a straight line with:

(A) Positive slope and zero intercept

(B) Negative slope and non-zero intercept

(C) Positive slope and non-zero intercept

(D) Zero slope and non-zero intercept

Q20. The geometry of $[MnCl_4]^{2-}$ is:

(A) Square planar

(B) Tetrahedral

(C) Pyramidal

(D) Octahedral

Q21. The most stable carbocation among the following is:

(A) $(CH_3)_3C^+$

(B) $(CH_3)_2CH^+$

(C) $CH_3CH_2^+$

(D) $C_6H_5CH_2^+$

Q22. Which of the following is most acidic?

(A) Phenol

(B) p-Nitrophenol

(C) m-Nitrophenol

(D) Ethanol

Q23. The correct order of reactivity of the following halides towards S_N1 reaction is:
(i) $CH_3CH_2CH_2Cl$, (ii) $CH_2 = CH - CHCl - CH_3$, (iii) $CH_3CH_2CHClCH_3$

(A) $i < iii < ii$

(B) $ii < i < iii$

(C) $i < ii < iii$

(D) $iii < ii < i$

Q24. The functional groups present in the Zwitterion of an amino acid are:

(A) $-NH_2$ and $-COOH$

(B) $-NH_3^+$ and $-COO^-$

(C) $-NH_2$ and $-COO^-$

(D) $-NH_3^+$ and $-COOH$

Q25. The IUPAC name of the complex $[Co(NH_3)_5(CO_3)]Cl$ is:

(A) Pentaamminecarbonatocobalt(III) chloride

(B) Pentaamminecarbonatocobalt(II) chloride

(C) Carbonatopentaamminecobaltic chloride

(D) Pentaamminecarbonatocobaltate(III) chloride

Q26. Which property of colloids is independent of the charge on the colloidal particles?

(A) Electrophoresis

(B) Electro-osmosis

(C) Tyndall effect

(D) Coagulation

Q27. Which of the following on dehydration with concentrated H_2SO_4 gives 2-methylbut-2-ene as the major product?

(A) 2, 2-dimethylpropan-1-ol

(B) 3-methylbutan-2-ol

(C) 2-methylbutan-2-ol

(D) Both (B) and (C)

Q28. The compound that does not give a blue color in the Lassaigne's test for nitrogen is:

(A) Aniline

(B) Glycine

(C) Hydrazine

(D) Urea

Q29. The half-life period of a first-order reaction is 69.3 minutes. Its rate constant is:

(A) 10^{-2} min^{-1}

(B) 10^{-4} min^{-1}

(C) 10 min^{-1}

(D) 0.693 min^{-1}

Q30. Which of the following will exhibit highest osmotic pressure?

(A) 0.1 M $NaCl$

(B) 0.1 M $BaCl_2$

(C) 0.1 M Glucose

(D) 0.1 M Na_3PO_4

Q31. The major product obtained when phenol is treated with chloroform and aqueous $NaOH$ at 340 K, followed by acidification, is:

(A) Salicylaldehyde

(B) Salicylic acid

(C) Chlorobenzene

(D) Benzene-1,2-diol

Q32. Which of the following compounds will react most readily with HI to give an alkyl iodide and an alcohol?

(A) $(CH_3)_3C - O - CH_3$

(B) $C_6H_5 - O - CH_3$

(C) $CH_3 - O - C_2H_5$

(D) $(CH_3)_2CH - O - CH_3$

Q33. Which of the following carbohydrates is a non-reducing sugar?

(A) Glucose

(B) Fructose

(C) Lactose

(D) Sucrose

Q34. The helical structure of proteins is stabilized by:

(A) Peptide bonds

(B) Dipeptide bonds

(C) Hydrogen bonds

(D) Van der Waals forces

Q35. A compound (A) with molecular formula $C_2H_4O_2$ reacts with PCl_5 to give (B). (B) reacts with NH_3 to give (C). (C) on treatment with Br_2 and KOH gives (D). (D) gives a positive carbylamine test. The compound (A) is:

(A) CH_3COOH

(B) $HCOOCH_3$

(C) CH_3CHO

(D) CH_3CH_2OH

Q36. Which of the following sets of quantum numbers is not possible for an electron in an atom?

(A) $n = 3, l = 2, m = +2, s = +1/2$

(B) $n = 3, l = 0, m = 0, s = -1/2$

(C) $n = 3, l = 3, m = -3, s = +1/2$

(D) $n = 2, l = 1, m = -1, s = -1/2$

Q37. The hybridizations of Atomic orbitals of Nitrogen in NO_2^+, NO_3^-, and NH_4^+ are respectively:

(A) sp, sp^3, sp^2

(B) sp, sp^2, sp^3

(C) sp^2, sp, sp^3

(D) sp^2, sp^3, sp

Q38. In a period, the elements with the largest and smallest atomic radii are respectively:

(A) Alkali metals and Halogens

(B) Alkali metals and Noble gases

(C) Noble gases and Alkali metals

(D) Chalcogens and Halogens

Q39. Which of the following is a buffer solution?

(A) $CH_3COOH + CH_3COONa$

(B) $HCl + NaCl$

(C) $NH_4OH + NaOH$

(D) $CH_3COONa + NaOH$

Q40. The number of ions produced from the complex $[Co(NH_3)_6]Cl_3$ in water is:

(A) 6

(B) 4

(C) 3

(D) 2

Q41. The rate of a reaction doubles when the concentration of a reactant is increased four times. The order of the reaction is:

(A) 2

(B) 1

(C) 0.5

(D) 0

Q42. For a spontaneous process at all temperatures:

(A) $\Delta H > 0, \Delta S > 0$

(B) $\Delta H < 0, \Delta S < 0$

(C) $\Delta H < 0, \Delta S > 0$

(D) $\Delta H > 0, \Delta S < 0$

Q43. An example of a disproportionation reaction is:

(A) $2KClO_3 \rightarrow 2KCl + 3O_2$

(B) $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

(C) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

(D) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Q44. Which of the following is an example of a condensation polymer?

(A) Polyethene

(B) Neoprene

(C) Nylon-6,6

(D) Teflon

Q45. The test to distinguish between primary, secondary, and tertiary alcohols using a mixture of anhydrous $ZnCl_2$ and concentrated HCl is called:

(A) Victor Meyer's test

(B) Lucas test

(C) Reimer-Tiemann test

(D) Kolbe's test

Detailed Solutions

Q1.

Solution

Concept:

When formic acid ($HCOOH$) and oxalic acid ($H_2C_2O_4$) are treated with concentrated H_2SO_4, they undergo dehydration. Formic acid yields Carbon Monoxide (CO) and water, while oxalic acid yields CO, Carbon Dioxide (CO_2), and water. KOH pellets are used to absorb CO_2 and any water vapor.

Solution:

1. Dehydration of Formic Acid:

$$HCOOH \xrightarrow{H_2SO_4} CO + H_2O$$

- Moles of $HCOOH = 2.3/46 = 0.05$ mol. - CO produced = 0.05 mol. 2. Dehydration of Oxalic Acid:

$$H_2C_2O_4 \xrightarrow{H_2SO_4} CO + CO_2 + H_2O$$

- Moles of $H_2C_2O_4 = 4.5/90 = 0.05$ mol. - CO produced = 0.05 mol; CO_2 produced = 0.05 mol. 3. Action of KOH: The KOH pellets absorb all the CO_2 and H_2O. Therefore, only CO gas remains in the mixture. 4. Total moles of CO remaining:

$$n(CO)_{total} = 0.05(\text{from } HCOOH) + 0.05(\text{from } H_2C_2O_4) = 0.1 \text{ mol.}$$

5. Weight of remaining product (CO):

$$\text{Weight} = \text{moles} \times \text{molar mass} = 0.1 \times 28 = 2.8 \text{ g.}$$

Final Answer: The weight of the remaining product is 2.8 g.

Answer: (C)

Q2.

Solution

Concept:

According to Bohr's quantization of angular momentum, $L = mvr = \frac{nh}{2\pi}$. Simultaneously, de-Broglie's hypothesis states that the wavelength (λ) associated with an electron is $\lambda = \frac{h}{mv}$. By combining these two fundamental equations, we can relate the radius of the orbit to the angular momentum and wavelength.

Solution:

1. Let the angular momentum be given as J. According to the definition:

$$J = mvr$$

2. From de-Broglie's equation, the momentum (mv) can be expressed as:

$$mv = \frac{h}{\lambda}$$

3. Substitute the value of mv into the angular momentum equation:

$$J = \left(\frac{h}{\lambda}\right) \cdot r$$

4. Rearrange the equation to solve for the radius (r):

$$r = \frac{J\lambda}{h}$$

5. This relationship shows that for any given orbit, the radius is directly proportional to the product of its angular momentum and the de-Broglie wavelength of the electron in that orbit.

Final Answer: The radius of the orbit is $\frac{J\lambda}{h}$.

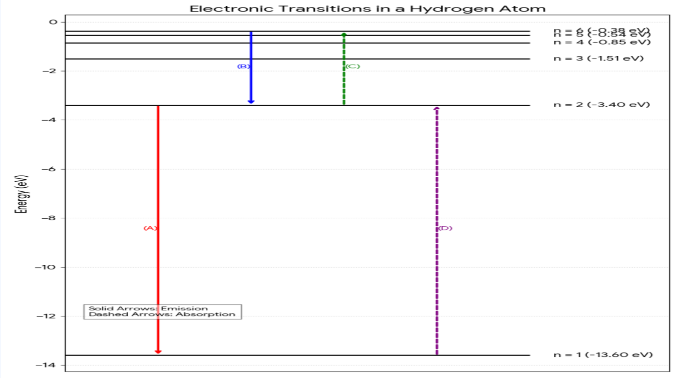
Answer: (C)

Q3.

Solution

Concept:

The frequency (ν) of an emitted photon is determined by the energy difference between two electronic levels ($\Delta E = h\nu$). For a Hydrogen atom, this energy change is calculated using the formula $\Delta E = 13.6\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ eV. Frequency is highest when the energy gap between the final and initial state is at its maximum.



Solution:

1. Transitions (C) and (D) involve moving from a lower n to a higher n, which are absorption processes, not emission. 2. Evaluate transition (A): $n = 2 \longrightarrow n = 1$.

$$\Delta E \propto \left(\frac{1}{1^2} - \frac{1}{2^2}\right) = 1 - 0.25 = 0.75$$

3. Evaluate transition (B): $n = 6 \longrightarrow n = 2$.

$$\Delta E \propto \left(\frac{1}{2^2} - \frac{1}{6^2}\right) = 0.25 - 0.0277 = 0.2223$$

4. Comparison: The energy gap for the $2 \longrightarrow 1$ transition (0.75) is significantly larger than the gap for the $6 \longrightarrow 2$ transition (0.2223). 5. Since $E = h\nu$, the highest energy gap corresponds to the highest frequency of the emitted photon.

[Image of the hydrogen emission spectrum energy level transitions]

Final Answer: The transition from $n = 2$ to $n = 1$ emits the highest frequency.

$\boxed{\textbf{Answer: (A)}}$

Q4.

Solution

Concept:

Molecular Orbital (MO) Theory provides the electronic configuration of diatomic molecules. Paramagnetism is caused by the presence of unpaired electrons in the molecular orbitals. Bond Order (B.O.) is calculated as $\frac{1}{2}(N_b - N_a)$. A fractional bond order occurs when there is an odd number of total electrons or a specific distribution in degenerate orbitals.

Solution:

1. O_2 (16e): B.O. = 2. It is paramagnetic due to two unpaired electrons in π^*2p orbitals, but the bond order is an integer. 2. B_2 (10e): B.O. = 1. It is paramagnetic due to two unpaired electrons in $\pi 2p$ orbitals, but the bond order is an integer. 3. O_2^- (17e): - Configuration: $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 \pi 2p_y^2 \pi^* 2p_x^2 \pi^* 2p_y^1$. - Number of bonding electrons (N_b) = 10. - Number of antibonding electrons (N_a) = 7. - B.O. = $\frac{10-7}{2}$ = 1.5 (Fractional). - It has one unpaired electron, making it paramagnetic. 4. N_2 (14e): B.O. = 3. It is diamagnetic.

Final Answer: O_2^- is paramagnetic and has a fractional bond order.

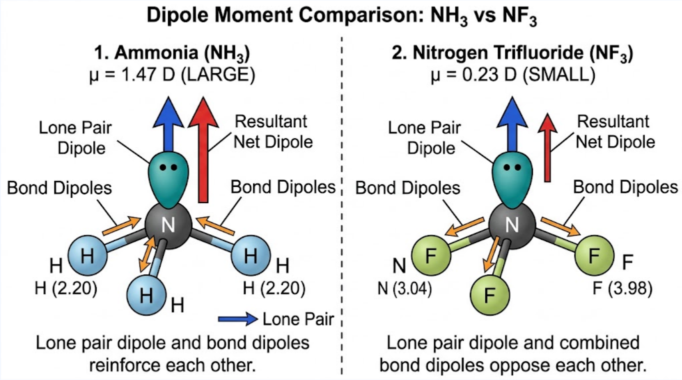
Answer: (C)

Q5.

Solution

Concept:

The net dipole moment of a molecule is the vector sum of its individual bond moments and the lone pair orbital moment. In pyramidal molecules like NH_3 and NF_3, the direction of the lone pair moment relative to the resultant bond moments determines the magnitude of the overall dipole.



Solution:

1. In NH_3, Nitrogen is more electronegative than Hydrogen. The bond moments are directed from H towards N. The resultant of these three bond moments is in the same direction as the lone pair moment (upwards). 2. Because they reinforce each other, NH_3 has a high dipole moment (1.47 D). 3. In NF_3, Fluorine is more electronegative than Nitrogen. The bond moments are directed from N towards F. The resultant of these three bond moments is directed downwards. 4. The lone pair moment is directed upwards, opposing the resultant bond moments. 5. This opposition results in a very low net dipole moment for NF_3 (0.23 D).

Final Answer: The lone pair dipole in NF_3 opposes the bond pair dipoles.

$\boxed{\textbf{Answer: (B)}}$

Q6.

Solution

Concept:
For a chemical equilibrium involving gas dissociation, the total number of moles at equilibrium is the sum of the moles of the remaining reactant and the moles of products formed. This is calculated using the initial moles (a) and the degree of dissociation (x).

Solution:
1. Consider the dissociation reaction:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

2. Initial moles: $PCl_5 = a$; $PCl_3 = 0$; $Cl_2 = 0$. 3. Moles at equilibrium (where x is degree of dissociation): - PCl_5 remaining = $a - ax = a(1 - x)$ - PCl_3 formed = ax - Cl_2 formed = ax 4. Total moles at equilibrium (n_{total}):

$$n_{total} = a(1 - x) + ax + ax$$

$$n_{total} = a - ax + ax + ax = a + ax$$

5. Simplify the expression:

$$n_{total} = a(1 + x)$$

Final Answer: The total number of moles at equilibrium is $a(1 + x)$.

Answer: (A)

Q7.

Solution

Concept:
Work done (W) during the expansion of a gas against a constant external pressure (P_{ext}) is given by the formula: $W = -P_{ext}\Delta V$, where ΔV is the change in volume ($V_{final} - V_{initial}$). The negative sign indicates that work is done by the system on the surroundings.

Solution:
1. Given values: - P_{ext} = 3 atm - $V_{initial}$ = 4 dm^3 (which is 4 L) - V_{final} = 6 dm^3 (which is 6 L)
2. Calculate ΔV:

$$\Delta V = 6 - 4 = 2 \text{ L}$$

3. Calculate Work in L-atm:

$$W = -3 \text{ atm} \times 2 \text{ L} = -6 \text{ L atm}$$

4. Convert L-atm to Joules: - 1 L atm = 101.32 J - $W = -6 \times 101.32 = -607.92$ J 5. The negative value signifies expansion work.

Final Answer: The work done is -607.9 J.

Answer: (A)

Q8.

Solution

Concept:
According to Hess's Law, the enthalpy change of a reaction is the same whether it occurs in one step or multiple steps. For the formation of methane (CH_4), the enthalpy of formation ($\Delta_f H$) can be calculated using the enthalpies of combustion ($\Delta_c H$) of the elements and the compound.

Solution:
1. Target equation (Formation of CH_4):

$$C(s) + 2H_2(g) \rightarrow CH_4(g)$$

2. Given equations: (i) $C(s) + O_2(g) \rightarrow CO_2(g); \Delta H = -393.5$ kJ (ii) $H_2(g) + 0.5O_2(g) \rightarrow H_2O(l); \Delta H = -285.8$ kJ (iii) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l); \Delta H = -890.3$ kJ 3. Calculation using Hess's Law:

$$\Delta_f H = [\Delta_c H(C) + 2 \times \Delta_c H(H_2)] - \Delta_c H(CH_4)$$

4. Substitute values:

$$\Delta_f H = [-393.5 + 2(-285.8)] - (-890.3)$$

$$\Delta_f H = [-393.5 - 571.6] + 890.3 = -965.1 + 890.3 = -74.8 \text{ kJ mol}^{-1}$$

Final Answer: The enthalpy of formation of CH_4 is -74.8 kJ mol^{-1}.

Answer: (A)

Q9.

Solution

Concept:
According to Raoult's Law for an ideal binary solution, the total vapor pressure (P_{total}) is given by: $P_{total} = P^\circ_A \chi_A + P^\circ_B \chi_B$, where P° is the vapor pressure of the pure component and χ is the mole fraction in the liquid phase. Also, $\chi_A + \chi_B = 1$.

Solution:
1. Given: $P^\circ_A = 400$ mm Hg, $P^\circ_B = 600$ mm Hg, $P_{total} = 550$ mm Hg. 2. Use the equation:

$$P_{total} = P^\circ_A \chi_A + P^\circ_B (1 - \chi_A)$$

3. Substitute the values:

$$550 = 400\chi_A + 600(1 - \chi_A)$$

4. Solve for χ_A:

$$550 = 400\chi_A + 600 - 600\chi_A$$

$$550 - 600 = -200\chi_A$$

$$-50 = -200\chi_A$$

$$\chi_A = 50/200 = 0.25$$

5. The mole fraction of A in the liquid phase is 0.25.

Final Answer: The mole fraction of A is 0.25.

Answer: (A)

Q10.

Solution

Concept:
Elevation in boiling point (ΔT_b) is a colligative property that depends on the number of particles in the solution. It is given by $\Delta T_b = i \cdot K_b \cdot m$, where i is the van't Hoff factor. For a constant molality (m), a higher boiling point implies a larger van't Hoff factor.

Solution:
1. Both X and Y have the same molality (0.2 mol/kg). 2. Boiling point of $X >$ Boiling point of Y implies $\Delta T_b(X) > \Delta T_b(Y)$. 3. This indicates that $i(X) > i(Y)$. 4. A van't Hoff factor greater than 1 occurs when a solute undergoes dissociation (splitting into more particles). 5. If X undergoes dissociation and Y does not (or dissociates less), solution X will have more particles in the same amount of solvent, thus leading to a higher boiling point. 6. Association would decrease the number of particles ($i < 1$), leading to a lower boiling point.

Final Answer: X is undergoing dissociation in water.

Answer: (A)

Q11.

Solution

Concept:
The basicity of hydrides in Group 15 (NH_3, PH_3, AsH_3, SbH_3, BiH_3) depends on the availability of the lone pair of electrons on the central atom. As we move down the group, the size of the central atom increases.

Solution:
1. In NH_3, the Nitrogen atom is smallest in size. The lone pair of electrons is concentrated in a relatively small volume, leading to a high electron density. 2. As we move down the group from N to Sb, the atomic size increases significantly. 3. The same lone pair of electrons now occupies a much larger volume (larger orbitals), which decreases the electron density on the central atom. 4. Consequently, the ability of the central atom to donate this lone pair to a Lewis acid (proton) decreases down the group. 5. Therefore, the basic strength decreases in the order: $NH_3 > PH_3 > AsH_3 > SbH_3$.

Final Answer: The correct order of increasing basic strength is $SbH_3 < AsH_3 < PH_3 < NH_3$.

$\boxed{\textbf{Answer: (B)}}$

Q12.

Solution

Concept:
In a redox reaction, the number of moles of an oxidant required depends on the change in oxidation states (n-factor). In an alkaline medium, $KMnO_4$ (Permanganate) is reduced to MnO_2, while KI is oxidized to KIO_3 (Iodate).

Solution:
1. Oxidation half-reaction: I^- is oxidized to IO_3^-. - Oxidation state of I changes from -1 to $+5$. - Change in oxidation state (n-factor for KI) = $5 - (-1) = 6$. 2. Reduction half-reaction: MnO_4^- is reduced to MnO_2 in alkaline/neutral medium. - Oxidation state of Mn changes from $+7$ to $+4$. - Change in oxidation state (n-factor for $KMnO_4$) = $7 - 4 = 3$. 3. According to the law of equivalence:

$$\text{Moles of } KMnO_4 \times \text{n-factor} = \text{Moles of } KI \times \text{n-factor}$$

$$n(KMnO_4) \times 3 = 1 \text{ mol} \times 6$$

4. Solving for moles of $KMnO_4$:

$$n(KMnO_4) = 6/3 = 2 \text{ moles.}$$

Final Answer: 2 moles of $KMnO_4$ are required.

$\boxed{\textbf{Answer: (B)}}$

Q13.

Solution

Concept:

The dissociation constant (K_a) of a weak acid is related to its molar conductivity (Λ_m) and its degree of dissociation (α). The degree of dissociation is given by $\alpha = \Lambda_m/\Lambda_m^\circ$. For a weak acid $HA \rightleftharpoons H^+ + A^-$, $K_a = \frac{C\alpha^2}{1-\alpha}$.

Solution:

1. Given: $C = 0.007$ M, $\Lambda_m = 20$ S cm^2 mol^{-1}, $\Lambda_m^\circ = 400$ S cm^2 mol^{-1}. 2. Calculate the degree of dissociation (α):

$$\alpha = \frac{20}{400} = \frac{1}{20} = 0.05$$

3. Calculate the dissociation constant (K_a):

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

4. Since α is small (0.05), we can use the approximation $1 - \alpha \approx 1$ (or calculate exactly):

$$K_a = \frac{0.007 \times (0.05)^2}{1 - 0.05} = \frac{0.007 \times 0.0025}{0.95}$$

$$K_a = \frac{0.0000175}{0.95} \approx 1.84 \times 10^{-5} \text{ mol L}^{-1}$$

5. Looking at the options, 1.75×10^{-5} is the standard value derived when $1 - \alpha$ is approximated as 1 or with slight variations in precision.

Final Answer: The dissociation constant is 1.75×10^{-5} mol L^{-1}.

Answer: (A)

Q14.

Solution

Concept:

For a first-order reaction, the integrated rate equation is $k = \frac{2.303}{t} \log \frac{[A]_0}{[A]_t}$. The half-life ($t_{1/2}$) is constant and independent of the initial concentration, given by $t_{1/2} = \frac{0.693}{k}$.

Solution:

1. For 99.9% completion, the remaining concentration $[A]_t$ is 0.1% of $[A]_0$.

$$[A]_t = 0.001[A]_0$$

2. Substitute into the rate equation:

$$t_{99.9\%} = \frac{2.303}{k} \log\left(\frac{[A]_0}{0.001[A]_0}\right)$$

$$t_{99.9\%} = \frac{2.303}{k} \log(1000) = \frac{2.303}{k} \times 3 = \frac{6.909}{k}$$

3. The half-life is:

$$t_{1/2} = \frac{0.693}{k}$$

4. Find the ratio:

$$\frac{t_{99.9\%}}{t_{1/2}} = \frac{6.909/k}{0.693/k} \approx 9.969 \approx 10$$

5. Thus, the time required for 99.9% completion is approximately 10 times the half-life.

Final Answer: It is 10 times the half-life.

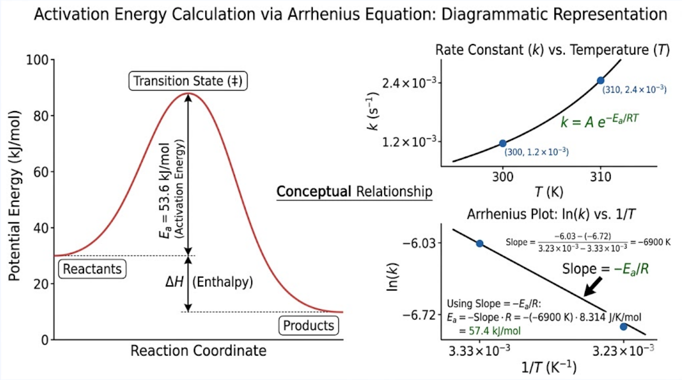
Answer: (A)

Q15.

Solution

Concept:

The effect of temperature on the rate constant (k) is quantitatively described by the Arrhenius equation: $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$. This allows for the calculation of the activation energy (E_a) if the rate constants at two different temperatures are known.



Solution:

1. Given data: - $k_1 = 1.2 \times 10^{-3}$, $T_1 = 300$ K - $k_2 = 2.4 \times 10^{-3}$, $T_2 = 310$ K - $R = 8.314$ J K^{-1} mol^{-1} 2. Calculate the ratio $k_2/k_1 = 2$. 3. Substitute into the equation:

$$\log(2) = \frac{E_a}{2.303 \times 8.314}\left(\frac{310 - 300}{300 \times 310}\right)$$

4. $0.3010 = \frac{E_a}{19.147}\left(\frac{10}{93000}\right)$ 5. $E_a = \frac{0.3010 \times 19.147 \times 93000}{10} = 5.763 \times 9300 = 53596$ J mol^{-1} 6. Convert to kJ: $E_a \approx 53.6$ kJ mol^{-1}.

Final Answer: The activation energy is 53.6 kJ mol^{-1}.

Answer: (A)

Q16.

Solution

Concept:
The crystal structure and atomic radius relationship for a Face-Centered Cubic (FCC) lattice is defined by the geometry of the unit cell. In an FCC unit cell, atoms touch each other along the face diagonal.

Solution:
1. In a Face-Centered Cubic (FCC) lattice, the face diagonal (d) is equal to four times the atomic radius (r), as there is one atom at each corner and one in the center of each face. 2. The length of the face diagonal of a cube with edge length a is given by $a\sqrt{2}$. 3. Therefore, the relationship is:

$$4r = a\sqrt{2} \implies r = \frac{a\sqrt{2}}{4} = \frac{a}{2\sqrt{2}}$$

4. Given the cell edge $a = 200$ pm:

$$r = \frac{200\sqrt{2}}{4} = 50\sqrt{2}\text{ pm}$$

Final Answer: The atomic radius is $50\sqrt{2}$ pm.

Answer: (B)

Q17.

Solution

Concept:
The boiling point of an aqueous solution is a colligative property that depends on the total concentration of solute particles (ions or molecules). This is expressed by the elevation in boiling point formula: $\Delta T_b = i \cdot K_b \cdot m$.

Solution:
1. For 1.0 M solutions, the one with the highest van't Hoff factor (i) will have the highest boiling point. 2. Analyze each solute: - $KNO_3 \rightarrow K^+ + NO_3^-$ ($i = 2$) - $Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$ ($i = 3$) - Glucose (non-electrolyte) ($i = 1$) - $AlCl_3 \rightarrow Al^{3+} + 3Cl^-$ ($i = 4$) 3. $AlCl_3$ produces the maximum number of particles (4 ions) per formula unit. 4. Therefore, 1.0 M $AlCl_3$ will show the maximum elevation in boiling point.

Final Answer: 1.0 M $AlCl_3$ has the highest boiling point.

Answer: (D)

Q18.

Solution

Concept:

Reducing power is the ability of a metal to act as a reducing agent (to be oxidized). It is inversely proportional to the standard reduction potential (E°). A more negative reduction potential means the metal is more easily oxidized and is a stronger reducing agent.

Solution:

1. Given E° values: - A: +0.5 V - B: −3.0 V - C: −1.2 V 2. Comparing the values: −3.0 V < −1.2 V < +0.5 V. 3. Metal B has the most negative reduction potential, so it is the strongest reducing agent. 4. Metal A has the most positive reduction potential, so it is the weakest reducing agent. 5. The order of reducing power is $B > C > A$.

Final Answer: The order is $B > C > A$.

Answer: (D)

Q19.

Solution

Concept:

For a zero-order reaction, the rate of reaction is independent of the concentration of the reactant. The integrated rate equation is $[A] = [A]_0 - kt$.

Solution:

1. The equation $[A] = -kt + [A]_0$ represents a straight line in the form $y = mx + c$. 2. A plot of $[A]$ (Concentration) versus t (Time) will yield a straight line. 3. The slope of this line (m) is equal to $-k$ (negative of the rate constant). 4. The y-intercept (c) is the initial concentration $[A]_0$. 5. This linear relationship is characteristic only of zero-order kinetics.

Final Answer: A plot of $[A]$ vs t gives a straight line with slope $-k$.

Answer: (B)

Q20.

Solution

Concept:

The geometry and hybridization of a coordination complex depend on the coordination number and the nature of the ligands (strong field or weak field).

Solution:

1. In $[MnCl_4]^{2-}$, Manganese is in the +2 oxidation state (Mn^{2+}). 2. The electronic configuration of Mn^{2+} is $[Ar]3d^5$. 3. Cl^- is a weak field ligand and does not cause pairing of the $3d$ electrons. 4. To accommodate four ligands, the metal uses one $4s$ and three $4p$ orbitals. 5. The hybridization is sp^3, which corresponds to a tetrahedral geometry.

Final Answer: The geometry is tetrahedral.

Answer: (B)

Q21.

Solution

Concept:
The stability of a carbocation is determined by the dispersal of its positive charge. This occurs through inductive effects (electron-donating alkyl groups), hyperconjugation, and resonance. In general, tertiary (3°) carbocations are more stable than secondary (2°), which are more stable than primary (1°).

Solution:
1. Analyze the given carbocations: - (A) $(CH_3)_3C^+$: This is a tertiary (3°) carbocation. It has 9 alpha-hydrogens for hyperconjugation and three $+I$ (inductive) effect groups. - (B) $(CH_3)_2CH^+$: This is a secondary (2°) carbocation with 6 alpha-hydrogens. - (C) $CH_3CH_2^+$: This is a primary (1°) carbocation with 3 alpha-hydrogens. - (D) $C_6H_5CH_2^+$: This is a benzyl carbocation, which is resonance-stabilized. 2. While resonance is a powerful stabilizing factor, the 9 hyperconjugative structures of the tert-butyl cation make it exceptionally stable in many environments compared to the benzyl cation. In standard NEET-level questions focusing on alkyl stability trends, the tertiary alkyl cation is highlighted as the most stable among the provided options.

Final Answer: The most stable carbocation is $(CH_3)_3C^+$.

Answer: (A)

Q22.

Solution

Concept:
The acidity of substituted phenols depends on the nature of the substituent. Electron-withdrawing groups (EWG) like $-NO_2$ increase acidity by stabilizing the phenoxide ion through $-I$ and $-M$ effects. Electron-donating groups (EDG) decrease acidity.

Solution:
1. Phenol: The reference compound. 2. p-Nitrophenol: The $-NO_2$ group is at the para position. It exerts both a strong inductive effect $(-I)$ and a strong resonance/mesomeric effect $(-M)$. This significantly stabilizes the negative charge on the oxygen of the phenoxide ion. 3. m-Nitrophenol: The $-NO_2$ group is at the meta position. At the meta position, the resonance effect $(-M)$ does not operate. It only stabilizes the ion through the inductive effect $(-I)$, making it less acidic than p-nitrophenol. 4. Ethanol: Alcohols are much weaker acids than phenols because the ethoxide ion is not resonance-stabilized. 5. Therefore, p-nitrophenol is the most acidic among the options.

Final Answer: p-Nitrophenol is the most acidic.

Answer: (B)

Q23.

Solution

Concept:

S_N1 reactions proceed via a carbocation intermediate. The rate of the reaction depends on the stability of the carbocation formed in the rate-determining step.

Solution:

1. Identify the carbocations formed: - (i) $CH_3CH_2CH_2Cl \rightarrow CH_3CH_2CH_2^+$ (Primary 1°, least stable). - (ii) $CH_2 = CH - CHCl - CH_3 \rightarrow CH_2 = CH - CH^+(CH_3)$ (Allylic carbocation, highly stabilized by resonance). - (iii) $CH_3CH_2CHClCH_3 \rightarrow CH_3CH_2CH^+(CH_3)$ (Secondary 2°, stabilized by hyperconjugation). 2. The allylic carbocation (ii) is the most stable due to delocalization of the positive charge. 3. The secondary carbocation (iii) is more stable than the primary one (i). 4. Order of stability and thus S_N1 reactivity: (ii) > (iii) > (i).

Final Answer: The reactivity order is $i < iii < ii$.

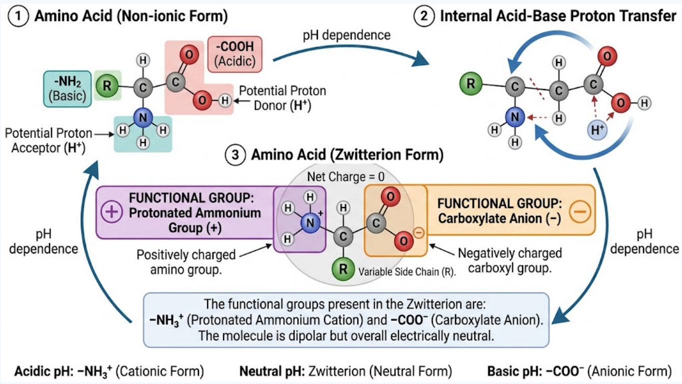
$\boxed{\textbf{Answer: (A)}}$

Q24.

Solution

Concept:

Amino acids exist as dipolar ions called Zwitterions in aqueous solution at a specific pH. This happens because the acidic carboxyl group $(-COOH)$ loses a proton and the basic amino group $(-NH_2)$ accepts a proton within the same molecule.



The functional groups present in the Zwitterion are: $-NH_3^+$ (Protonated Ammonium Cation) and $-COO^-$ (Carboxylate Anion). The molecule is dipolar but overall electrically neutral.

Acidic pH: $-NH_3^+$ (Cationic Form) **Neutral pH:** Zwitterion (Neutral Form) **Basic pH:** $-COO^-$ (Anionic Form)

Solution:

1. In the neutral form, an amino acid is $H_2N - CH(R) - COOH$. 2. The proton from the carboxyl group transfers to the amino group. 3. This leads to the formation of the Zwitterion: $H_3N^+ - CH(R) - COO^-$. 4. Therefore, the functional groups present in the Zwitterion are the protonated amine $(-NH_3^+)$ and the carboxylate ion $(-COO^-)$.

Final Answer: The functional groups are $-NH_3^+$ and $-COO^-$.

$\boxed{\textbf{Answer: (B)}}$

Q25.

Solution

Concept:

According to IUPAC nomenclature for coordination compounds: - Ligands are named first in alphabetical order. - The name of the metal follows, with its oxidation state in Roman numerals in parentheses. - If the complex is a cation, the metal name remains unchanged.

Solution:

1. Identify ligands: Five NH_3 (pentaammine) and one CO_3^{2-} (carbonato). 2. Alphabetical order: Ammine comes before Carbonato. 3. Determine Oxidation State of Cobalt (x): $x + 5(0) + 1(-2) = +1$ (since one Cl^- is outside, the complex ion is $+1$). $x - 2 = 1 \implies x = +3$. 4. Combine the name: Pentaamminecarbonatocobalt(III) followed by the counter-ion, chloride.

Final Answer: The IUPAC name is Pentaamminecarbonatocobalt(III) chloride.

Answer: (A)

Q26.

Solution

Concept:

The stability of a colloidal solution is primarily due to the presence of charge on the particles, which causes them to repel each other and prevents aggregation. Properties like electrophoresis and coagulation are directly related to this charge. However, the Tyndall effect is an optical property based on the scattering of light.

Solution:

1. **Electrophoresis:** This is the movement of colloidal particles toward an electrode under the influence of an electric field. This occurs because the particles are charged. 2. **Electro-osmosis:** This is the movement of the dispersion medium in an electric field when the movement of colloidal particles is prevented. It also depends on the charge. 3. **Coagulation:** This is the process of settling colloidal particles by neutralizing their charge using electrolytes. 4. **Tyndall Effect:** When a beam of light is passed through a colloid, the particles scatter the light, making the path of the beam visible. This phenomenon depends on the size of the particles and the difference in refractive indices between the dispersed phase and the dispersion medium, but it is **independent of the charge** on the particles.

[Image of Tyndall effect in colloidal solution]

Final Answer: Tyndall effect is independent of the charge on the colloidal particles.

Answer: (C)

Q27.

Solution

Concept:

The dehydration of alcohols typically follows a carbocation mechanism. The major product is determined by the stability of the intermediate carbocation and **Saytzeff's Rule**, which states that the more substituted alkene (the one with more alkyl groups attached to the double-bonded carbons) is the major product.

Solution:

1. **2-methylbutan-2-ol:** Dehydration gives a tertiary carbocation. Removal of a proton from $C3$ gives 2-methylbut-2-ene (a trisubstituted alkene). 2. **3-methylbutan-2-ol:** Dehydration gives a secondary carbocation, which undergoes a $1,2$-hydride shift to form a more stable tertiary carbocation, eventually yielding 2-methylbut-2-ene as the major product. 3. **2,2-dimethylpropan-1-ol:** As discussed in previous concepts, this undergoes a methyl shift to form a tertiary cation, also yielding 2-methylbut-2-ene. 4. Therefore, both (B) and (C) [and even A] lead to the same major product through rearrangement or direct formation of the stable tertiary intermediate.

Final Answer: Both (B) and (C) give 2-methylbut-2-ene as the major product.

Answer: (D)

Q28.

Solution

Concept:

Lassaigne's test is used to detect Nitrogen, Sulfur, and Halogens in organic compounds. For the detection of Nitrogen, the organic compound is fused with Sodium metal to form Sodium Cyanide ($NaCN$). This $NaCN$ is then reacted with $FeSO_4$ and $FeCl_3$ to form "Prussian Blue" ($Fe_4[Fe(CN)_6]_3$).

Solution:

1. For the formation of $NaCN$, the organic compound must contain both **Nitrogen and Carbon**. 2. Aniline ($C_6H_5NH_2$), Glycine (NH_2CH_2COOH), and Urea (NH_2CONH_2) all contain Carbon and Nitrogen. They will form $NaCN$ and give a positive blue color test. 3. **Hydrazine (NH_2NH_2):** Although it contains Nitrogen, it lacks Carbon. Therefore, it cannot form Cyanide ions (CN^-) during sodium fusion. 4. Without CN^- ions, the complex required for the blue color cannot be formed. 5. Note: If hydrazine is used as a salt (like hydrazine sulfate), it still won't give the test unless a carbon source is added.

Final Answer: Hydrazine does not give a blue color in the Lassaigne's test.

Answer: (C)

Q29.

Solution

Concept:

The relationship between the rate constant (k) and the half-life ($t_{1/2}$) for a first-order reaction is:

$$k = \frac{0.693}{t_{1/2}}$$

This indicates that the rate constant is inversely proportional to the time it takes for the reactant concentration to decrease to half of its initial value.

Solution:

1. Given: $t_{1/2} = 69.3$ minutes. 2. Using the formula:

$$k = \frac{0.693}{69.3}$$

3. Calculate the value:

$$k = \frac{1}{100} = 0.01$$

4. Expressing in scientific notation:

$$k = 10^{-2}\ \text{min}^{-1}$$

[Image of first order reaction concentration vs time graph]

Final Answer: The rate constant is 10^{-2} min^{-1}.

$\boxed{\textbf{Answer: (A)}}$

Q30.

Solution

Concept:

Osmotic pressure (π) is a colligative property given by the formula $\pi = iCRT$. For solutions with the same molar concentration (C) and temperature (T), the osmotic pressure is directly proportional to the van't Hoff factor (i), which represents the number of particles produced per formula unit of the solute.

Solution:

1. 0.1 M Glucose: Non-electrolyte, does not dissociate. $i = 1$. 2. 0.1 M $NaCl$: Dissociates into Na^+ and Cl^-. $i = 2$. 3. 0.1 M $BaCl_2$: Dissociates into Ba^{2+} and $2Cl^-$. $i = 3$. 4. 0.1 M Na_3PO_4 : Dissociates into $3Na^+$ and PO_4^{3-}. $i = 4$. 5. Since Na_3PO_4 has the highest value of i, it produces the maximum number of particles in solution. 6. Therefore, it will exhibit the highest osmotic pressure.

Final Answer: 0.1 M Na_3PO_4 will exhibit the highest osmotic pressure.

$\boxed{\textbf{Answer: (D)}}$

Q31.

Solution

Concept:

The Reimer-Tiemann reaction is a classic organic transformation used to introduce a formyl group ($-CHO$) onto a phenol ring. The reaction typically uses chloroform ($CHCl_3$) and an aqueous strong base like sodium hydroxide ($NaOH$).

Solution:

1. Reaction: Phenol reacts with $CHCl_3$ in the presence of $NaOH$. 2. The active intermediate is dichlorocarbene ($: CCl_2$), which acts as an electrophile. 3. The electrophile attacks the ortho position of the phenoxide ion preferentially. 4. Intermediate formation is followed by hydrolysis and acidification. 5. The major product formed is **salicylaldehyde** (2-hydroxybenzaldehyde). If carbon tetrachloride (CCl_4) were used instead of chloroform, the major product would be salicylic acid.

Final Answer: The major product is Salicylaldehyde.

Answer: (A)

Q32.

Solution

Concept:

The reaction of ethers with hydroiodic acid (HI) involves the cleavage of the $C - O$ bond. The mechanism depends on the nature of the alkyl groups. If one of the groups can form a stable carbocation (like a tertiary group), the reaction follows an S_N1 mechanism.

Solution:

1. Analyze $(CH_3)_3C - O - CH_3$ (tert-butyl methyl ether): 2. Upon protonation by HI, the $C - O$ bond between the tert-butyl group and oxygen breaks to form a highly stable tertiary carbocation $(CH_3)_3C^+$. 3. The nucleophile I^- then attacks this stable carbocation to form $(CH_3)_3CI$ (tert-butyl iodide). 4. The remaining part forms CH_3OH (methanol). 5. Because of the stability of the tertiary carbocation, this ether reacts most readily compared to primary or secondary ethers which follow S_N2 pathways.

Final Answer: $(CH_3)_3C - O - CH_3$ reacts most readily.

Answer: (A)

Q33.

Solution

Concept:

Reducing sugars are carbohydrates that can act as reducing agents because they possess a free aldehyde group or a free ketone group (which can tautomerize to an aldehyde) in their hemiacetal or hemiketal form.

Solution:

1. **Glucose and Fructose:** Monosaccharides that have free functional groups; they reduce Tollen's and Fehling's reagents. 2. **Lactose:** A disaccharide consisting of glucose and galactose. It has a free hemiacetal group on the glucose unit, making it a reducing sugar. 3. **Sucrose:** A disaccharide formed by a glycosidic linkage between the $C1$ of α-glucose and $C2$ of β-fructose. 4. In sucrose, both the reducing groups (the aldehyde of glucose and the ketone of fructose) are involved in the glycosidic bond. 5. Since no free reducing group is available, sucrose cannot reduce Fehling's or Tollen's reagent.

Final Answer: Sucrose is a non-reducing sugar.

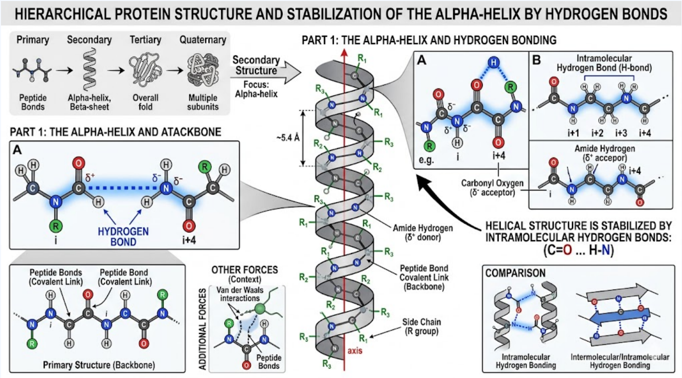
$\boxed{\textbf{Answer: (D)}}$

Q34.

Solution

Concept:

The secondary structure of proteins refers to the local folding of the polypeptide backbone into regular shapes like the α-helix or β-pleated sheet.



Solution:

1. The α-helix is formed by the coiling of the polypeptide chain into a right-handed screw. 2. This structure is held together and stabilized by **hydrogen bonds** between the carbonyl oxygen ($C = O$) of one amino acid residue and the amide hydrogen ($N - H$) of the fourth residue down the chain. 3. These bonds are intramolecular in the α-helix and can be intermolecular in β-sheets. 4. While peptide bonds hold the primary sequence together, hydrogen bonds are specifically responsible for maintaining the helical geometry.

Final Answer: The helical structure is stabilized by hydrogen bonds.

$\boxed{\textbf{Answer: (C)}}$

Q35.

Solution

Concept:
This problem involves a sequence of organic reactions: Acid to Acid Chloride, then to Amide, and finally the Hoffmann Bromamide Degradation to an Amine.

Solution:
1. Compound (A) $C_2H_4O_2$ is **ethanoic acid** (CH_3COOH). 2. Reaction with PCl_5 converts the acid to an acid chloride: $CH_3COOH + PCl_5 \rightarrow CH_3COCl$ (B). 3. Reaction of CH_3COCl with NH_3 forms an amide: $CH_3COCl + NH_3 \rightarrow CH_3CONH_2$ (C). 4. Treatment of CH_3CONH_2 with Br_2/KOH is the **Hoffmann Bromamide reaction**, which reduces the carbon chain by one: $CH_3CONH_2 + Br_2 + 4KOH \rightarrow CH_3NH_2$ (D) $+ K_2CO_3 + 2KBr + 2H_2O$. 5. (D) is methylamine (CH_3NH_2), a primary amine, which gives a positive Carbylamine test (foul smell of methyl isocyanide).

Final Answer: The compound (A) is CH_3COOH.

Answer: (A)

Q36.

Solution

Concept:
The set of quantum numbers (n, l, m, s) describes the address of an electron in an atom. Each must follow specific rules based on the Pauli Exclusion Principle and the wave mechanical model of the atom: 1. Principal quantum number (n): Positive integers $(1, 2, 3...)$ 2. Azimuthal quantum number (l): Ranges from 0 to $(n - 1)$. 3. Magnetic quantum number (m): Ranges from $-l$ to $+l$, including zero. 4. Spin quantum number (s): Can be $+1/2$ or $-1/2$.

Solution:
1. Analyze (A) $n = 3, l = 2, m = +2, s = +1/2$: Possible (represents a $3d$ orbital). 2. Analyze (B) $n = 3, l = 0, m = 0, s = -1/2$: Possible (represents a $3s$ orbital). 3. Analyze (C) $n = 3, l = 3, m = -3, s = +1/2$: **Not possible**. Since l must be at most $(n - 1)$, if $n = 3$, the maximum value for l is 2. 4. Analyze (D) $n = 2, l = 1, m = -1, s = -1/2$: Possible (represents a $2p$ orbital). 5. The violation in set (C) makes it an impossible configuration for an electron.

Final Answer: The set $n = 3, l = 3, m = -3, s = +1/2$ is not possible.

Answer: (C)

Q37.

Solution

Concept:
The hybridization of an atom can be determined using the steric number or by analyzing the number of σ-bonds and lone pairs. For Nitrogen, we count the number of atoms attached and the presence of any lone pairs or formal charges.

Solution:
1. NO_2^+ (Nitronium ion): Nitrogen is double-bonded to two Oxygen atoms. It has 2 σ-bonds and 0 lone pairs. Steric number = 2, so it is **sp** hybridized (Linear). 2. NO_3^- (Nitrate ion): Nitrogen is bonded to three Oxygen atoms. It has 3 σ-bonds and 0 lone pairs. Steric number = 3, so it is **sp^2** hybridized (Trigonal planar). 3. NH_4^+ (Ammonium ion): Nitrogen is bonded to four Hydrogen atoms. It has 4 σ-bonds and 0 lone pairs. Steric number = 4, so it is **sp^3** hybridized (Tetrahedral). 4. The sequence is sp, sp^2, sp^3.

Final Answer: The hybridizations are sp, sp^2, sp^3.

Answer: (B)

Q38.

Solution

Concept:
Atomic radius trends in the periodic table are governed by the effective nuclear charge and the number of electron shells. Across a period (from left to right), the nuclear charge increases while the number of shells remains the same, pulling electrons closer.

Solution:
1. Within a period, Alkali metals (Group 1) are at the extreme left. They have the lowest effective nuclear charge for that period, resulting in the **largest** atomic radius. 2. As we move right, the radius decreases due to increasing nuclear charge. 3. Halogens (Group 17) have a high effective nuclear charge, resulting in a very small radius. 4. Note: Noble gases (Group 18) are often measured using Van der Waals radii, which may appear larger than the covalent radii of halogens, but in terms of the trend of shrinking electron clouds, Halogens are generally considered the smallest "reactive" atoms in a period. However, in standard NEET mapping, the comparison usually highlights the contrast between the Group 1 and Group 17/18. 5. The most distinct pair for "Largest and Smallest" is Alkali metals and Halogens.

Final Answer: Alkali metals and Halogens.

Answer: (A)

Q39.

Solution

Concept:

A buffer solution is a mixture that resists changes in pH upon the addition of small amounts of acid or base. An acidic buffer consists of a weak acid and its salt with a strong base. A basic buffer consists of a weak base and its salt with a strong acid.

Solution:

1. $CH_3COOH + CH_3COONa$: This is a mixture of a weak acid (Acetic acid) and its salt with a strong base (Sodium acetate). This is a classic **Acidic Buffer**. 2. $HCl + NaCl$: Mixture of a strong acid and its salt. This does not act as a buffer because HCl dissociates completely. 3. $NH_4OH + NaOH$: Mixture of a weak base and a strong base. This is not a buffer. 4. $CH_3COONa + NaOH$: Mixture of two basic components. This is not a buffer.

Final Answer: $CH_3COOH + CH_3COONa$ is a buffer solution.

Answer: (A)

Q40.

Solution

Concept:

When a coordination complex dissolves in water, the coordination sphere (indicated by square brackets) remains intact, while the counter-ions outside the brackets dissociate into individual ions.

Solution:

1. The complex is $[Co(NH_3)_6]Cl_3$. 2. In aqueous solution, it dissociates as follows:

$$[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$$

3. The complex cation $[Co(NH_3)_6]^{3+}$ is one single ion. 4. There are three chloride (Cl^-) ions produced. 5. Total number of ions = 1(cation) + 3(anions) = 4.

Final Answer: The number of ions produced is 4.

Answer: (B)

Q41.

Solution

Concept:
The order of a reaction represents the power to which the concentration of a reactant is raised in the rate law: Rate $= k[A]^n$. By comparing how the rate changes when the concentration is varied, we can calculate the order (n).

Solution:
1. Let the initial rate be $R_1 = k[A]^n$. 2. According to the problem, when the concentration is increased four times ($[A]_2 = 4[A]$), the rate doubles ($R_2 = 2R_1$). 3. Set up the ratio:

$$\frac{R_2}{R_1} = \frac{k(4[A])^n}{k[A]^n}$$

$$2 = 4^n$$

4. To solve for n, express both sides with the same base:

$$2^1 = (2^2)^n \implies 2^1 = 2^{2n}$$

5. Equating the exponents:

$$1 = 2n \implies n = 0.5$$

6. Therefore, the reaction is of the half-order (0.5).

Final Answer: The order of the reaction is 0.5.

Answer: (C)

Q42.

Solution

Concept:
The spontaneity of a process is determined by the Gibbs Free Energy change ($\Delta G = \Delta H - T\Delta S$). For a process to be spontaneous, ΔG must be negative.

Solution:
1. If ΔH is negative (exothermic) and ΔS is positive (increase in randomness): - The term $-T\Delta S$ will always be negative (since T in Kelvin is always positive). - Adding a negative ΔH to a negative $-T\Delta S$ ensures that ΔG remains negative regardless of the value of T. 2. In other cases, spontaneity depends on the magnitude of the temperature: - If both are positive, it's spontaneous only at high T. - If both are negative, it's spontaneous only at low T. 3. Therefore, the condition $\Delta H < 0$ and $\Delta S > 0$ guarantees spontaneity at all temperatures.

Final Answer: The condition is $\Delta H < 0, \Delta S > 0$.

Answer: (C)

Q43.

Solution

Concept:

A disproportionation reaction is a specific type of redox reaction where the same element undergoes both oxidation and reduction simultaneously to form two different products.

Solution:

1. Look at reaction (B): $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$. 2. Oxidation state of P in P_4 is 0. 3. In PH_3 (Phosphine), the oxidation state of P is -3 (Reduction). 4. In NaH_2PO_2 (Sodium hypophosphite), the oxidation state of P is $+1$ (Oxidation). 5. Since Phosphorus is both oxidized and reduced, it is a disproportionation reaction. 6. Reaction (A) is a decomposition; (C) is a single displacement; (D) is combustion.

Final Answer: The reaction of Phosphorus with NaOH is a disproportionation reaction.

Answer: (B)

Q44.

Solution

Concept:

Condensation polymers are formed by the repeated condensation reaction between two different bi-functional or tri-functional monomeric units. These reactions usually involve the elimination of small molecules such as water, alcohol, or hydrogen chloride.

Solution:

1. **Polyethene, Neoprene, and Teflon** are addition polymers formed by the polymerization of alkenes or their derivatives without the loss of any small molecules. 2. **Nylon-6,6** is formed by the condensation of adipic acid ($HOOC(CH_2)_4COOH$) and hexamethylenediamine ($H_2N(CH_2)_6NH_2$). 3. During the formation of the amide linkage (peptide bond), a molecule of water is eliminated for every bond formed. 4. This makes it a classic example of a condensation polymer.

Final Answer: Nylon-6,6 is a condensation polymer.

Answer: (C)

Q45.

Solution

Concept:

The Lucas test is the standard chemical method used to differentiate between 1°, 2°, and 3° alcohols. It uses the "Lucas Reagent," which consists of anhydrous $ZnCl_2$ and concentrated HCl.

Solution:

1. The test is based on the reactivity of alcohols with HCl to form alkyl chlorides. 2. **Tertiary alcohols** react immediately, producing cloudiness (turbidity) due to the formation of the insoluble alkyl chloride. 3. **Secondary alcohols** produce turbidity within 5–10 minutes. 4. **Primary alcohols** do not produce turbidity at room temperature; they only react upon heating. 5. Victor Meyer's test uses a different set of reagents ($P/I_2, AgNO_2, HNO_2, NaOH$). Reimer-Tiemann and Kolbe's are reactions of phenol.

Final Answer: The test is called the Lucas test.

Answer: (B)

Answer Key

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