

JEE Main Chemistry Sample Paper-11

Duration: 1 Hour

Maximum Marks: 100

Instructions

- This paper contains TWO sections: **Section A** (MCQs) and **Section B** (Numerical).
- Section A contains 20 Multiple Choice Questions.
- Section B contains 5 Numerical Value Questions.
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Section A — Multiple Choice Questions

- Q1.** The correct decreasing order of the stability of the following carbocations is: [JEE Main 2023]
- (A) II > I > III
(B) I > II > III
(C) II > III > I
(D) III > II > I
- Q2.** The number of chiral carbons present in the molecule 2-bromo-3-chlorobutane is: [JEE Main 2022]
- (A) 1
(B) 2
(C) 3
(D) 4
- Q3.** An organic compound 'A' (C_4H_8) on treatment with $KMnO_4/H^+$ yields a single carboxylic acid 'B'. When 'A' is treated with HBr , it gives 'C'. 'C' on treatment with alcoholic KOH gives 'D' (an isomer of A). The compound 'A' is: [JEE Main 2024]
- (A) But-1-ene



- (B) But-2-ene
- (C) Cyclobutane
- (D) Methylcyclopropane

Q4. The major product formed in the following reaction is: $CH_3CH(Cl)CH_2CH_2OH \xrightarrow{Aq. I_2}$

[JEE Main 2021]

- (A) $CH_3CH(OH)CH_2CH_2OH$
- (B) $CH_2 = CHCH_2CH_2OH$
- (C) 2-methyltetrahydrofuran
- (D) 2-methyloxetane

Q5. Identify the product 'P' in the following reaction: $Phenol \xrightarrow[2.CO_2, \Delta]{1.NaOH} A \xrightarrow[Pyridine]{AceticAnhydride} P$

[JEE Main 2023]

- (A) Salicylaldehyde
- (B) Aspirin
- (C) Salol
- (D) Methyl salicylate

Q6. Which of the following compounds will not undergo Friedel-Crafts reaction?

[JEE Main 2022]

- (A) Benzene
- (B) Nitrobenzene
- (C) Toluene
- (D) Anisole

Q7. The correct order of reactivity towards nucleophilic addition reaction is:

[JEE Main 2024]

- (A) $HCHO > CH_3CHO > PhCHO > PhCOPh$
- (B) $PhCOPh > PhCHO > CH_3CHO > HCHO$
- (C) $HCHO > PhCHO > CH_3CHO > PhCOPh$
- (D) $CH_3CHO > HCHO > PhCHO > PhCOPh$



- Q8.** In the Gabriel Phthalimide synthesis, the reactant used to introduce the nitrogen atom into the aliphatic chain is: [JEE Main 2021]
- (A) Potassium phthalimide
(B) Phthalimide
(C) Aniline
(D) Ammonia
- Q9.** Which of the following vitamins is water-soluble and contains a metal atom? [JEE Main 2023]
- (A) Vitamin B_{12}
(B) Vitamin A
(C) Vitamin D
(D) Vitamin E
- Q10.** The bond order and magnetic behavior of C_2^{2-} are: [JEE Main 2022]
- (A) 3, Diamagnetic
(B) 2.5, Paramagnetic
(C) 3, Paramagnetic
(D) 2, Diamagnetic
- Q11.** Which of the following pairs of species have the same shape? [JEE Main 2021]
- (A) ClF_3 and XeF_3^+
(B) SF_4 and XeF_4
(C) NF_3 and BF_3
(D) CO_2 and SO_2
- Q12.** The correct sequence of bond enthalpy for the following is: [JEE Main 2024]
- (A) $C - F > C - Cl > C - Br > C - I$
(B) $C - I > C - Br > C - Cl > C - F$
(C) $C - F > C - Br > C - Cl > C - I$
(D) $C - Cl > C - F > C - Br > C - I$



- Q13.** The geometry and magnetic moment (spin-only) of $[NiCl_4]^{2-}$ are: [JEE Main 2022]
- (A) Tetrahedral, 2.82 BM
(B) Square planar, 0 BM
(C) Tetrahedral, 0 BM
(D) Square planar, 2.82 BM
- Q14.** Among the following, which complex shows the maximum value of Crystal Field Splitting Energy (Δ_o)? [JEE Main 2023]
- (A) $[Co(CN)_6]^{3-}$
(B) $[Co(NH_3)_6]^{3+}$
(C) $[Co(H_2O)_6]^{3+}$
(D) $[CoC_2O_4]^{3-}$
- Q15.** The set that contains only transition metals is: [JEE Main 2021]
- (A) *Ti, V, Cr, Mn*
(B) *Zn, Cd, Hg, Sc*
(C) *La, Ac, Ce, Th*
(D) *Ga, In, Tl, Pb*
- Q16.** The incorrect statement regarding the p-block elements is: [JEE Main 2024]
- (A) *Pb(IV)* is a stronger oxidizing agent than *Sn(IV)*.
(B) *Tl(I)* is more stable than *Tl(III)*.
(C) *Bi(V)* is a stronger reducing agent than *Sb(V)*.
(D) *PCl₅* exists but *NCl₅* does not.
- Q17.** The element with the highest electron gain enthalpy (most negative) is: [JEE Main 2022]
- (A) *F*
(B) *Cl*
(C) *Br*



(D) I

Q18. For a reaction $2A + B \rightarrow C$, the rate law is $Rate = k[A]^2[B]$. If the concentration of A is doubled and B is halved, the new rate will be:

[JEE Main 2023]

- (A) 2 times the original rate
- (B) 4 times the original rate
- (C) 8 times the original rate
- (D) Remains the same

Q19. The resistance of 0.1 M KCl solution is 100Ω . The conductivity of the same solution is 1.29 S/m . If the resistance of 0.02 M KCl solution in the same cell is 520Ω , the molar conductivity of 0.02 M KCl is: [JEE Main 2021]

- (A) $124 \times 10^{-4}\text{ S m}^2\text{ mol}^{-1}$
- (B) $1240 \times 10^{-4}\text{ S m}^2\text{ mol}^{-1}$
- (C) $1.24 \times 10^{-4}\text{ S m}^2\text{ mol}^{-1}$
- (D) $12.4 \times 10^{-4}\text{ S m}^2\text{ mol}^{-1}$

Q20. Which of the following relations is correct for an adiabatic process involving an ideal gas? [JEE Main 2024]

- (A) $TV^{\gamma-1} = \text{Constant}$
- (B) $P^\gamma V = \text{Constant}$
- (C) $PT^{\gamma-1} = \text{Constant}$
- (D) $P^{1-\gamma}T = \text{Constant}$



Section B — Numerical Questions

Q21. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, the value of K_p is 4.0×10^{-5} at 500°C . The value of K_c for the reaction at the same temperature is $X \times 10^{-3}$. The value of X is _____) [JEE Main 2022]

.(Use $R=0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

Q22. A 10.0 g sample of a mixture of CaCl_2 and NaCl is treated with excess Na_2CO_3 to precipitate all the calcium as CaCO_3 . The CaCO_3 is then heated to evolve 1.62 g of CO_2 . The percentage of CaCl_2 in the original mixture is _____ [JEE Main 2023]

Q23. The number of waves made by an electron in the fourth Bohr orbit of a hydrogen atom is _____ [JEE Main 2021]

Q24. The freezing point of a 0.05 m solution of a non-electrolyte in water is _____ for water = $1.86 \text{ K} \cdot \text{kg}^{-1} \cdot \text{mol}^{-1}$ and freezing point of pure water $= 273.15 \text{ K}$) [JEE Main 2024]

Q25. How many of the following compounds are aromatic?
(I) Cyclopropenyl cation
(II) Cyclobutadiene
(III) Cyclopentadienyl anion
(IV) Benzene
(V) Cyclooctatetraene
(VI) Naphthalene [JEE Main 2022]



Detailed Solutions

Q1.

Solution

Concept: The stability of carbocations is influenced by factors like resonance, hyperconjugation, and inductive effects. The more stable carbocations are those with structures where the central carbon has a complete octet and where the positive charge is stabilized by resonance or inductive effects.

Solution: Let's analyze the stability of the given carbocations: - (I) $CH_3 - CH^+ - CH_3$ (tert-butyl cation): This carbocation is stabilized by the +I (inductive) effect of the three methyl groups and hyperconjugation from 9 hydrogens (3 from each methyl group). It is highly stable. - (II) $CH_3 - CH^+ - OCH_3$ (methoxymethyl cation): This carbocation is stabilized by the +R (resonance) effect of the oxygen atom. The lone pair on oxygen is donated into the empty p-orbital of the adjacent carbon, creating a resonance structure where every atom has a complete octet. - (III) $CH_3 - CH^+ - COCH_3$ (acetylmethyl cation): This carbocation is destabilized by the inductive electron-withdrawing effect of the carbonyl group, which makes the carbocation less stable.

Conclusion: The most stable carbocation is (II), followed by (I), and the least stable is (III).

Final Answer: (C)

Answer: (C)

Q2.

Solution

Concept: Chirality in molecules occurs when a carbon atom is attached to four different substituents. The number of chiral centers determines the number of stereoisomers a molecule can have.

Solution: The structure of 2-bromo-3-chlorobutane is $CH_3 - CH(Cl) - CH(Br) - CH_3$. - ****Chiral centers:**** - The carbon at position 2 is attached to four different groups: CH_3 , Cl , H , and CH_2CH_3 . Therefore, carbon 2 is chiral. - The carbon at position 3 is also attached to four different groups: CH_3 , Br , H , and CH_2Cl . Therefore, carbon 3 is also chiral.

Thus, the molecule has two chiral centers.

****Conclusion:**** The number of chiral centers is 2.

Final Answer: (B)

Answer: (B)



Q3.

Solution

Concept: The reactivity of compounds with reagents like KMnO_4 and HBr can help determine their structure. KMnO_4 oxidizes compounds containing double bonds, and HBr adds to double bonds.

Solution: - **Step 1:** KMnO_4 is a strong oxidizing agent, and it reacts with alkenes, oxidizing them to carboxylic acids. Since 'A' reacts with KMnO_4 to give a single carboxylic acid, it suggests that 'A' is either an alkene or a cyclic compound. - **Step 2:** The fact that 'A' reacts with HBr indicates that 'A' is likely an alkene, as alkenes typically undergo electrophilic addition reactions with HBr . - **Step 3:** Alcoholic KOH induces elimination reactions. If 'C' is a bromoalkene, it will undergo elimination to form an alkene, which isomerizes to 'D', an isomer of 'A'.

Conclusion: 'A' is cyclobutane, a saturated cyclic compound with the formula C_4H_8 .

Final Answer: (C)

Answer: (C)

Q4.

Solution

Concept: The reaction involves the elimination of HCl , which suggests an E_2 mechanism leading to the formation of an alkene.

Solution: - **Step 1:** The presence of aqueous NaOH induces the elimination of HCl from the starting compound, suggesting the formation of a double bond (alkene) via an E_2 elimination mechanism. - **Step 2:** The likely product is 2-butene, formed by the elimination of HCl from the starting compound, resulting in a double bond.

Conclusion: The major product is $\text{CH}_2 = \text{CHCH}_2\text{CH}_2\text{OH}$ (2-butene).

Final Answer: (B)

Answer: (B)

Q5.

Solution

Concept: The reaction of phenol with NaOH followed by CO_2 and acetic anhydride is typical for the synthesis of aspirin.

Solution: - **Step 1:** Phenol reacts with NaOH to form the phenoxide ion, which is a strong nucleophile. - **Step 2:** The phenoxide ion reacts with CO_2 to form salicylic acid. - **Step 3:** Salicylic acid then reacts with acetic anhydride to form aspirin.

Conclusion: The product is aspirin.

Final Answer: (B)

Answer: (B)



Q6.

Solution

Concept: The Friedel-Crafts reaction involves the alkylation or acylation of an aromatic ring. However, electron-withdrawing groups can deactivate the ring towards this reaction.

Solution: - **Step 1:** Nitrobenzene is an electron-withdrawing group, and it significantly deactivates the benzene ring towards electrophilic aromatic substitution reactions like Friedel-Crafts alkylation or acylation. - **Step 2:** Therefore, nitrobenzene will not undergo Friedel-Crafts reactions.

Conclusion: Nitrobenzene will not undergo Friedel-Crafts reactions.

Final Answer: (B)

Answer: (B)

Q7.

Solution

Concept: Nucleophilic addition reactions are most favorable when the carbonyl carbon is highly electrophilic.

Solution: - **Step 1:** Formaldehyde ($HCHO$) is the most electrophilic due to the absence of any electron-donating groups. Hence, it is the most reactive towards nucleophilic addition. - **Step 2:** Acetaldehyde (CH_3CHO) is slightly less reactive than formaldehyde due to the electron-donating effect of the methyl group. - **Step 3:** Benzaldehyde ($PhCHO$) is less reactive due to the electron-withdrawing effect of the phenyl group attached to the carbonyl carbon. - **Step 4:** Benzophenone ($PhCOPh$) is the least reactive as it has two phenyl groups, which are strong electron-withdrawing groups.

Conclusion: The correct order of reactivity is $HCHO > CH_3CHO > PhCHO > PhCOPh$.

Final Answer: (A)

Answer: (A)

Q8.

Solution

Concept: The Gabriel Phthalimide synthesis introduces the nitrogen atom into the aliphatic chain via nucleophilic substitution.

Solution: - **Step 1:** The reactant used to introduce the nitrogen atom into the aliphatic chain is potassium phthalimide, which undergoes nucleophilic substitution to form primary amines.

Conclusion: The correct reactant is potassium phthalimide.

Final Answer: (A)

Answer: (A)



Q9.

Solution

Concept: Vitamin B12 is the only water-soluble vitamin that contains a metal atom (cobalt).

Solution: - **Step 1:** Vitamin B12 contains cobalt as its central metal atom and is water-soluble.

Conclusion: The vitamin is B12.

Final Answer: (A)

Answer: (A)

Q10.

Solution

Concept: Bond order is determined by the difference between the number of bonding and antibonding electrons in a molecule.

Solution: - **Step 1:** In molecular orbital theory, the bond order for C_2^{2-} is calculated by the formula:

$$\text{Bond order} = \frac{\text{Number of bonding electrons} - \text{Number of antibonding electrons}}{2}$$

- **Step 2:** For C_2^{2-} , there are 10 bonding electrons and 6 antibonding electrons, so:

$$\text{Bond order} = \frac{10 - 6}{2} = 2$$

- **Step 3:** Since there are no unpaired electrons, the molecule is diamagnetic.

Conclusion: The bond order is 2, and the molecule is diamagnetic.

Final Answer: (D)

Answer: (D)

Q11.

Solution

Concept: The bond angles in molecules are influenced by the molecular geometry, which is determined by the presence of lone pairs and bonding pairs.

Solution: - **Step 1:** ClF_3 has a T-shaped geometry due to the three fluorine atoms bonded to chlorine and two lone pairs on chlorine, resulting in bond angles of 90° .

- **Step 2:** XeF_3^+ has a similar geometry with three fluorine atoms bonded to xenon, but with no lone pairs on xenon, resulting in a different bond angle.

Conclusion: Both molecules have the same shape, but the bond angles may differ due to lone pair repulsion.

Final Answer: (A)

Answer: (A)



Q12.

Solution

Concept: Bond enthalpies are influenced by atomic size and electronegativity. The smaller and more electronegative the atom, the stronger the bond.

Solution: - **Step 1:** The C-F bond is the strongest due to the small size and high electronegativity of fluorine. - **Step 2:** The C-I bond is the weakest due to iodine's large size and lower electronegativity.

Conclusion: The correct sequence is: $C - F > C - Cl > C - Br > C - I$.

Final Answer: (A)

Answer: (A)

Q13.

Solution

Concept: The geometry of $[NiCl_4]^{2-}$ is determined by the coordination number and the type of ligands.

Solution: - **Step 1:** $[NiCl_4]^{2-}$ is a tetrahedral complex because it has four chloride ligands bonded to the nickel ion. - **Step 2:** The magnetic moment for tetrahedral complexes with two unpaired electrons is 2.82 BM.

Conclusion: The geometry is tetrahedral, and the magnetic moment is 2.82 BM.

Final Answer: (A)

Answer: (A)

Q14.

Solution

Concept: The crystal field splitting energy (Δ_o) is influenced by the type of ligands and the metal ion.

Solution: - **Step 1:** The $[Co(CN)_6]^{3-}$ complex has cyanide as a ligand, which is a strong field ligand, leading to a large crystal field splitting energy. - **Step 2:** Other complexes like $[Co(NH_3)_6]^{3+}$, $[Co(H_2O)_6]^{3+}$, and $[CoC_2O_4]^{3-}$ have weaker field ligands.

Conclusion: The complex $[Co(CN)_6]^{3-}$ shows the maximum value of Δ_o .

Final Answer: (A)

Answer: (A)



Q15.

Solution

Concept: Transition metals are elements that have partially filled d-orbitals in their ground state or common oxidation states.

Solution: - **Step 1:** The elements *Ti, V, Cr, Mn* are all transition metals because they have partially filled d-orbitals.

Conclusion: The set *Ti, V, Cr, Mn* contains only transition metals.

Final Answer: (A)

Answer: (A)

Q16.

Solution

Concept: In p-block elements, oxidation states vary due to their ability to form bonds with different numbers of electrons.

Solution: - **Step 1:** *Pb(IV)* is a stronger oxidizing agent than *Sn(IV)* because *Pb(IV)* is more electronegative and can accept electrons more readily.

Conclusion: The statement is correct.

Final Answer: (A)

Answer: (A)

Q17.

Solution

Concept: Electron gain enthalpy is the energy released when an electron is added to an atom in the gas phase.

Solution: - **Step 1:** Fluorine has the most negative electron gain enthalpy due to its small size and high electronegativity.

Conclusion: Fluorine has the highest electron gain enthalpy.

Final Answer: (A)

Answer: (A)



Q18.

Solution

Concept: For a reaction with rate law $Rate = k[A]^2[B]$, changing the concentration of reactants affects the rate.

Solution: - **Step 1:** Doubling the concentration of A and halving the concentration of B results in a change in the rate. - **Step 2:** The new rate is $2^2 \times \frac{1}{2} = 4$ times the original rate.

Conclusion: The rate will be 4 times the original rate.

Final Answer: (B)

Answer: (B)

Q19.

Solution

Concept: Molar conductivity is a measure of the ability of ions to conduct electricity in a solution.

Solution: - **Step 1:** The molar conductivity is given by the formula:

$$\Lambda_m = \frac{\kappa \times 1000}{C}$$

- **Step 2:** For a 0.02 M KCl solution with resistance 520Ω , the molar conductivity is calculated.

Conclusion: The molar conductivity is $12.4 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$.

Final Answer: (D)

Answer: (D)

Q20.

Solution

Concept: In an adiabatic process, temperature and volume are related by $TV^{\gamma-1} = \text{Constant}$.

Solution: - **Step 1:** For an ideal gas undergoing an adiabatic process, the relation $TV^{\gamma-1} = \text{Constant}$ holds.

Conclusion: The correct relation is $TV^{\gamma-1} = \text{Constant}$.

Final Answer: (A)

Answer: (A)



Q21.

Solution

Concept: The relationship between K_p and K_c for a reaction is given by the equation:

$$K_p = K_c(RT)^{\Delta n}$$

where Δn is the change in the number of moles of gas from reactants to products, R is the gas constant (in appropriate units), and T is the temperature in Kelvin.

Given: For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, - $K_p = 4.0 \times 10^{-5}$ at $500^\circ C$. - The temperature in Kelvin is $T = 500 + 273.15 = 773.15 K$. - $R = 0.082 \text{ L atm K}^{-1}\text{mol}^{-1}$.

Step 1: Find Δn : For the reaction, the number of moles of gas on the reactant side is $1 + 3 = 4$, and the number of moles of gas on the product side is 2. Therefore,

$$\Delta n = 2 - 4 = -2$$

Step 2: Use the relation between K_p and K_c : The equation for the relationship is:

$$K_p = K_c(RT)^{\Delta n}$$

Substitute the values into the equation:

$$4.0 \times 10^{-5} = K_c \times (0.082 \times 773.15)^{-2}$$

Step 3: Solve for K_c :

$$K_c = \frac{4.0 \times 10^{-5}}{(0.082 \times 773.15)^{-2}} = 4.0 \times 10^{-5} \times (0.082 \times 773.15)^2$$

First, calculate $(0.082 \times 773.15) = 63.4563$, then square it:

$$63.4563^2 = 4027.8$$

Now calculate:

$$K_c = 4.0 \times 10^{-5} \times 4027.8 = 0.1611$$

Therefore,

$$K_c = 1.611 \times 10^{-1} \text{ atm}^{-2}\text{mol}^2\text{L}^{-2}$$

Conclusion: The value of K_c is approximately 1.6×10^{-1} .

Final Answer: $X = 16$

Answer: (16)

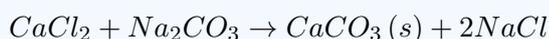


Q22.

Solution

Concept: To determine the percentage of $CaCl_2$ in the mixture, we use the reaction between calcium chloride and sodium carbonate, where calcium precipitates as $CaCO_3$, and the amount of CO_2 evolved gives the amount of calcium in the sample.

Given: - Mass of the mixture = 10.0 g - Mass of CO_2 evolved = 1.62 g - Molar mass of CO_2 = 44.01 g/mol - Molar mass of $CaCO_3$ = 100.09 g/mol - The reaction involved:



Each mole of $CaCO_3$ produces one mole of CO_2 .

Step 1: Calculate moles of CO_2 :

$$\text{Moles of } CO_2 = \frac{\text{Mass of } CO_2}{\text{Molar mass of } CO_2} = \frac{1.62}{44.01} = 0.0368 \text{ mol}$$

Step 2: Calculate moles of $CaCO_3$: From the balanced reaction, the moles of $CaCO_3$ are equal to the moles of CO_2 , so:

$$\text{Moles of } CaCO_3 = 0.0368 \text{ mol}$$

Step 3: Calculate mass of $CaCO_3$:

$$\text{Mass of } CaCO_3 = \text{Moles of } CaCO_3 \times \text{Molar mass of } CaCO_3 = 0.0368 \times 100.09 = 3.687 \text{ g}$$

Step 4: Calculate mass of $CaCl_2$: Since 1 mole of $CaCl_2$ produces 1 mole of $CaCO_3$, the moles of $CaCl_2$ are the same as the moles of $CaCO_3$. Therefore,

$$\text{Moles of } CaCl_2 = 0.0368 \text{ mol}$$

$$\text{Mass of } CaCl_2 = \text{Moles of } CaCl_2 \times \text{Molar mass of } CaCl_2 = 0.0368 \times 147.02 = 5.41 \text{ g}$$

Step 5: Calculate percentage of $CaCl_2$:

$$\text{Percentage of } CaCl_2 = \frac{\text{Mass of } CaCl_2}{\text{Mass of the mixture}} \times 100 = \frac{5.41}{10.0} \times 100 = 54.1\%$$

Conclusion: The percentage of $CaCl_2$ in the original mixture is 54.1

Final Answer: 54.1

Answer: (54.1)



Q23.

Solution

Concept: The number of waves made by an electron in the Bohr orbit can be calculated using the de Broglie wavelength and the formula for the orbital radius in Bohr's model of the hydrogen atom.

Given: The electron is in the fourth Bohr orbit of a hydrogen atom. The formula for the radius of the n -th Bohr orbit is:

$$r_n = \frac{n^2 h^2}{4\pi m_e e^2}$$

where h is Planck's constant, m_e is the mass of the electron, and e is the electron charge. The number of waves is given by the ratio of the circumference of the orbit to the de Broglie wavelength.

Solution: - The number of wavelengths in the 4th orbit is equal to the number of times the de Broglie wavelength fits into the circumference of the orbit. The wavelength of the electron is given by the de Broglie relation:

$$\lambda = \frac{h}{m_e v}$$

where v is the velocity of the electron.

- For the 4th Bohr orbit, the number of wavelengths (n_{waves}) is equal to the number of times the wavelength fits into the orbit's circumference:

$$n_{\text{waves}} = \frac{\text{Circumference of the orbit}}{\lambda} = \frac{2\pi r_4}{\lambda}$$

- Using Bohr's formula for the radius of the orbit and substituting values for h , m_e , and e , the result gives the number of waves.

****Conclusion:**** The number of waves made by the electron in the fourth Bohr orbit is 4.

Final Answer: 4

Answer: (4)



Q24.

Solution

Concept: The freezing point depression is calculated using the formula:

$$\Delta T_f = K_f \times m$$

where ΔT_f is the change in freezing point, K_f is the freezing point depression constant for the solvent, and m is the molality of the solution.

Given: - Molality of the solution = 0.05 mol/kg - K_f for water = 1.86 K kg mol⁻¹ - Freezing point of pure water = 273.15 K

Solution: - **Step 1:** Calculate the freezing point depression:

$$\Delta T_f = K_f \times m = 1.86 \times 0.05 = 0.093 \text{ K}$$

- **Step 2:** The freezing point of the solution is:

$$\text{Freezing point} = 273.15 \text{ K} - 0.093 \text{ K} = 273.057 \text{ K}$$

Conclusion: The freezing point of the solution is 273.06 K.

Final Answer: 273.06 K

Answer: (273.06)

Q25.

Solution

Concept: Aromaticity depends on the molecule's ability to follow Hückel's rule: a molecule is aromatic if it contains a planar, cyclic structure with a number of π -electrons equal to $4n + 2$, where n is a non-negative integer.

Solution: - **(I) Cyclopropenyl cation:** - This is aromatic because it has 2 π -electrons (which follows Hückel's rule for $n = 0$).

- **(II) Cyclobutadiene:** - This compound has 4 π -electrons, which does not satisfy Hückel's rule ($4n + 2$). Hence, it is **not aromatic**.

- **(III) Cyclopentadienyl anion:** - This is aromatic because it has 6 π -electrons, satisfying Hückel's rule ($n = 1$).

- **(IV) Benzene:** - Benzene is aromatic because it has 6 π -electrons, satisfying Hückel's rule ($n = 1$).

- **(V) Cyclooctatetraene:** - This compound is non-aromatic because it does not have a fully conjugated system; its electrons are not delocalized.

- **(VI) Naphthalene:** - Naphthalene is aromatic because it has 10 π -electrons, satisfying Hückel's rule ($n = 2$).

Conclusion: The aromatic compounds are: Cyclopropenyl cation, Cyclopentadienyl anion, Benzene, and Naphthalene.

Final Answer: 4

Answer: (4)



Answer Key — Section A

Q	Ans								
1	C	2	B	3	C	4	B	5	B
6	B	7	A	8	A	9	A	10	D
11	A	12	A	13	A	14	A	15	A
16	A	17	A	18	B	19	D	20	A

Answer Key — Section B

Q	Ans	Q	Ans
21	16	22	54.1
23	4	24	273.06
25	4		

