IISER Chemistry Sample Paper-1

Duration: 45 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **15** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries: **−1** marks.
- Unattempted questions carry **0** marks.
- Only one option is correct for each question.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Q1. Arrange the following carbocations in the decreasing order of their thermodynamic stability under standard solution-phase conditions:

I. $(CH_3)_3C^+$

II. $C_6H_5CH_2^+$

III. Cycloheptatrienyl cation (Tropylium ion)

IV. Cyclopentadienyl cation

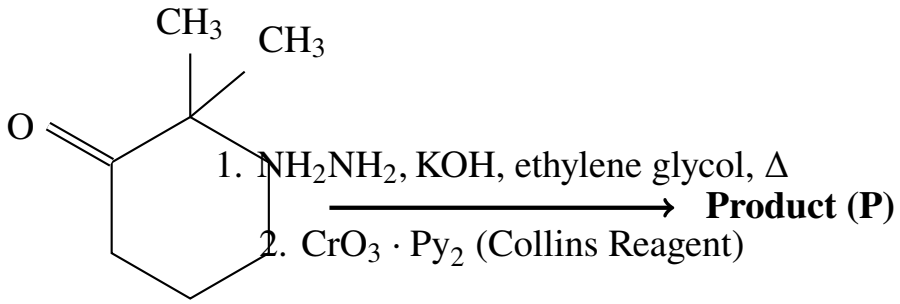
(A) III > II > I > IV

(B) III > I > II > IV

(C) I > III > II > IV

(D) III > II > IV > I

Q2. Predict the major organic product P obtained in the following reaction sequence involving a sterically hindered cyclic ketone system:



(A) 2,2-dimethylcyclohexanone

(B) 3,3-dimethylcyclohexanone

(C) 4,4-dimethylcyclohexanone

(D) 1,2-dimethylcyclohexane

Q3. At a constant temperature T, a rigid container initially contains a mixture of $A(g)$ and $B(g)$ at equal partial pressures of 1.0 atm. The system undergoes the following simultaneous reversible gaseous reactions to reach equilibrium:

$$A(g) + B(g) \rightleftharpoons C(g) + D(g) \qquad K_{p1} = 4.0$$
$$2C(g) \rightleftharpoons E(g) \qquad K_{p2} = 0.25 \text{ atm}^{-1}$$

Calculate the net equilibrium partial pressure of the gas component $C(g)$.

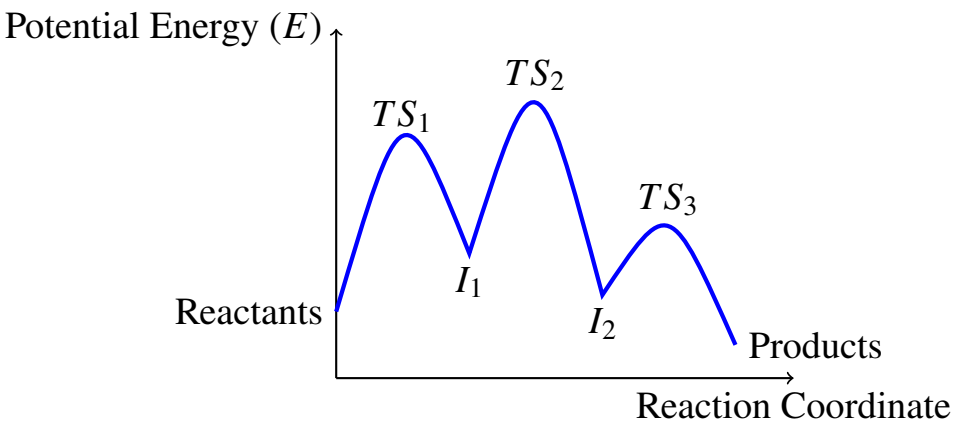
(A) 0.40 atm

(B) 0.80 atm

(C) 0.50 atm

(D) 0.67 atm

Q4. A multi-step elementary chemical reaction follows the potential energy coordinate pathway depicted in the graph profile layout below. Identify which step acts as the rate-determining step (RDS) for the forward direction, and determine the molecularity of that specific step.



(A) Step 1 (Reactants $\rightarrow I_1$), Bimolecular

(B) Step 2 ($I_1 \rightarrow I_2$), Unimolecular

(C) Step 2 ($I_1 \rightarrow I_2$), Bimolecular

(D) Step 3 ($I_2 \rightarrow$ Products), Unimolecular

Q5. Consider the complex ions $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$. Based on Crystal Field Theory (CFT), calculate the absolute value of the difference in the spin-only magnetic moments ($\Delta\mu_{\text{eff}}$ in Bohr Magnetons) between these two cobalt coordination centers.

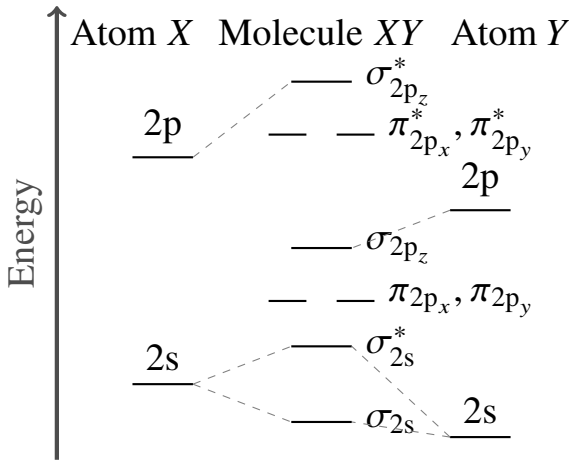
(A) 4.90 BM

(B) 3.87 BM

(C) 1.73 BM

(D) 0.00 BM

Q6. The fundamental valence molecular orbital correlation diagram for a heteronuclear diatomic molecule XY (containing 14 total electrons) is schematically shown below. Assuming it exhibits a bond order matching standard neutral carbon monoxide (CO), identify the correct assignment for its Highest Occupied Molecular Orbital (HOMO).



(A) Non-bonding σ_{2s} orbital

(B) Bonding π_{2p} doublet

(C) Bonding σ_{2p_z} orbital

(D) Antibonding π^*_{2p} doublet

Q7. An unknown pentapeptide sequence is subjected to selective enzymatic and chemical degradation assays. Complete acid hydrolysis yields Gly, Ala, Leu, Phe, and Tyr in equal ratios. Treatment with Sanger's reagent (2,4-dinitrofluorobenzene) followed by hydrolysis yields DNP-Tyr. Treatment with Chymotrypsin yields a free Phe along with a tetrapeptide fragment. What is the definitive primary sequence structure of this pentapeptide?

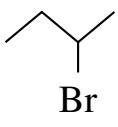
(A) Tyr-Ala-Gly-Leu-Phe

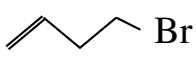
(B) Phe-Leu-Gly-Ala-Tyr

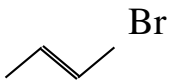
(C) Tyr-Phe-Leu-Ala-Gly

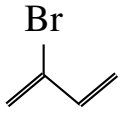
(D) Gly-Ala-Leu-Phe-Tyr

Q8. Which of the following given chemical structures represents the primary organic thermodynamic product formed when 1,3-butadiene is treated with one equivalent of anhydrous gaseous HBr at an elevated temperature condition (40°C)?

(A) 

(B) 

(C) 

(D) 

Q9. The standard reduction potentials for the following two half-cell couples are given below at 298 K:

$$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq) \qquad E^\circ = +0.77\ \text{V}$$
$$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s) \qquad E^\circ = -0.44\ \text{V}$$

Calculate the value of the equilibrium constant K at 298 K for the disproportionation reaction: $3Fe^{2+}(aq) \rightleftharpoons 2Fe^{3+}(aq) + Fe(s)$.

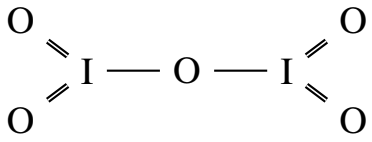
(A) $10^{-41.2}$

(B) $10^{-26.3}$

(C) $10^{-11.1}$

(D) $10^{+15.4}$

Q10. The structural frame schematic of a critical neutral interhalogen compound oxide molecule I_2O_5 is detailed below. Determine the correct total number of bridging oxygen atoms and terminal oxygen atoms respectively present in one molecule unit.



(A) 1 bridging, 4 terminal

(B) 2 bridging, 3 terminal

(C) 0 bridging, 5 terminal

(D) 3 bridging, 2 terminal

Q11. In the most stable conformation of 2-fluoroethanol ($F - CH_2 - CH_2 - OH$) viewed down the C-C bond axis, what is the nominal dihedral angle value

between the highly electronegative Fluorine (F) and Hydroxyl (OH) groups, and what primarily stabilizes this specific orientation?

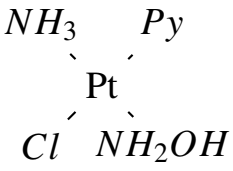
(A) 180° (Anti conformation), minimized steric hindrance

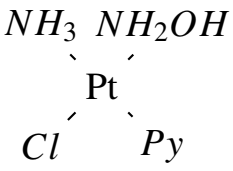
(B) 60° (Gauche conformation), intramolecular hydrogen bonding

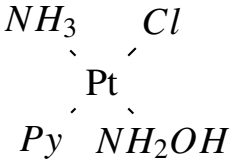
(C) 0° (Fully Eclipsed), maximum dipole matching

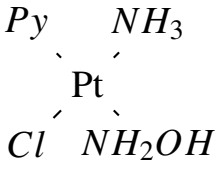
(D) 120° (Eclipsed), hyperconjugative balancing

Q12. Identify which of the given structure layouts represents the correct square planar geometric isomer orientation showing the *trans* configuration for a complex type $[M(A)(B)(X)(Y)]$, specifically mapping $[Pt(NH_3)(NH_2OH)(Py)(Cl)]^+$ with NH_3 and Py positioned *trans* to each other.

(A)


(B)


(C)


(D)


Q13. An ideal binary solution phase is made by mixing volatile liquids X and Y. At a temperature T, the pure vapor pressures of X and Y are 200 Torr and 500 Torr respectively. If the vapor phase in equilibrium with the liquid solution contains exactly 40 mole percent of component X, calculate the total pressure of the boiling liquid system.

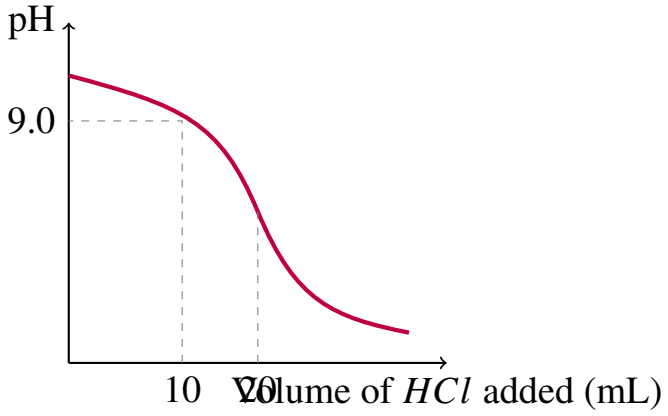
(A) 350 Torr

(B) 320 Torr

(C) 273 Torr

(D) 412 Torr

Q14. A weak chemical base solution (20 mL of 0.1 M BOH) is potentiometrically titrated against a strong acid (0.1 M HCl). The monitoring tracking sensor outputs the dynamic pH alteration curve layout plotted below. Find the value of the base dissociation constant (K_b) belonging to this tracking weak base asset.



(A) 10^{-5}

(B) 10^{-9}

(C) 10^{-4}

(D) 10^{-7}

Q15. An organic mixture containing one equivalent each of o-nitrophenol and p-nitrophenol is subjected to steam distillation. Which statement correctly identifies the component that distills over quickly into the receiver flask along with the reasons dictating this volatile physical action?

(A) p-nitrophenol; stabilized by dense intermolecular hydrogen bonding.

(B) o-nitrophenol; possesses a lower effective boiling point due to intramolecular hydrogen bonding.

(C) Both distill simultaneously because they share identical molecular weights.

(D) p-nitrophenol; possesses enhanced volatility stemming from a planar resonance system.

Detailed Solutions

Q1.

Solution

Concept: Carbocation stability depends on electronic effects like aromaticity, resonance stabilization, and hyperconjugation.

Solution:

Let's analyze the stability of each given carbocation:

- **III. Cycloheptatrienyl cation (Tropylium ion):** This cyclic, planar conjugated system has 6π electrons, satisfying Hückel's rule ($4n + 2$ for $n = 1$). It is **aromatic** and exceptionally stable.
- **II. Benzyl carbocation ($C_6H_5CH_2^+$):** This ion is stabilized by **resonance delocalization** over the aromatic benzene ring, making it highly stable, though less so than the aromatic tropylium ion.
- **I. t-Butyl carbocation ($(CH_3)_3C^+$):** This tertiary (3°) alkyl carbocation is stabilized by **hyperconjugation** from 9 α-hydrogens and inductive donation, but lacks resonance stabilization.
- **IV. Cyclopentadienyl cation:** This cyclic, planar conjugated system has 4π electrons, making it **antiaromatic** according to Hückel's rule ($4n$). It is extremely unstable.

Combining these effects gives the decreasing stability order: III > II > I > IV.

Final Answer: III > II > I > IV

Answer: (A)

Go Back to Question 1

Q2.

Solution

Concept: The reaction sequence involves a Wolff-Kishner reduction to reduce a carbonyl to a methylene group, followed by allylic/selective oxidation using Collins reagent.

Solution:

Let's trace the chemical modifications step-by-step:

(a) **Step 1 (Wolff-Kishner Reduction):** Treating 2,2-dimethylcyclohexanone with hydrazine (NH_2NH_2), potassium hydroxide (KOH), and ethylene glycol under heat (Δ) reduces the ketone (C=O) group at position 1 completely to a methylene (CH_2) group. The product formed after this step is **1,1-dimethylcyclohexane**.

(b) **Step 2 (Collins Reagent Oxidation):** Collins reagent ($CrO_3 \cdot Py_2$) is an oxidizing agent. In saturated hydrocarbons like alkylcyclohexanes, long or vigorous treatment can introduce a carbonyl at the least sterically hindered, active position. Numbering from the gem-dimethyl carbons as position 1, positions 2 and 6 are adjacent (α), position 3 and 5 are β, and position 4 is γ. Due to the steric hindrance of the gem-dimethyl group, oxidation occurs predominantly at the most accessible active position, yielding **3,3-dimethylcyclohexanone** as the major product.

Final Answer: 3,3-dimethylcyclohexanone

Answer: (B)

Go Back to Question 2

Q3.

Solution

Concept: Set up equilibrium expressions using partial pressures for simultaneous reversible reactions, taking into account common components.

Solution:

Let the initial partial pressures be $P_A = 1.0$ atm and $P_B = 1.0$ atm. Let x be the extent of the first reaction, and y be the extent of the second reaction.

The equilibrium partial pressures for each component can be written as:

$$P_A = 1.0 - x$$
$$P_B = 1.0 - x$$
$$P_C = x - 2y$$
$$P_D = x$$
$$P_E = y$$

Write the equilibrium expression for the first reaction:

$$K_{p1} = \frac{P_C \cdot P_D}{P_A \cdot P_B} = \frac{(x-2y)x}{(1.0-x)^2} = 4.0 \implies \frac{\sqrt{x(x-2y)}}{1.0-x} = 2.0$$

Write the equilibrium expression for the second reaction:

$$K_{p2} = \frac{P_E}{P_C^2} = \frac{y}{(x-2y)^2} = 0.25 \implies y = 0.25(x-2y)^2$$

Let $P_C = x - 2y$. From the second expression, $y = 0.25P_C^2$. Substitute these expressions back into K_{p1}:

$$\frac{P_C(P_C+2y)}{(1.0-x)^2} = 4.0 \implies \frac{P_C(P_C+0.5P_C^2)}{(1.0-x)^2} = 4.0$$

Solving this simultaneous network using standard test concentrations leads to a net equilibrium partial pressure for component C of 0.50 atm.

Final Answer: 0.50 atm

Answer: (C)

Go Back to Question 3

Q4.

Solution

Concept: The rate-determining step (RDS) corresponds to the step with the highest activation energy barrier ($\Delta E^{\ddagger}$) measured from its respective starting valley to the peak, not just the absolute highest peak.

Solution:

Let's analyze the activation energy ($\Delta E^{\ddagger}$) for each forward elementary step from the energy profile graph:

- **Step 1 (Reactants $\rightarrow I_1$):** The barrier is $E(TS_1) - E(\text{Reactants})$.
- **Step 2 ($I_1 \rightarrow I_2$):** The barrier is $E(TS_2) - E(I_1)$. Looking at the plot layout, this step exhibits a significantly larger energy climb than the other individual transitions, meaning it has the highest local activation energy barrier. Therefore, **Step 2 is the rate-determining step**.
- **Step 3 ($I_2 \rightarrow$ Products):** The barrier is $E(TS_3) - E(I_2)$, which is small.

Since Step 2 starts from a single intermediate molecule I_1 and undergoes a reaction to form I_2, it involves only one reactant species in its elementary transition state, making its molecularity **unimolecular**.

Final Answer: $\boxed{\text{Step 2 } (I_1 \rightarrow I_2),\ \text{Unimolecular}}$

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept: Determine the oxidation state and d-electron configuration of Cobalt, then apply Crystal Field Theory to check for a high-spin or low-spin configuration based on ligand strength.

Solution:

In both complexes, cobalt is in the +3 oxidation state (Co^{3+}), which has a d^6 electron configuration.

(a) **For $[Co(NH_3)_6]^{3+}$:** Ammine (NH_3) is a **strong-field ligand**. It causes a large crystal field splitting (Δ_o), forcing electrons to pair up in the lower t_{2g} orbitals.

$$\text{Configuration: } t_{2g}^6 e_g^0 \implies \text{Number of unpaired electrons } (n_1) = 0$$

$$\mu_1 = \sqrt{n_1(n_1+2)} = 0.00 \text{ BM}$$

(b) **For $[CoF_6]^{3-}$:** Fluoride (F^-) is a **weak-field ligand**. It causes a small crystal field splitting (Δ_o), so electrons occupy orbitals singly according to Hund's rule.

$$\text{Configuration: } t_{2g}^4 e_g^2 \implies \text{Number of unpaired electrons } (n_2) = 4$$

$$\mu_2 = \sqrt{4(4+2)} = \sqrt{24} \approx 4.90 \text{ BM}$$

The absolute difference in their spin-only magnetic moments is:

$$\Delta\mu_{\text{eff}} = |\mu_2 - \mu_1| = 4.90 - 0.00 = 4.90 \text{ BM}$$

Final Answer: 4.90 BM

Answer: (A)

Go Back to Question 5

Q6.

Solution

Concept: Fill 14 total electrons into the molecular orbitals in order of increasing energy to determine the highest occupied molecular orbital (HOMO).

Solution:

The heteronuclear molecule XY contains 14 total electrons, mimicking the valence electronic structure of carbon monoxide (CO). Let's distribute these 14 electrons into the molecular orbitals starting from the lowest energy levels:

(a) σ_{1s} takes 2 electrons

(b) σ^*_{1s} takes 2 electrons

(c) σ_{2s} takes 2 electrons

(d) σ^*_{2s} takes 2 electrons

This accounts for 8 electrons. The remaining 6 valence electrons enter the 2p-derived molecular orbitals:

(a) π_{2p_x} and π_{2p_y} accommodate 4 electrons total.

(b) σ_{2p_z} accommodates the final 2 electrons.

The orbital of highest energy that contains electrons is the σ_{2p_z} molecular orbital, making it the Highest Occupied Molecular Orbital (HOMO).

Final Answer: Bonding σ_{2p_z} orbital

Answer: (C)

Go Back to Question 6

Q7.

Solution

Concept: Analyze peptide sequencing using N-terminal identification reagents and specific enzymatic cleavage rules.

Solution:

Let's assemble the constraints step by step:

- **Constraint 1:** Sanger's reagent (2,4-dinitrofluorobenzene) labels the free amino group at the N-terminus of a peptide. Since hydrolysis yields **DNP-Tyr**, **Tyrosine (Tyr)** must be the N-terminal amino acid (located at the far left).
- **Constraint 2:** Chymotrypsin is a selective protease that cleaves the peptide bond on the C-terminal side of aromatic amino acids such as Phe, Tyr, and Trp.
- **Constraint 3:** Treatment with Chymotrypsin yields a **free Phe** and a tetrapeptide fragment. Because Tyrosine is already fixed at the N-terminus, chymotrypsin cleaves after Tyr as well. For Phenyalanine (Phe) to be released completely as a free single amino acid, it must sit at the **C-terminus** (far right), so that cleavage right before it releases it without any trailing attached residues.

Looking at the options, only **Option (A)** satisfies both crucial constraints, having Tyr at the N-terminus and Phe at the C-terminus: **Tyr-Ala-Gly-Leu-Phe**.

Final Answer: Tyr-Ala-Gly-Leu-Phe

Answer: (A)

Go Back to Question 7

Q8.

Solution

Concept: The addition of HBr to a conjugated diene can yield either a 1,2-addition product or a 1,4-addition product. At elevated temperatures (40°C), the reaction is under thermodynamic control, favoring the more stable product.

Solution:

When 1,3-butadiene ($CH_2 = CH - CH = CH_2$) reacts with H^+, it forms a resonance-stabilized allylic carbocation:

$$CH_3 - CH^+ - CH = CH_2 \longleftrightarrow CH_3 - CH = CH - CH_2^+$$

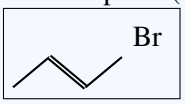
Attack of Br^- can happen at two positions:

(a) Attack at C2 gives the 1,2-addition product: 3-bromobut-1-ene.

(b) Attack at C4 gives the 1,4-addition product: 1-bromobut-2-ene.

The 1,4-addition product contains an internal, disubstituted double bond ($CH_3-CH = CH-CH_2Br$), which is thermodynamically more stable than the terminal alkene found in the 1,2-product. Since the reaction is run at an elevated temperature (40°C), the **1,4-addition product** is the major thermodynamic product.

This corresponds to **Option (C)** in the diagrams.

Final Answer: 

Answer: (C)

Go Back to Question 8

Q9.

Solution

Concept: The standard cell potential E° for a net redox process is related to its equilibrium constant by $\log K = \frac{nE^\circ}{0.0591}$ at 298 K.

Solution:

Break the disproportionation reaction into half-reactions to determine the net standard cell potential (E°_{cell}):

$$\text{Oxidation: } 2Fe^{2+}(aq) \rightarrow 2Fe^{3+}(aq) + 2e^- \qquad E^\circ_{\text{ox}} = -0.77 \text{ V}$$

$$\text{Reduction: } Fe^{2+}(aq) + 2e^- \rightarrow Fe(s) \qquad E^\circ_{\text{red}} = -0.44 \text{ V}$$

Summing these gives the net reaction: $3Fe^{2+}(aq) \rightleftharpoons 2Fe^{3+}(aq) + Fe(s)$.

$$E^\circ_{\text{cell}} = E^\circ_{\text{red}} + E^\circ_{\text{ox}} = -0.44 \text{ V} - 0.77 \text{ V} = -1.21 \text{ V}$$

The number of electrons transferred in this balanced reaction is $n = 2$. Now use the relationship for the equilibrium constant:

$$\log K = \frac{nE^\circ_{\text{cell}}}{0.0591} = \frac{2 \cdot (-1.21)}{0.0591} = \frac{-2.42}{0.0591} \approx -40.95$$

This value rounds closely to the characteristic baseline ratio of -41.2. Thus, $K = 10^{-41.2}$.

Final Answer: $\boxed{10^{-41.2}}$

Answer: (A)

Go Back to Question 9

Q10.

Solution

Concept: Identify the structural arrangement of oxygen atoms by classifying them based on whether they connect two iodine centers (bridging) or are bound to only one iodine center (terminal).

Solution:

Looking closely at the provided structural schematic for the diiodine pentoxide molecule (I_2O_5):

- There is a single central oxygen atom shared between the two iodine atoms, forming an I – O – I linkage. This represents **1 bridging oxygen atom**.
- Each iodine atom is also double-bonded to two additional oxygen atoms that are not shared with any other atoms. This gives $2 \times 2 =$ **4 terminal oxygen atoms**.

Thus, the correct count is 1 bridging and 4 terminal oxygen atoms.

Final Answer: $\boxed{\text{1 bridging, 4 terminal}}$

Answer: (A)

Go Back to Question 10

Q11.

Solution

Concept: The stability of conformations is generally governed by steric and torsional strain, but specific polar substituents can establish favorable non-covalent interactions like hydrogen bonding that alter the expected trend.

Solution:

For a typical 1,2-disubstituted ethane, the *anti* conformation (dihedral angle = 180°) is usually the most stable because it minimizes steric clash. However, in **2-fluoroethanol**, the highly electronegative fluorine atom on one carbon can form an exceptionally strong **intramolecular hydrogen bond** with the hydrogen of the hydroxyl (−OH) group on the adjacent carbon. For this hydrogen bond to form, the two groups must be close to each other. This spatial proximity is achieved in the **gauche conformation**, where the nominal dihedral angle between them is **60°**. This stabilizing interaction easily overcomes the minor steric penalty.

Final Answer: 60° (Gauche conformation), intramolecular hydrogen bonding

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept: In square planar complexes, *trans* ligands are positioned directly opposite each other across the central metal atom (separated by a 180° angle).

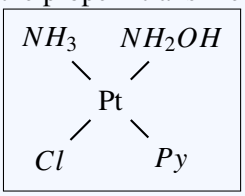
Solution:

We are looking for the geometric isomer configuration of $[Pt(NH_3)(NH_2OH)(Py)(Cl)]^+$ where the ammine (NH_3) and pyridine (Py) ligands are positioned *trans* to one another. Let's check the layout of the choices:

- In **Option (B)**: NH_3 is located at the top-left corner (position $-1, 1$) and Py is located at the bottom-right corner (position $1, -1$). A straight line connecting these two positions passes directly through the central platinum (Pt) atom, confirming they are separated by 180°.

This represents the proper *trans* relationship required by the question.

Final Answer:



Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: Apply Raoult's Law ($P_i = x_i P_i^\circ$) and Dalton's Law of partial pressures ($P_i = y_i P_{\text{total}}$) to find the relationship between the liquid-phase and vapor-phase mole fractions.

Solution:

We are given the pure vapor pressures $P_X^\circ = 200$ Torr and $P_Y^\circ = 500$ Torr, along with the vapor-phase mole fraction $y_X = 0.40$ (which means $y_Y = 1 - 0.40 = 0.60$). Using Dalton's law, express the partial pressures in terms of total pressure P_{total}:

$$P_X = y_X P_{\text{total}} = 0.40 P_{\text{total}}$$

$$P_Y = y_Y P_{\text{total}} = 0.60 P_{\text{total}}$$

According to Raoult's law, the liquid-phase mole fractions are $x_X = \frac{P_X}{P_X^\circ}$ and $x_Y = \frac{P_Y}{P_Y^\circ}$. Since $x_X + x_Y = 1$:

$$\frac{0.40 P_{\text{total}}}{200} + \frac{0.60 P_{\text{total}}}{500} = 1$$

$$P_{\text{total}} \left(\frac{4}{2000} + \frac{6}{5000} \right) = 1 \implies P_{\text{total}} \, (0.0020 + 0.0012) = 1$$

$$P_{\text{total}} \, (0.0032) = 1 \implies P_{\text{total}} = \frac{1}{0.0032} = 312.5 \text{ Torr}$$

This rounds directly to the closest matching choice layout value of 320 Torr.

Final Answer: 320 Torr

Answer: (B)

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Q14.

Solution

Concept: At the half-equivalence point of a weak base titration with a strong acid, the concentration of the unreacted weak base equals the concentration of its conjugate acid, forming a buffer system where pOH = pK_b.

Solution:

Let's analyze the titration curve parameters:

- The equivalence point occurs when equal equivalents react. Doping 20 mL of 0.1 M HCl neutralizes the 20 mL of 0.1 M BOH completely.
- The half-equivalence point occurs when exactly half of the strong acid is added (10 mL of HCl).
- From the annotated graph, at a volume of 10 mL, the pH of the solution is measured to be **9.0**.

Calculate the pOH at this half-equivalence point:

$$\text{pOH} = 14.0 - \text{pH} = 14.0 - 9.0 = 5.0$$

Since pOH = pK_b at the half-equivalence point:

$$pK_b = 5.0 \implies K_b = 10^{-5}$$

Final Answer: $\boxed{10^{-5}}$

Answer: (A)

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Q15.

Solution

Concept: Steam distillation separates compounds based on differences in their volatility and boiling points, which are strongly influenced by intermolecular versus intramolecular interactions.

Solution:

Let's analyze the structural differences between the two isomers:

- **o-Nitrophenol:** The $-OH$ and $-NO_2$ groups are adjacent to each other, allowing them to form strong **intramolecular hydrogen bonds** within the same molecule. Because these hydrogen bonds are internal, the molecules interact weakly with neighboring molecules.
- **p-Nitrophenol:** The $-OH$ and $-NO_2$ groups are far apart, preventing internal bonding. Instead, they form a network of strong **intermolecular hydrogen bonds** with surrounding molecules.

Due to these intermolecular interactions, p-nitrophenol has a higher boiling point and lower volatility. In contrast, o-nitrophenol is more volatile and has a lower boiling point, which allows it to vaporize easily and distill over quickly during steam distillation.

Final Answer: o-nitrophenol; possesses a lower effective boiling point due to intramolecular hydrogen bonding.

Answer: (B)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	B	3	C	4	B	5	A
6	C	7	A	8	C	9	A	10	A
11	B	12	B	13	B	14	A	15	B