IISER Chemistry Sample Paper-5

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. The following reaction sequence is carried out:

$$\mathrm{C_6H_5CH_2Br} \xrightarrow{\text{alc. KCN}} A \xrightarrow{\mathrm{LiAlH_4}} B \xrightarrow{\mathrm{NaNO_2}/HCl} C$$

Assuming each step proceeds under ideal conditions and side reactions are negligible, identify the compound C formed at the end of the sequence.

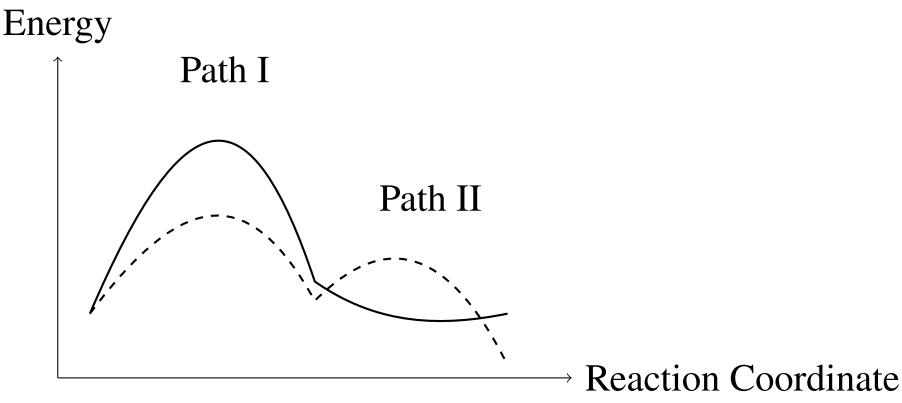
(A) Benzyl alcohol

(B) Phenethyl alcohol

(C) Phenylacetic acid

(D) Styrene

Q2. Consider the following reaction coordinate diagram for two competing reaction pathways leading to different products.



Path I represents a single-step process while Path II proceeds through an intermediate. Which statement is most appropriate?

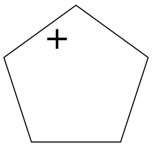
(A) Path II is always slower

(B) Path I has lower activation energy

(C) Path II may dominate kinetically

(D) Product of Path I is necessarily more stable

Q3. The cyclic species shown below undergoes complete delocalization of its π-electrons.



According to Hückel's rule and molecular orbital considerations, the species is classified as:

(A) Aromatic

(B) Antiaromatic

(C) Non-aromatic

(D) Homoaromatic

Q4. An unknown carbonyl compound X gives a positive Tollens' test, a positive iodoform test, and readily forms a cyanohydrin. Based on these observations, identify compound X.

(A) Formaldehyde

(B) Acetaldehyde

(C) Acetone

(D) Benzaldehyde

Q5. Determine the total number of stereoisomers possible for the compound

$$CH_3CH(OH)CH(Br)CH(OH)CH_3$$

taking into account all possible optical and meso forms.

(A) 4

(B) 6

(C) 8

(D) 10

Q6. For the gaseous equilibrium

$$2A(g) \rightleftharpoons B(g) + C(g)$$

the equilibrium constant is $K_p = 4$ at a fixed temperature. The volume of the reaction vessel is suddenly reduced to half while maintaining constant temperature. Which of the following statements is correct regarding the subsequent shift of equilibrium?

(A) K_p doubles

(B) Equilibrium shifts left

(C) Equilibrium shifts right

(D) No shift occurs

Q7. A galvanic cell is represented as

$$\mathrm{Zn}|\mathrm{Zn}^{2+}(0.01\mathrm{M})||\mathrm{Cu}^{2+}(1\mathrm{M})|\mathrm{Cu}$$

Given that

$$E^{\circ}_{\text{cell}} = 1.10\ V$$

and temperature is 298 K, determine the closest value of the cell potential using the Nernst equation.

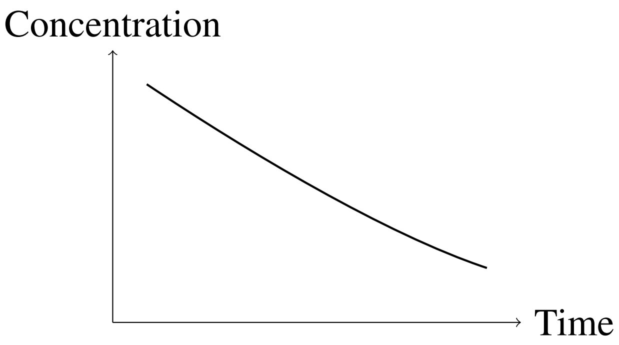
(A) 1.04 V

(B) 1.10 V

(C) 1.16 V

(D) 1.22 V

Q8. The concentration-versus-time graph for a reaction is shown below.



Based on the shape of the curve, the reaction is most likely:

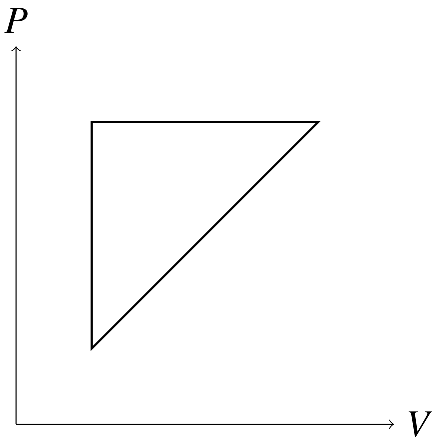
(A) Zero-order

(B) First-order

(C) Second-order

(D) Autocatalytic

Q9. One mole of an ideal gas undergoes the cyclic process represented on the P-V diagram below.



Ignoring frictional losses and assuming quasi-static processes, the net work done by the gas over one complete cycle is:

(A) Zero

(B) Positive

(C) Negative

(D) Cannot be determined

Q10. A weak monoprotic acid HA has

$$K_a = 10^{-5}.$$

Assuming ideal behavior and neglecting higher-order corrections, estimate the pH of a $0.1\ M$ aqueous solution of the acid.

(A) 2

(B) 3

(C) 4

(D) 5

Q11. The coordination complex

$$[\mathrm{Co(NH_3)_4Cl_2}]^+$$

possesses an octahedral geometry. Considering only geometrical isomerism, determine the number of distinct geometrical isomers possible.

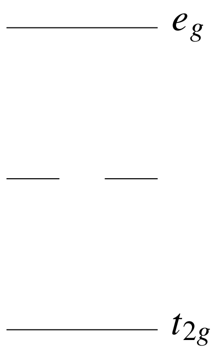
(A) 1

(B) 2

(C) 3

(D) 4

Q12. The crystal-field splitting pattern shown below is observed for a transition-metal complex.



This splitting pattern is characteristic of:

(A) Tetrahedral field

(B) Square planar field

(C) Octahedral field

(D) Trigonal planar field

Q13. Using molecular orbital theory and considering the standard ordering of molecular orbitals for oxygen and heavier homonuclear diatomic molecules, determine the bond order of O_2^+.

(A) 2

(B) 2.5

(C) 3

(D) 3.5

Q14. Among the halogens listed below, identify the species that acts as the strongest oxidizing agent under standard conditions.

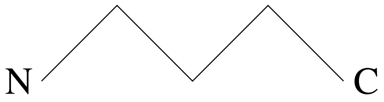
(A) Cl_2

(B) Br_2

(C) I_2

(D) F_2

Q15. The schematic representation below illustrates a sequence of amino-acid residues connected through peptide linkages.



The diagram most appropriately represents which level of protein structure?

(A) β-sheet structure

(B) α-helix structure

(C) Primary structure

(D) Triple helix structure

Detailed Solutions

Q1.

Solution

Concept: The synthesis involves successive transformations of a benzyl halide: nucleophilic substitution (S_N2) with a cyanide source, reduction of the nitrile to a primary amine, and diazotization followed by substitution with water to yield an alcohol.

Solution: Step 1: Treat benzyl bromide ($C_6H_5CH_2Br$) with alcoholic KCN. The cyanide ion (CN^-) acts as a nucleophile and undergoes a nucleophilic substitution (S_N2) reaction, replacing the bromide leaving group to form benzyl cyanide (phenylacetonitrile, *A*):

$$C_6H_5CH_2Br + KCN \xrightarrow{\text{alc.}} C_6H_5CH_2CN + KBr$$

Step 2: Reduce the nitrile *A* using the strong reducing agent lithium aluminum hydride ($LiAlH_4$). This reduces the $-CN$ group to a primary amine group ($-CH_2NH_2$), forming phenethylamine (2-phenylethan-1-amine, *B*):

$$C_6H_5CH_2CN \xrightarrow{LiAlH_4} C_6H_5CH_2CH_2NH_2$$

Step 3: Treat the primary aliphatic amine *B* with nitrous acid generated in situ ($NaNO_2/HCl$). This leads to diazotization, forming an extremely unstable aliphatic diazonium salt ($C_6H_5CH_2CH_2N_2^+$). Under the reaction conditions, this intermediate rapidly decomposes to release nitrogen gas (N_2) and yield a primary carbocation, which is subsequently attacked by water to form phenethyl alcohol (2-phenylethanol, *C*):

$$C_6H_5CH_2CH_2NH_2 \xrightarrow{NaNO_2/HCl} [C_6H_5CH_2CH_2N_2^+Cl^-] \xrightarrow{H_2O} C_6H_5CH_2CH_2OH + N_2 + HCl$$

Thus, compound *C* is phenethyl alcohol, which corresponds to Option B.

Final Answer: $\boxed{\text{Phenethyl alcohol}}$

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

Go Back to Question 1

Q2.

Solution

Concept: A reaction coordinate diagram represents the energy changes along a reaction pathway. The rate of a reaction is determined by its overall activation energy (E_a), which corresponds to the difference in energy between the reactants and the highest energy transition state of the rate-determining step.

Solution: Step 1: Analyze Path I. It is a single-step process (characterized by a single energy peak) with a high transition state energy. Consequently, it has a large activation energy.

Step 2: Analyze Path II. It is a two-step process that proceeds through a valley, representing a stable reactive intermediate. It is bounded by two transition states. The first transition state serves as the rate-determining step, and its energy peak is lower than that of Path I. Therefore, Path II has a smaller overall activation energy than Path I.

Step 3: Relate activation energy to reaction kinetics. According to the Arrhenius equation:

$$k = Ae^{-\frac{E_a}{RT}}$$

A lower activation energy leads to a larger rate constant k, resulting in a much faster reaction rate. Under kinetic control (typically at lower temperatures or shorter reaction times), the pathway with the lower activation energy will predominate.

Step 4: Assess the options.
Since Path II has a lower energy barrier, it has a higher rate and may dominate kinetically (Option C). The product of Path II is also shown to be at a lower energy level than that of Path I, making it thermodynamically more stable. Path I has a higher activation energy, and Path II is faster.

Final Answer: $\boxed{\text{Path II may dominate kinetically}}$

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

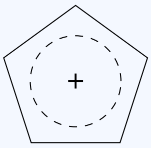
Go Back to Question 2

Q3.

Solution

Concept: According to Hückel's rule, a planar, monocyclic, completely conjugated system containing $(4n + 2)$ π-electrons is classified as aromatic, whereas one containing $4n$ π-electrons (where n is an integer ≥ 1) is classified as antiaromatic.

Solution: Step 1: Identify the species and its structure. The given cyclic species is the cyclopentadienyl cation.



Step 2: Determine the hybridization and conjugation. Every carbon in the five-membered ring is sp^2-hybridized, offering a continuous ring of overlapping p-orbitals. The carbon carrying the positive charge has an empty p-orbital, which allows complete delocalization of the π-electrons.

Step 3: Count the number of π-electrons. There are two double bonds, which contribute:

$$2 \times 2 = 4 \ \pi\text{-electrons}$$

Step 4: Apply Hückel's rule. Since the number of π-electrons is 4, it satisfies the $4n$ rule (for $n = 1$). Therefore, the cyclopentadienyl cation is antiaromatic, which is characterized by thermodynamic instability.

Final Answer: $\boxed{\text{Antiaromatic}}$

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

Go Back to Question 3

Q4.

Solution

Concept: Chemical tests can distinguish between different types of carbonyl compounds:
1. Tollens' test is positive for aldehydes.
2. The iodoform test is positive for compounds containing a methyl ketone ($CH_3 - CO-$) group or a group that can be oxidized to it.
3. Cyanohydrin formation is characteristic of aldehydes and ketones reacting with HCN.

Solution: Step 1: Use Tollens' test. A positive Tollens' test confirms the presence of an aldehyde group ($-CHO$), as aldehydes reduce Tollens' reagent ($[Ag(NH_3)_2]^+$) to metallic silver, forming a silver mirror. This eliminates Acetone (Option C), which is a ketone.

Step 2: Use the iodoform test. A positive iodoform test indicates the presence of a methyl carbonyl group. The only aldehyde that contains a methyl group directly bonded to the carbonyl carbon is acetaldehyde (CH_3CHO):

$$CH_3CHO + 3I_2 + 4NaOH \longrightarrow CHI_3 \downarrow \text{(yellow ppt)} + HCOONa + 3NaI + 3H_2O$$

Formaldehyde (HCHO) and benzaldehyde (C_6H_5CHO) lack a methyl group directly bonded to the carbonyl and thus give a negative iodoform test. This eliminates Options A and D.

Step 3: Confirm with cyanohydrin formation. Acetaldehyde reacts readily with HCN to form acetaldehyde cyanohydrin due to low steric hindrance and high electrophilicity:

$$CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$$

Therefore, compound X is acetaldehyde.

Final Answer: $\boxed{\text{Acetaldehyde}}$

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

Go Back to Question 4

Q5.

Solution

Concept: For a symmetrical compound with two identical terminal chiral centers and a pseudoasymmetric central carbon, the stereoisomers include both optically active (chiral) enantiomeric pairs and optically inactive (meso) diastereomers.

Solution: Step 1: Identify the structure and carbon numbering:

$$\overset{1}{C}H_3 - \overset{2}{C}H(OH) - \overset{3}{C}H(Br) - \overset{4}{C}H(OH) - \overset{5}{C}H_3$$

Step 2: Analyze the stereocenters.

- C2 and C4 are chiral centers.
- C3 is a pseudoasymmetric center. Its stereochemical priority depends on the configurations at C2 and C4.

Step 3: Enumerate the stereoisomers based on the configuration of C2 and C4.

(a) **When** C2 **and** C4 **have the same configuration:** If C2 and C4 are both R or both S, the substituents on C3 are identical in configuration. In this case, C3 is not a stereocenter. This gives a pair of optically active enantiomers:

- Isomer 1: $(2R, 4R)$
- Isomer 2: $(2S, 4S)$

(b) **When** C2 **and** C4 **have opposite configurations:** If one center is R and the other is S, the substituents on C3 are enantiomorphic, which makes C3 a pseudoasymmetric center. It can adopt either the r or s configuration. Because of the R/S mismatch, the molecule possesses an internal plane of symmetry. This yields two meso compounds:

- Isomer 3: $(2R, 3r, 4S)$ (meso)
- Isomer 4: $(2R, 3s, 4S)$ (meso)

Step 4: Sum the stereoisomers.

$$\text{Total number of stereoisomers} = 2\ (\text{chiral}) + 2\ (\text{meso}) = 4$$

Final Answer: $\boxed{4}$

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

Go Back to Question 5

Q6.

Solution

Concept: The shift of a system at chemical equilibrium due to a change in volume is governed by Le Chatelier's principle and the reaction quotient (Q).

Solution: Step 1: Determine the change in the number of gaseous moles (Δn_g) for the equilibrium:

$$2A(g) \rightleftharpoons B(g) + C(g)$$

$$\Delta n_g = n_{\text{products}} - n_{\text{reactants}} = (1 + 1) - 2 = 0$$

Step 2: Set up the reaction quotient Q_p in terms of partial pressures:

$$Q_p = \frac{P_B \cdot P_C}{P_A^2}$$

Step 3: Analyze the effect of halving the volume of the vessel. Reducing the volume to half doubles the total pressure and consequently doubles the partial pressure of each gas ($P_i' = 2P_i$). The new reaction quotient Q_p' is:

$$Q_p' = \frac{(2P_B)(2P_C)}{(2P_A)^2} = \frac{4 \cdot P_B \cdot P_C}{4 \cdot P_A^2} = \frac{P_B \cdot P_C}{P_A^2} = Q_p$$

Step 4: Since $Q_p' = Q_p = K_p$, the system remains at equilibrium. No net forward or reverse shift occurs. Note also that the equilibrium constant K_p depends solely on temperature, so it remains constant.

Final Answer: $\boxed{\text{No shift occurs}}$

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

Go Back to Question 6

Q7.

Solution

Concept: The potential of a electrochemical cell is related to the standard cell potential (E°_{cell}) and the concentration of reactants and products by the Nernst equation:

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{RT}{nF} \ln Q$$

Solution: Step 1: Write the overall cell reaction: Anode: $\text{Zn(s)} \rightarrow \text{Zn}^{2+}\text{(aq)} + 2\text{e}^-$
Cathode: $\text{Cu}^{2+}\text{(aq)} + 2\text{e}^- \rightarrow \text{Cu(s)}$
Overall: $\text{Zn(s)} + \text{Cu}^{2+}\text{(aq)} \rightleftharpoons \text{Zn}^{2+}\text{(aq)} + \text{Cu(s)}$
The number of moles of electrons transferred is $n = 2$.
Step 2: Write the reaction quotient Q:

$$Q = \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} = \frac{0.01\text{ M}}{1\text{ M}} = 10^{-2}$$

Step 3: Apply the Nernst equation at 298 K:

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0592}{n} \log Q$$

Step 4: Substitute the values into the equation:

$$E_{\text{cell}} = 1.10 - \frac{0.0592}{2} \log(10^{-2})$$

$$E_{\text{cell}} = 1.10 - (0.0296) \cdot (-2)$$

$$E_{\text{cell}} = 1.10 + 0.0592 = 1.1592\text{ V} \approx 1.16\text{ V}$$

The closest value of the cell potential is 1.16 V.

Final Answer: $\boxed{1.16\text{ V}}$

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

Go Back to Question 7

Q8.

Solution

Concept: The order of a chemical reaction dictates how the concentration of a reactant changes as a function of time, which can be distinguished by the shape of its concentration-versus-time plot.

Solution: Step 1: Evaluate the shape of the concentration-versus-time graph. The curve is a non-linear, smoothly decaying curve where the rate of consumption (slope of the curve) decreases over time as the concentration of the reactant drops.

Step 2: Compare with standard integrated rate laws:

- **Zero-order kinetics:** $[A]_t = -kt + [A]_0$. This produces a straight line with a constant negative slope. Since the given plot is curved, it is not zero-order.
- **First-order kinetics:** $[A]_t = [A]_0 e^{-kt}$. This produces an exponential decay curve, which matches the shape shown in the graph.
- **Second-order kinetics:** $[A]_t = \frac{[A]_0}{1+kt[A]_0}$. This also produces a curve, but in standard chemical kinetics, a generic decaying curve representing concentration versus time is typically classified as a first-order decay.

Step 3: Confirm with first-order properties. The curve is characteristic of exponential decay, where the half-life is constant and independent of the initial concentration. This matches the behavior of a first-order reaction.

Final Answer: $\boxed{\text{First-order}}$

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

Go Back to Question 8

Q9.

Solution

Concept: The net work done by a gas over a complete thermodynamic cycle is given by the cyclic integral of pressure with respect to volume:

$$W_{\text{net}} = \oint P\,dV$$

On a P-V diagram, the magnitude of the work is equal to the area enclosed by the path of the cycle, and its sign is determined by the direction of the cycle.

Solution: Step 1: Identify the vertices of the triangular cycle:

$$(1,1) \to (1,4) \to (4,4) \to (1,1)$$

Step 2: Trace the direction of the cycle:

- From $(1,1)$ to $(1,4)$: The volume is constant ($V = 1$) while the pressure increases. This is an isochoric process where $W_1 = 0$.
- From $(1,4)$ to $(4,4)$: The pressure is constant ($P = 4$) while the volume increases from 1 to 4. This is an isobaric expansion where the work is positive:

$$W_2 = P\Delta V = 4 \cdot (4-1) = +12$$

- From $(4,4)$ to $(1,1)$: Both pressure and volume decrease linearly. This is a compression step, meaning the work done by the gas is negative ($W_3 < 0$).

Step 3: Analyze the direction. Tracing the vertices shows that the loop proceeds in a **clockwise** direction.
Step 4: Determine the sign of the net work. For any clockwise cycle on a P-V diagram, the expansion occurs at a higher pressure than the compression, resulting in a positive area. Mathematically:

$$W_3 = \int_4^1 P\,dV = \int_4^1 V\,dV = \left[\frac{V^2}{2}\right]_4^1 = \frac{1}{2} - 8 = -7.5$$

$$W_{\text{net}} = W_1 + W_2 + W_3 = 0 + 12 - 7.5 = +4.5 > 0$$

Thus, the net work done by the gas is positive.

Final Answer: $\boxed{\text{Positive}}$

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

Go Back to Question 9

Q10.

Solution

Concept: For a weak monoprotic acid HA, the concentration of hydrogen ions $[\mathrm{H}^+]$ at equilibrium can be estimated using the acid dissociation constant (K_a) and the initial concentration (C).

Solution: Step 1: Write the dissociation equilibrium for HA:

$$\mathrm{HA(aq)} \rightleftharpoons \mathrm{H^+(aq)} + \mathrm{A^-(aq)}$$

Step 2: State the equilibrium concentrations. If x is the concentration of H^+ formed:

$$K_a = \frac{[\mathrm{H}^+][\mathrm{A}^-]}{[\mathrm{HA}]} = \frac{x^2}{C - x}$$

Step 3: Apply the weak-acid approximation. Since $K_a = 10^{-5}$ is very small compared to the concentration $C = 0.1$ M, the degree of dissociation is small ($x \ll C$). Therefore, we can approximate $C - x \approx C$:

$$K_a \approx \frac{x^2}{C} \implies x = [\mathrm{H}^+] \approx \sqrt{K_a \cdot C}$$

Step 4: Calculate $[\mathrm{H}^+]$ and pH:

$$[\mathrm{H}^+] \approx \sqrt{10^{-5} \cdot 0.1} = \sqrt{10^{-6}} = 10^{-3}\ \mathrm{M}$$

$$\mathrm{pH} = -\log_{10}[\mathrm{H}^+] = -\log_{10}(10^{-3}) = 3$$

Final Answer: $\boxed{3}$

Answer: (B)

Go Back to Question 10

Q11.

Solution

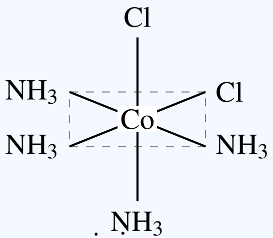
Concept: Geometrical isomerism in octahedral coordination complexes depends on the spatial distribution of the ligands. For complexes of the type $[MA_4B_2]$, two distinct geometrical arrangements exist: *cis* and *trans*.

Solution: Step 1: Identify the formula type. The complex $[Co(NH_3)_4Cl_2]^+$ is an octahedral complex of the general form $[MA_4B_2]$, where M = Co^{3+}, A = NH_3, and B = Cl^-.

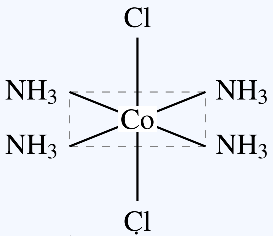
Step 2: Determine the spatial arrangements of the two chloride (Cl^-) ligands:

(a) ***cis*-isomer:** The two chloride ligands occupy adjacent coordination sites, with a Cl – Co – Cl bond angle of 90°.

(b) ***trans*-isomer:** The two chloride ligands occupy opposite coordination sites, with a Cl – Co – Cl bond angle of 180°.



cis-isomer



trans-isomer

Step 3: Since no other distinct spatial arrangements can be constructed for these ligands, the number of geometrical isomers is exactly 2.

Final Answer: $\boxed{2}$

Answer: (B)

Go Back to Question 11

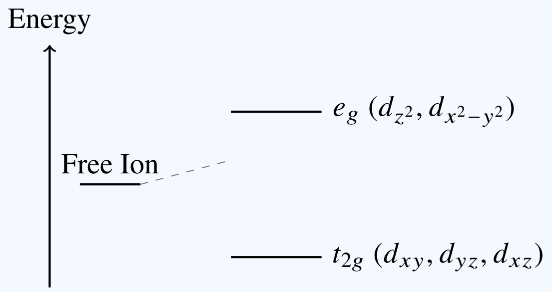
Q12.

Solution

Concept: Under crystal field theory, the five degenerate d-orbitals of a transition-metal ion split into sets of different energies when surrounded by a ligand field. The specific splitting pattern and the degeneracy of the resulting levels depend on the geometry of the complex.

Solution: Step 1: Analyze the energy levels in the provided diagram:

- The lower energy level consists of three degenerate orbitals, labeled as t_{2g} (d_{xy}, d_{yz}, d_{xz}).
- The higher energy level consists of two degenerate orbitals, labeled as e_g $(d_{z^2}, d_{x^2-y^2})$.



Step 2: Relate the splitting to the field geometry:

- **Octahedral field:** Six ligands approach along the Cartesian axes. The d-orbitals that point directly along the axes $(d_{z^2}, d_{x^2-y^2})$ experience greater electrostatic repulsion and rise in energy (e_g set), while the orbitals pointing between the axes (d_{xy}, d_{yz}, d_{xz}) are stabilized (t_{2g} set).
- **Tetrahedral field:** The splitting is inverted (e is lower, t_2 is higher).

Step 3: Because the t_{2g} set is lower in energy than the e_g set, this splitting pattern is characteristic of an octahedral field.

Final Answer: $\boxed{\text{Octahedral field}}$

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

Go Back to Question 12

Q13.

Solution

Concept: According to Molecular Orbital (MO) theory, the bond order of a homonuclear diatomic molecule or ion is calculated using the number of bonding electrons (N_b) and antibonding electrons (N_a):

$$\text{Bond Order} = \frac{N_b - N_a}{2}$$

Solution: Step 1: Calculate the total number of electrons in O_2^+. An oxygen atom has 8 electrons. Therefore, the diatomic ion O_2^+ has:

$$\text{Total electrons} = (2 \times 8) - 1 = 15 \text{ electrons}$$

Step 2: Write the molecular orbital configuration. For oxygen and heavier diatomic molecules, the σ_{2p_z} orbital is lower in energy than the π_{2p_x} and π_{2p_y} orbitals:

$$\sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \sigma_{2p_z}^2\ \left(\pi_{2p_x}^2 = \pi_{2p_y}^2\right)\ \left(\pi_{2p_x}^{*1} = \pi_{2p_y}^{*0}\right)$$

Step 3: Count the bonding (N_b) and antibonding (N_a) electrons:

- Bonding electrons (N_b): $\sigma_{1s}(2), \sigma_{2s}(2), \sigma_{2p_z}(2), \pi_{2p_x}(2), \pi_{2p_y}(2) \implies N_b = 10$
- Antibonding electrons (N_a): $\sigma_{1s}^*(2), \sigma_{2s}^*(2), \pi_{2p_x}^*(1) \implies N_a = 5$

Step 4: Calculate the bond order:

$$\text{Bond Order} = \frac{10 - 5}{2} = 2.5$$

Final Answer: $\boxed{2.5}$

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

Go Back to Question 13

Q14.

Solution

Concept: The oxidizing strength of a halogens is a measure of its tendency to gain electrons and undergo reduction. A stronger oxidizing agent corresponds to a more positive standard reduction potential (E°_{red}).

Solution: Step 1: Define the reduction reaction for halogens (X_2):

$$X_2 + 2e^- \rightarrow 2X^-$$

Step 2: Compare the standard reduction potentials (E°) at 298 K for the halogens:

- $F_2(g) + 2e^- \longrightarrow 2F^-(aq) \quad E^\circ = +2.87\ \text{V}$
- $Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq) \quad E^\circ = +1.36\ \text{V}$
- $Br_2(l) + 2e^- \longrightarrow 2Br^-(aq) \quad E^\circ = +1.09\ \text{V}$
- $I_2(s) + 2e^- \longrightarrow 2I^-(aq) \quad E^\circ = +0.54\ \text{V}$

Step 3: Analyzing the values shows that fluorine (F_2) possesses the most positive standard reduction potential. This indicates that F_2 has the greatest thermodynamic tendency to be reduced, which is driven by its low $F-F$ bond dissociation energy and high hydration enthalpy of the fluoride ion (F^-).

Step 4: Consequently, F_2 is the strongest oxidizing agent among the halogens under standard conditions.

Final Answer: $\boxed{F_2}$

Answer: (D)

Go Back to Question 14

Q15.

Solution

Concept: Protein structure is categorized into four distinct levels: primary, secondary, tertiary, and quaternary. The primary structure is defined as the linear sequence of amino acid residues in the polypeptide chain.

Solution: Step 1: Analyze the schematic representation. The diagram displays a continuous zig-zag chain starting at an 'N' label and terminating at a 'C' label.

Step 2: Define the labels:

- 'N' represents the N-terminus (amino-terminus) of the polypeptide.
- 'C' represents the C-terminus (carboxyl-terminus) of the polypeptide.

Step 3: Relate the diagram to the levels of protein structure:

- **Primary structure:** The linear covalent backbone of amino acids connected via peptide bonds from the N-terminus to the C-terminus.
- **Secondary structure:** Localized folding patterns stabilized by hydrogen bonds, such as α-helices or β-sheets.

Step 4: Since the diagram shows a simplified linear sequence of connected residues spanning from the N-terminal to the C-terminal, it represents the primary structure of a protein.

Final Answer: $\boxed{\text{Primary structure}}$

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

Go Back to Question 15

Answer Key

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