AME CET Chemistry Sample Paper-8

Duration: 20 Minutes **Maximum Marks: 80**

Instructions

- This paper contains **20** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries: **−1 marks**.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Q1. A sample of 4.4 g of a gas occupies 2.24 L at STP. The gas could be:

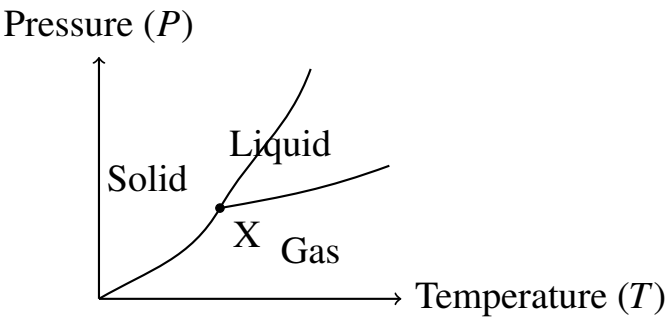
(A) CO_2

(B) O_2

(C) CH_4

(D) CO

Q2. Consider the following phase diagram for a substance:



What is the state of degrees of freedom (F) at the point marked as 'X'?

(A) F = 0

(B) F = 1

(C) F = 2

(D) F = 3

Q3. The major product obtained in the following reaction sequence is:

$$CH_3\text{-}CH = CH_2 \xrightarrow{HBr/Peroxide} A \xrightarrow{alc.\ KOH} B$$

(A) $CH_3\text{-}CH_2\text{-}CH_3$

(B) $CH_3\text{-}CH(OH)\text{-}CH_3$

(C) $CH_3\text{-}CH = CH_2$

(D) $CH_3\text{-}CH_2\text{-}CH_2\text{-}Br$

Q4. Which of the following molecules features a central atom with sp^3d hybridization and has a T-shaped spatial geometry?

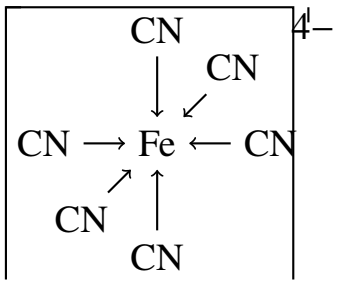
(A) SF_4

(B) ClF_3

(C) XeF_2

(D) BF_3

Q5. The IUPAC name of the complex ion shown below is:



(A) Hexacyanoferrate(II) ion

(B) Hexacyanoferrate(III) ion

(C) Hexacyanoiron(II) ion

(D) Tetracyanoferrate(IV) ion

Q6. The standard reduction potentials of three metallic elements X, Y, and Z are +0.34 V, −3.05 V, and −1.66 V respectively. The order of their reducing power is:

(A) X > Y > Z

(B) X > Z > Y

(C) Y > Z > X

(D) Y > X > Z

Q7. In physical adsorption (physisorption), the forces operating between the adsorbate and the adsorbent molecules are:

(A) Chemical covalent bonds

(B) Ionic interactions

(C) Weak van der Waals forces

(D) Hydrogen bonding forces

Q8. Which of the following p-block hydrides exhibits the highest boiling point due to intermolecular hydrogen bonding effects?

(A) H_2O

(B) H_2S

(C) NH_3

(D) HF

Q9. An aqueous solution of glucose freezes at $-0.186^{\circ}C$. What is the molality of this solution? (K_f for water = 1.86 K kg mol^{-1})

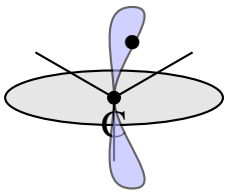
(A) 0.1 m

(B) 0.01 m

(C) 1.0 m

(D) 0.5 m

Q10. Which organic intermediate structure is represented in the diagram below, showing three coplanar hybrid orbitals and one unhybridized perpendicular p-orbital containing a single unpaired electron?



(A) Alkyl Carbanion

(B) Alkyl Carbocation

(C) Carbon free radical

(D) Singlet Carbene

Q11. The correct increasing order of acidic strength among the following carboxylic acids is:

(A) $CH_3COOH < ClCH_2COOH < Cl_2CHCOOH < Cl_3CCOOH$

(B) $Cl_3CCOOH < Cl_2CHCOOH < ClCH_2COOH < CH_3COOH$

(C) $CH_3COOH < Cl_3CCOOH < Cl_2CHCOOH < ClCH_2COOH$

(D) $ClCH_2COOH < CH_3COOH < Cl_2CHCOOH < Cl_3CCOOH$

Q12. The bond order of O_2^+ species according to Molecular Orbital (MO) Theory is:

(A) 2.0

(B) 2.5

(C) 1.5

(D) 3.0

Q13. What type of structural isomerism is shown by the pair $[Co(NH_3)_5(SO_4)]Br$ and $[Co(NH_3)_5Br]SO_4$?

(A) Linkage isomerism

(B) Coordination isomerism

(C) Ionization isomerism

(D) Solvate isomerism

Q14. During the electrolysis of an aqueous solution of $CuSO_4$ using inert platinum electrodes, the products liberated at the cathode and anode respectively are:

(A) H_2 and O_2

(B) Cu and O_2

(C) Cu and H_2

(D) O_2 and Cu

Q15. For a reversible chemical reaction at equilibrium, if the temperature is increased for an endothermic process, the equilibrium constant (K):

(A) Increases

(B) Decreases

(C) Remains unchanged

(D) First decreases then increases

Q16. Identify the major product formed when phenol reacts with $CHCl_3$ in the presence of aqueous NaOH (Reimer-Tiemann reaction):

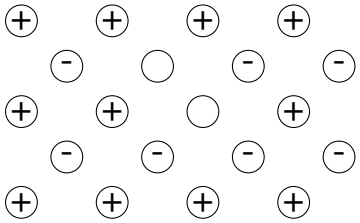
(A) Salicylic acid

(B) Salicylaldehyde

(C) Benzene

(D) Benzoic acid

Q17. Which type of crystal defect is represented in the two-dimensional lattice layout below, characterized by equal missing numbers of cations and anions?



(A) Frenkel defect

(B) Schottky defect

(C) Metal excess defect

(D) Interstitial defect

Q18. According to VSEPR theory, the shape of the XeF_4 molecule is square planar. How many lone pairs of electrons are residing on the central Xenon atom?

(A) 1

(B) 2

(C) 3

(D) 4

Q19. Which of the following transition metal ions exhibits highest magnetic moment in its ground state electronic configuration?

(A) Mn^{2+}

(B) Fe^{2+}

(C) Cu^{2+}

(D) Cr^{3+}

Q20. The conversion of an optically active alkyl halide into a racemic mixture via S_N1 mechanism proceeds through which of the following geometric structural transition phases?

(A) A pyramidal carbanion state

(B) A planar carbocation intermediate

(C) A pentavalent transition state

(D) A tetrahedral free radical state

Detailed Solutions

Q1.

Solution

Concept:

The mole concept establishes a relationship between the mass of a substance and its volume at standard temperature and pressure (STP). One mole of any ideal gas occupies a molar volume of 22.4 liters at STP, and its mass equals its gram molecular mass.

Solution:

(a) First, determine the number of moles (n) of the gas present in the given volume. Using the molar volume relationship at STP, $n = \frac{\text{Given Volume}}{\text{Molar Volume}} = \frac{2.24\ \text{L}}{22.4\ \text{L mol}^{-1}} = 0.1$ mol.

(b) Next, calculate the molar mass (M) of the gas using the mass formula. Since Moles $= \frac{\text{Mass}}{\text{Molar Mass}}$, we have 0.1 mol $= \frac{4.4\ \text{g}}{M}$, which yields $M = \frac{4.4\ \text{g}}{0.1\ \text{mol}} = 44\ \text{g mol}^{-1}$.

(c) Now, evaluate the molecular masses of the given choices to find a match. The molecular mass of carbon dioxide (CO_2) is calculated as $12 + (2 \times 16) = 44\ \text{g mol}^{-1}$.

(d) Checking other options, oxygen gas (O_2) is $32\ \text{g mol}^{-1}$, methane (CH_4) is $16\ \text{g mol}^{-1}$, and carbon monoxide (CO) is $28\ \text{g mol}^{-1}$.

(e) The calculated molar mass matches carbon dioxide perfectly, making it the identity of the unknown gas sample.

Final Answer: The gas is carbon dioxide.

Answer: (A)

Go Back to Question 1

Q2.

Solution

Concept:

The Gibbs phase rule defines the degrees of freedom in a heterogeneous chemical system at equilibrium. It is mathematically expressed as $F = C - P + 2$, where C is components, P is phases, and F is the remaining independent intensive variables.

Solution:

(a) Analyze the components in the system. A standard phase diagram represents a single pure substance, which means the number of chemical components (C) is equal to 1.

(b) Identify the significance of point X. Point X represents the triple point on the phase diagram, where the boundaries of the solid, liquid, and gas phases intersect.

(c) Determine the number of coexisting phases (P) at this intersection. At the triple point, all three distinct phases coexist in simultaneous dynamic equilibrium, so $P = 3$.

(d) Substitute these values into the Gibbs phase rule equation: $F = 1 - 3 + 2$. Solving this basic arithmetic expression yields $F = 0$.

(e) A value of zero indicates that the system is invariant at this point, meaning neither temperature nor pressure can be altered without causing at least one phase to disappear completely.

Final Answer: The degrees of freedom is zero.

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept:

Regioselective addition reactions of unsymmetrical alkenes follow rules based on reaction conditions. Free radical mechanism additions follow anti-Markovnikov regioselectivity, whereas elimination reactions with strong bases systematically yield the most stable or favored alkene product via dehydrohalogenation.

Solution:

(a) The starting material is propene. In the first step, propene reacts with hydrogen bromide (HBr) in the presence of an organic peroxide catalyst.

(b) The presence of peroxide triggers a free radical mechanism leading to anti-Markovnikov addition, where the bromine atom attaches to the less substituted terminal carbon, forming 1-bromopropane as intermediate A.

(c) In the second step, 1-bromopropane is treated with alcoholic potassium hydroxide (alc. KOH), which acts as a strong base inducing an elimination reaction.

(d) This reagent brings about dehydrohalogenation via an E2 mechanism, eliminating a hydrogen atom from the beta-carbon and the bromine atom from the alpha-carbon.

(e) This elimination reforms the carbon-carbon double bond, yielding propene as the major product B, effectively regenerating the original starting alkene structure.

Final Answer: The product is propene.

Answer: (C)

Go Back to Question 3

Q4.

Solution

Concept:

Valence Shell Electron Pair Repulsion (VSEPR) theory dictates molecular geometry based on steric numbers. The steric number is the sum of sigma bonds and lone pairs on a central atom, which determines hybridization and spatial orientation.

Solution:

(a) Examine the valence electron configuration of chlorine (Cl), which is the central atom in chlorine trifluoride (ClF_3). It contains 7 valence electrons.

(b) Chlorine forms 3 covalent single bonds with 3 fluorine atoms, utilizing 3 of its valence electrons, which leaves 4 non-bonding electrons remaining on the atom.

(c) These 4 remaining valence electrons form 2 distinct lone pairs. The steric number is calculated as 3 bonding pairs plus 2 lone pairs, giving a total of 5.

(d) A steric number of 5 corresponds to sp^3d hybridization, which possesses an underlying trigonal bipyramidal electronic geometry.

(e) To minimize electron repulsion, the 2 lone pairs occupy equatorial positions, forcing the 3 axial and equatorial fluorine bonds into an asymmetrical, T-shaped spatial layout.

Final Answer: The molecule is chlorine trifluoride.

Answer: (B)

Go Back to Question 4

Q5.

Solution

Concept:

The International Union of Pure and Applied Chemistry (IUPAC) nomenclature for coordination complexes follows systematic naming protocols. Anionic coordination spheres require the central metal name to take an "-ate" suffix, followed immediately by its oxidation state in Roman numerals.

Solution:

(a) Identify the ligands and their total quantity inside the coordination sphere. The complex contains 6 cyano (CN^-) groups acting as monodentate ligands, giving the prefix hexacyano.

(b) Determine the net charge of the ligands. Each cyano ligand carries a -1 charge, resulting in a combined total ligand charge of -6.

(c) Calculate the oxidation state of the central iron metal (Fe) atom. Setting up the algebraic equation: $x + 6(-1) = -4$, where -4 is the net ionic charge.

(d) Solving for x gives $x = +2$, which confirms that iron exists in the +2 oxidation state, represented as (II).

(e) Because the overall coordination complex carries a net negative charge, the name of the central iron atom is modified to its Latin form with the appropriate suffix, giving ferrate(II) ion.

Final Answer: The name is hexacyanoferrate(II) ion.

Answer: (A)

Go Back to Question 5

Q6.

Solution

Concept:

Standard reduction potentials measure the tendency of chemical species to gain electrons and undergo reduction. There exists an inverse relationship between a species' standard reduction potential and its inherent thermodynamic capacity to act as a reducing agent.

Solution:

(a) A lower, more negative standard reduction potential indicates that a metallic element releases electrons more readily, making it easily oxidized and consequently a more powerful reducing agent.

(b) Tabulate and compare the given standard reduction potentials for the three metallic elements: Y = −3.05 V, Z = −1.66 V, and X = +0.34 V.

(c) Element Y possesses the lowest and most negative reduction potential value among the group, establishing it clearly as the strongest reducing agent.

(d) Element Z possesses an intermediate negative reduction potential value, placing its reducing strength directly between the other two elements.

(e) Element X has a positive reduction potential, meaning it prefers reduction over oxidation, making it the weakest reducing agent, establishing the definitive decreasing order as Y > Z > X.

Final Answer: The reducing power order is Y greater than Z greater than X.

Answer: (C)

Go Back to Question 6

Q7.

Solution

Concept:

Adsorption is a surface phenomenon classified into physical adsorption or chemical adsorption based on interfacial forces. Physisorption involves weak intermolecular attraction without altering the electronic structures or forming true chemical linkages between phases.

Solution:

(a) In physical adsorption, gaseous adsorbate molecules accumulate on the surface of a solid or liquid adsorbent without creating specific electronic modifications.

(b) The binding interactions responsible for holding the adsorbate to the adsorbent surface are non-specific, long-range electrostatic attractions known as weak van der Waals forces.

(c) Because no formal chemical bonds are broken or created during this process, the enthalpy of physisorption remains characteristically low, typically ranging between 20 and 40 kJ/mol.

(d) This weak non-specific interaction allows physisorption to be highly reversible and form multiple molecular layers on the adsorbent material.

(e) Other interactions like covalent or ionic forces belong exclusively to chemisorption, confirming that van der Waals forces drive physisorption.

Final Answer: The forces are weak van der Waals forces.

Answer: (C)

Go Back to Question 7

Q8.

Solution

Concept:

The boiling points of molecular hydride compounds are governed by molecular mass and intermolecular forces. Strong intermolecular hydrogen bonding creates anomalously high cohesive forces, requiring significantly more thermal energy to volatilize the liquid phase into a gas.

Solution:

(a) While moving down a group, boiling points normally increase with molecular weight due to growing London dispersion forces, but period 2 hydrides often present deviations.

(b) Oxygen, fluorine, and nitrogen possess exceptionally high electronegativities and small atomic radii, enabling their hydrides to engage in intermolecular hydrogen bonding.

(c) Water (H_2O) molecules can form up to four stable hydrogen bonds per molecule in a highly cohesive three-dimensional network structure.

(d) Hydrogen fluoride (HF) forms strong individual hydrogen bonds but is restricted to an average of two bonds per molecule due to its stoichiometry.

(e) Because of this extensive four-coordinate hydrogen bonding network, water possesses greater cohesive forces than HF or NH_3, resulting in the highest boiling point.

Final Answer: The hydride is water.

Answer: (A)

Go Back to Question 8

Q9.

Solution

Concept:

Freezing point depression is a colligative property that depends entirely on the concentration of solute particles in a solution. The mathematical expression is $\Delta T_f = i \cdot K_f \cdot m$, where m is molality and i is the van 't Hoff factor.

Solution:

(a) Determine the value of the freezing point depression (ΔT_f). The depression is the change from pure water: $\Delta T_f = 0°\text{C} - (-0.186°\text{C}) = 0.186$ K.

(b) Identify the nature of the solute. Glucose is a non-electrolyte compound that does not dissociate or associate in aqueous solutions, meaning its van 't Hoff factor (i) is exactly 1.

(c) State the given cryoscopic constant (K_f) value for the solvent water, which is provided as 1.86 K kg mol^{-1}.

(d) Rearrange the colligative property equation to solve for solution molality: $m = \frac{\Delta T_f}{K_f}$. Substituting the numbers yields $m = \frac{0.186}{1.86}$.

(e) Performing this division yields a value of 0.1 mol kg^{-1}, confirming the molality of the aqueous glucose solution.

Final Answer: The molality is zero point one m.

Answer: (A)

Go Back to Question 9

Q10.

Solution

Concept:

Organic reaction intermediates are classified based on their total valence electron count, hybridization state, and spatial geometry. A neutral trivalent carbon atom possessing seven total valence electrons represents a free radical intermediate species.

Solution:

(a) Analyze the structural characteristics presented in the diagram. The central carbon atom is bonded to three substituents located within a single geometric plane.

(b) This coplanar layout demonstrates sp^2 hybridization of the central carbon atom, where three hybrid orbitals form three distinct sigma bonds separated by 120-degree angles.

(c) Observe the unhybridized p-orbital, oriented perpendicular to the sigma bonding plane. This orbital contains a single dot representing one unpaired non-bonding electron.

(d) Carbocations match this planar geometry but have an empty p-orbital, while carbanions possess eight valence electrons and adopt a pyramidal, sp^3-hybridized arrangement.

(e) A neutral trivalent carbon structure containing a single unpaired electron in its unhybridized orbital perfectly defines a carbon free radical intermediate.

Final Answer: The intermediate is a carbon free radical.

Answer: (C)

Go Back to Question 10

Q11.

Solution

Concept:

The acidic strength of carboxylic acids is fundamentally governed by the stability of the conjugate base carboxylate anion formed after deprotonation. Electron-withdrawing groups enhance acidity through the inductive effect by dispersing the negative charge over the functional molecule.

Solution:

(a) When a carboxylic acid loses a proton, it forms a negatively charged carboxylate anion which experiences stabilization or destabilization based on adjacent substituent groups.

(b) Highly electronegative chlorine atoms act as powerful electron-withdrawing groups that pull electron density away from the reaction center through sigma bonds.

(c) This negative inductive effect effectively disperses the localized negative charge on the carboxylate group, thereby increasing the overall thermodynamic stability of the anion.

(d) Acetic acid contains a methyl group which is weakly electron-donating via induction, making its conjugate base the least stable among the group.

(e) As successive hydrogen atoms on the alpha-carbon are replaced by chlorine atoms, the cumulative inductive effect increases, making trichloroacetic acid the strongest acid.

Final Answer: The increasing order of acidic strength is acetic acid followed by monochloroacetic acid, dichloroacetic acid, and trichloroacetic acid.

Answer: (A)

Go Back to Question 11

Q12.

Solution

Concept:

Molecular Orbital Theory describes the distribution of electrons in molecules using specific energy levels. The bond order provides a quantitative measure of the strength and stability of a covalent bond, calculated from bonding and antibonding populations.

Solution:

(a) A neutral oxygen molecule possesses a total of 16 electrons distributed throughout its molecular orbitals following standard Aufbau and Hund rules.

(b) The electronic configuration of a neutral oxygen molecule places 10 electrons in bonding molecular orbitals and 6 electrons in antibonding molecular orbitals.

(c) For the positively charged oxygen species, one electron is removed from the highest occupied molecular orbital to account for the single positive charge.

(d) This electron is specifically lost from an antibonding pi molecular orbital, reducing the total number of antibonding electrons from 6 down to 5.

(e) Applying the fundamental bond order formula gives one half of the quantity 10 bonding electrons minus 5 antibonding electrons, which yields two point five.

Final Answer: The bond order of the species is two point five.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept:

Structural isomerism in coordination chemistry arises when complexes share an identical empirical formula but feature different connectivity among atoms. This behavior depends on which chemical species are locked inside the inner coordination sphere versus the counterions.

Solution:

(a) In the first complex compound, the sulfate group is directly bound to the central cobalt atom, while the bromide ion resides outside.

(b) In the second complex compound, the bromide ion is directly bound to the central cobalt atom, while the sulfate group acts as the counterion.

(c) When dissolved in an aqueous solution, these compounds dissociate completely to yield entirely different sets of free ions in the solvent matrix.

(d) The first compound yields free bromide ions that form a precipitate with silver nitrate, whereas the second yields free sulfate ions forming a barium sulfate precipitate.

(e) This specific exchange of roles between a coordinated ligand and an external counterion precisely defines the structural class known as ionization isomerism.

Final Answer: The type of structural isomerism shown by the pair is ionization isomerism.

Answer: (C)

Go Back to Question 13

Q14.

Solution

Concept:

Electrolysis involves driving non-spontaneous chemical changes using an external electric current through an electrolyte. The identity of products liberated at the electrodes depends on preferential discharge potentials under standard thermodynamic conditions.

Solution:

(a) The aqueous solution contains copper cations, sulfate anions, hydrogen ions, and hydroxyl ions moving within the electrical field between the inert platinum plates.

(b) At the negative cathode, both copper ions and hydrogen ions migrate toward the surface to capture electrons and undergo chemical reduction.

(c) Copper possesses a higher reduction potential than hydrogen ions, meaning copper ions are preferentially discharged to form solid copper metal deposits.

(d) At the positive anode, both sulfate anions and water molecules compete to release electrons and undergo chemical oxidation.

(e) Water molecules possess a lower oxidation potential than sulfate ions, leading to preferential oxidation of water which generates gaseous oxygen molecules.

Final Answer: The products liberated at the cathode and anode are copper and oxygen gas.

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept:

The temperature dependence of a chemical equilibrium constant is quantitatively dictated by the van 't Hoff equation. Le Chatelier's principle qualitatively explains how a system at equilibrium shifts to counteract external perturbations.

Solution:

(a) An endothermic reaction is characterized by a positive standard enthalpy change, meaning the chemical process absorbs thermal energy from the surrounding environment.

(b) According to Le Chatelier's principle, applying external thermal energy via a temperature increase shifts the equilibrium position to consume the added heat.

(c) To consume this added heat, the system favors the forward direction, converting reactant molecules into additional product molecules.

(d) Because the equilibrium constant is defined as the ratio of product concentrations to reactant concentrations, favoring the products increases this value.

(e) The van 't Hoff equation mathematically mirrors this behavior, proving that the equilibrium constant must systematically increase as temperature rises for endothermic systems.

Final Answer: The equilibrium constant increases.

Answer: (A)

Go Back to Question 15

Q16.

Solution

Concept:

The Reimer-Tiemann reaction is an organic transformation used for the functionalization of aromatic rings. It proceeds via an electrophilic aromatic substitution mechanism involving a reactive carbene intermediate generated under highly basic conditions.

Solution:

(a) Reacting chloroform with strong aqueous sodium hydroxide induces alpha-elimination of a hydrogen atom and a chloride ion, generating a dichlorocarbene intermediate.

(b) Phenol reacts with the strong sodium hydroxide base to form a phenoxide ion, which activates the aromatic ring toward electrophilic attack.

(c) The neutral but highly electrophilic dichlorocarbene species attacks the electron-rich ortho position of the active phenoxide ring structure.

(d) Subsequent basic hydrolysis of the resulting intermediate yields a benzal chloride derivative that easily loses a water molecule.

(e) Acidification of this final reaction mixture delivers the ortho-hydroxybenzaldehyde product, commercially and systematically referred to as salicylaldehyde.

Final Answer: The major product formed is salicylaldehyde.

Answer: (B)

Go Back to Question 16

Q17.

Solution

Concept:

Crystal defects are structural imperfections occurring within an ordered crystalline lattice system. Stoichiometric point defects alter the structural regularity of the crystal lattice without modifying the overall chemical formula.

Solution:

(a) Analyze the provided two-dimensional lattice configuration, checking the distribution of positive cation sites and negative anion sites across the matrix.

(b) Notice that certain positions within the alternating pattern are completely empty, indicating missing constituent particles from their standard locations.

(c) Count the missing species to find that exactly one positive cation and one negative anion are absent from the structural grid.

(d) Because equal numbers of cations and anions are missing from their normal lattice positions, electrical neutrality is maintained.

(e) This specific configuration of vacant ion pairs within a crystalline solid structure defines the point defect known as a Schottky defect.

Final Answer: The type of crystal defect represented is a Schottky defect.

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept:

Valence Shell Electron Pair Repulsion theory determines the geometry of a molecule based on electron pair distributions around the central atom. Total valence electron counts dictate bonding and non-bonding pairs.

Solution:

(a) Identify the central atom as xenon, a noble gas element that inherently possesses 8 valence electrons in its outermost shell.

(b) Xenon forms 4 single covalent sigma bonds by sharing 4 of its valence electrons with 4 individual fluorine atoms.

(c) Subtracting these 4 bonding electrons from the original 8 valence electrons leaves 4 non-bonding electrons remaining on the xenon atom.

(d) These 4 remaining valence electrons arrange themselves into 2 distinct non-bonding lone pairs localized around the central core.

(e) The total steric number is 6, giving an octahedral electronic arrangement where the 2 lone pairs occupy axial positions to maximize symmetry.

Final Answer: The number of lone pairs residing on the central Xenon atom is two.

Answer: (B)

Go Back to Question 18

Q19.

Solution

Concept:

The magnetic behavior of transition metal complexes depends on the count of unpaired d-electrons. The spin-only magnetic moment formula relates this directly to the electronic configuration of the metal ion.

Solution:

(a) Write out the ground state electronic configurations for the transition metal ions by removing valence electrons from the highest shells first.

(b) Manganese in the plus two state loses its two valence s-electrons, leaving a stable half-filled d-shell with five unpaired electrons.

(c) Iron in the plus two state possesses six d-electrons, which results in one paired set and four lone unpaired electrons.

(d) Copper in the plus two state possesses nine d-electrons, containing four paired sets and leaving only a single unpaired electron.

(e) Chromium in the plus three state possesses three d-electrons, meaning it contains exactly three unpaired electrons in its lower energy orbitals.

(f) Since manganese possesses the maximum possible number of five unpaired electrons, it generates the highest spin-only magnetic moment.

Final Answer: The transition metal ion with the highest magnetic moment is manganese two plus.

Answer: (A)

Go Back to Question 19

Q20.

Solution

Concept:

Nucleophilic substitution reactions can proceed through different mechanistic pathways depending on structural environments. The first-order substitution mechanism involves a multi-step pathway driven by the thermodynamic stability of its intermediates.

Solution:

(a) In the first step of a first-order substitution process, the leaving halide group departs from the chiral carbon center.

(b) The loss of this leaving group generates a trivalent carbon intermediate known as an alkyl carbocation.

(c) This carbocation center exhibits sp2 hybridization, which forces its three remaining covalent bonds into a flat, planar geometric orientation.

(d) The unhybridized p-orbital projects symmetrically above and below this flat molecular plane, offering equal structural accessibility from either face.

(e) An incoming nucleophile attacks both faces with equal probability, leading to equal amounts of inversion and retention, creating a racemic mixture.

Final Answer: The process proceeds through a planar carbocation intermediate.

Answer: (B)

Go Back to Question 20

Answer Key

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