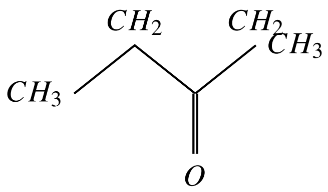
IISER Chemistry Sample Paper-7

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. An organic compound with molecular formula $C_5H_{10}O$ forms a crystalline phenylhydrazone derivative but does not reduce Tollens' reagent. On vigorous oxidation with chromic acid, it yields a mixture of ethanoic acid and propanoic acid as the only organic products. The compound's structural skeleton is illustrated in the diagram below:



Which compound corresponds to this description?

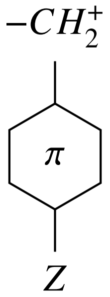
(A) Pentanal

(B) Pentan-2-one

(C) Pentan-3-one

(D) 2-Methylbutanal

Q2. Arrange the following benzylic carbocations in the decreasing order of their stability by evaluating the field effects indicated by the general template below:



Where the substituent Z corresponds to: (I) $Z = -CH_3$ (II) $Z = -NO_2$ (III) $Z = -H$ (IV) $Z = -OCH_3$

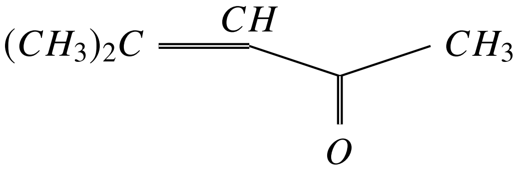
(A) IV > I > III > II

(B) I > IV > III > II

(C) IV > I > II > III

(D) II > III > I > IV

Q3. An alkene A undergoes reductive ozonolysis to yield a single carbonyl product B. Compound B exhibits a positive iodoform test but does not undergo a Cannizzaro reaction. When B is treated with dilute $NaOH$ followed by heating, it yields the α, β-unsaturated ketone shown below:



Identify the original alkene A:

(A) 2,3-Dimethylbut-2-ene

(B) 3,4-Dimethylhex-3-ene

(C) Hex-3-ene

(D) 2,5-Dimethylhex-3-ene

Q4. Consider the following transformation pathway:

$$\text{Propyne} \xrightarrow{Hg^{2+}/H_2SO_4} X \xrightarrow{NH_2OH} Y \xrightarrow{PCl_5/\Delta} Z$$

The major organic product Z features which structural composition?

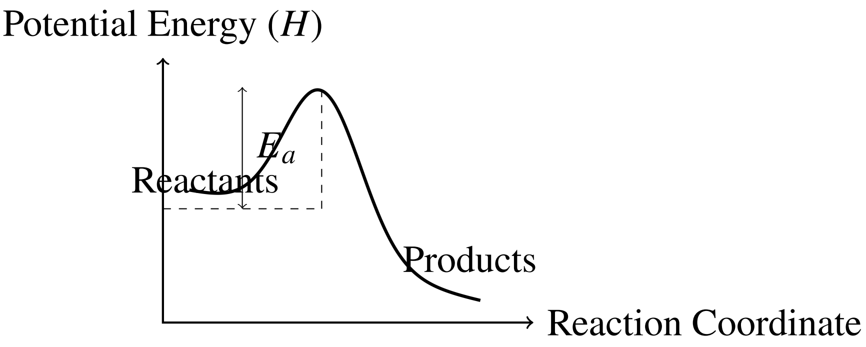
(A) N-Methylacetamide

(B) Propanamide

(C) N-Ethylformamide

(D) Acetone oxime

Q5. The potential energy profile for a specific chemical process is mapped out in the coordinate grid below:



For the complete combustion of 1-butene (C_4H_8) under standard state conditions, the difference between the enthalpy of reaction (ΔH) and internal energy change (ΔU) at temperature T (in Kelvin) is given by:

(A) $-2RT$

(B) $+2RT$

(C) $-3RT$

(D) zero

Q6. For a reversible gaseous reaction $2A(g) \rightleftharpoons B(g) + C(g)$, the equilibrium constant is K_1. If the volume of the reaction vessel is suddenly halved at constant temperature, the new equilibrium constant K_2 and the degree of dissociation (α) of A change such that:

(A) $K_2 = 2K_1$, and α remains unchanged

(B) $K_2 = K_1$, and α remains unchanged

(C) $K_2 = K_1$, and α increases

(D) $K_2 = \frac{1}{2}K_1$, and α decreases

Q7. For a pseudo-first-order reaction $A + B \longrightarrow$ Products where $[B] \gg [A]$, the half-life of A was found to be 40 min when $[B] = 0.5$ M. If the concentration of B is increased to 2.0 M keeping all other conditions identical, the new half-life of A will be:

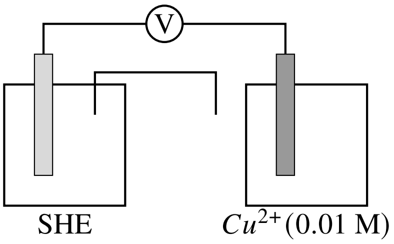
(A) 40 min

(B) 160 min

(C) 10 min

(D) 20 min

Q8. An electrochemical cell setup is constructed under the parameters outlined schematically below:



Given that the standard reduction potential $E^\circ(Cu^{2+}/Cu) = +0.34$ V, the electromotive force (EMF) of this cell at 298 K is closest to: (Take $\frac{2.303RT}{F} = 0.059$ V)

(A) 0.34 V

(B) 0.28 V

(C) 0.40 V

(D) 0.22 V

Q9. At 298 K, the solubility product (K_{sp}) of a sparingly soluble salt MX_2 is 4.0×10^{-12}. The solubility of this salt in a 0.01 M solution of a strong electrolyte NX containing a common ion is:

(A) 1.0×10^{-4} M

(B) 4.0×10^{-8} M

(C) 2.0×10^{-6} M

(D) 4.0×10^{-10} M

Q10. According to Molecular Orbital (MO) Theory, which of the following homonuclear diatomic species is paramagnetic and possesses a fractional bond order?

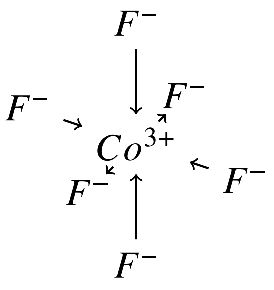
(A) O_2

(B) B_2

(C) O_2^+

(D) N_2^-

Q11. The coordination geometry of an octahedral complex $[CoF_6]^{3-}$ is modeled below, yielding a measured spin-only magnetic moment of 4.90 BM:



Which of the following statements correctly describes the hybridization and electronic configuration of the central metal ion? (Atomic number of $Co = 27$)

(A) d^2sp^3, low spin complex

(B) sp^3d^2, high spin complex

(C) sp^3d^2, low spin complex

(D) d^2sp^3, high spin complex

Q12. When orthophosphoric acid (H_3PO_4) is heated to around 250°C, it undergoes a dehydration reaction to form a condensed oxoacid compound P. Compound P contains:

(A) Two P – O – P linkages and two P = O bonds

(B) One P – O – P linkage and two P = O bonds

(C) One P – P bond and four P – OH bonds

(D) No P – O – P linkage but three P = O bonds

Q13. Among the following pairs of coordination isomers, which pair can show optical isomerism?

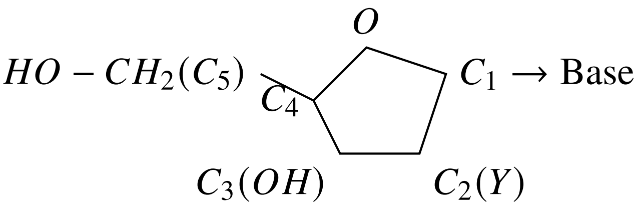
(A) cis-$[Pt(NH_3)_2Cl_2]$

(B) trans-$[Co(en)_2Cl_2]^+$

(C) cis-$[Co(en)_2Cl_2]^+$

(D) $[Co(NH_3)_5Cl]Cl_2$

Q14. The structural motif shown below describes a basic monomer component used in nucleic acids:



Which statement regarding the structural features of DNA and RNA is completely accurate?

(A) RNA contains thymine instead of uracil, and the sugar component lacks an oxygen atom at the C-2 position compared to DNA.

(B) DNA contains a 2-deoxyribose sugar component, while RNA contains a ribose sugar component, and both utilize identical pyrimidine bases.

(C) DNA is stabilized by hydrogen bonding between complementary base pairs (A-T and G-C) and contains 2-deoxyribose, whereas RNA contains ribose and replaces thymine with uracil.

(D) DNA forms a single-stranded right-handed helix, while RNA always forms a complementary double-stranded helical framework.

Q15. A gaseous mixture containing sulfur dioxide (SO_2) and oxygen (O_2) in a 2 : 1 molar ratio is allowed to react over a vanadium pentoxide (V_2O_5) catalyst at high temperature. If the total pressure at equilibrium is 3 atm and 50% of the initial SO_2 has converted to SO_3, the partial pressure of SO_3 at equilibrium is:

(A) 1.0 atm

(B) 1.2 atm

(C) 0.6 atm

(D) 1.5 atm

Detailed Solutions

Q1.

Solution

Concept: Identification of an unknown carbonyl compound depends on analyzing functional group test behaviors and profiling the structural identities of its characteristic acid cleavage pieces obtained via vigorous chromic acid oxidation.

Solution:

(a) The compound has the molecular formula $C_5H_{10}O$. It forms a crystalline phenylhydrazone, which implies it contains a reactive carbonyl group (either an aldehyde or a ketone).

(b) Because the compound does not reduce Tollens' reagent, it cannot be an aldehyde. Thus, it must be a ketone with a five-carbon framework (pentanone).

(c) Vigorous oxidation of asymmetric or symmetric ketones with chromic acid splits the carbon-carbon bonds flanking the carbonyl functional group according to Popoff's rule.

(d) The problem states that oxidation yields a mixture of ethanoic acid (CH_3COOH, a 2-carbon acid) and propanoic acid (CH_3CH_2COOH, a 3-carbon acid) as the only organic products.

(e) Cleaving a 5-carbon ketone to produce one 2-carbon fragment and one 3-carbon fragment implies that the carbonyl carbon must be located precisely at position 3. Symmetric cleavage of pentan-3-one directly gives these two specific carboxylic acids.

Final Answer: The structure of the compound is Pentan-3-one.

Answer: (C)

Go Back to Question 1

Q2.

Solution

Concept: The thermodynamic stability of benzylic carbocations depends strongly on the electronic nature of the functional group attached at the para-position, mediated through resonance (mesomeric) and inductive field effects.

Solution:

(a) Benzylic carbocations are stabilized by the delocalization of the positive charge into the aromatic π-system. Substituents at the para-position alter this stability through electron donation or withdrawal.

(b) In species (IV), the methoxy group ($-OCH_3$) acts as a powerful electron-donating group via the $+M$ resonance effect. It strongly delocalizes the positive charge, making it the most stable carbocation.

(c) In species (I), the methyl group ($-CH_3$) acts as an electron-donating group through hyperconjugation and a weak $+I$ inductive effect, stabilizing the positive center more than hydrogen.

(d) In species (III), the substituent is hydrogen ($-H$), which serves as the standard baseline for benzylic stability without extra electronic modifications.

(e) In species (II), the nitro group ($-NO_2$) is a powerful electron-withdrawing group via both $-M$ and $-I$ effects. It intensifies the positive charge on the benzylic carbon, drastically destabilizing the system.

Final Answer: The decreasing order of stability is IV > I > III > II.

Answer: (A)

Go Back to Question 2

Q3.

Solution

Concept: Retrosynthetic analysis of aldol condensation products combined with structural clues from ozonolysis can reveal the precise identity and connectivity of an unknown symmetrical alkene.

Solution:

(a) Reductive ozonolysis of alkene A gives a single product B, indicating that A must be a symmetric alkene cleaved right down its central double bond.

(b) Product B gives a positive iodoform test, confirming it contains a methyl ketone group $(CH_3C = O)$. It does not undergo the Cannizzaro reaction, confirming it possesses at least one α-hydrogen atom.

(c) Treating B with dilute $NaOH$ and heat forms 4-methylpent-3-en-2-one via self-aldol condensation. Retrosynthetic cleavage of this α, β-unsaturated ketone across its double bond ($= CH-$ and $= C(CH_3)_2$) reveals the starting monomer.

(d) Breaking the aldol product yields propan-2-one (CH_3COCH_3) as the sole building block, which aligns perfectly with all the chemical test traits observed for compound B.

(e) Rejoining two molecules of propan-2-one by replacing their carbonyl oxygen atoms with a central carbon-carbon double bond yields the symmetric alkene 2,3-dimethylbut-2-ene.

Final Answer: The original alkene A is 2,3-Dimethylbut-2-ene.

Answer: (A)

Go Back to Question 3

Q4.

Solution

Concept: The conversion path steps through Markovnikov hydration of an alkyne, oxime formation from the resulting ketone, and a Beckmann rearrangement driven by phosphorus pentachloride.

Solution:

(a) Propyne ($CH_3C \equiv CH$) undergoes hydration in the presence of Hg^{2+}/H_2SO_4. According to Markovnikov's rule, water adds to yield an enol intermediate ($CH_3C(OH) = CH_2$), which rapidly tautomerizes to form stable acetone (CH_3COCH_3) as compound X.

(b) Treating acetone (X) with hydroxylamine (NH_2OH) leads to a condensation reaction. The carbonyl oxygen is replaced by the oxime group, yielding acetone oxime ($(CH_3)_2C = NOH$) as compound Y.

(c) Compound Y is then treated with PCl_5 and heated, which sets up the conditions required to trigger a Beckmann rearrangement.

(d) During the Beckmann rearrangement, an alkyl group migrates from the carbon to the nitrogen atom as water is lost, transforming the oxime functional group into an amide.

(e) Since acetone oxime is entirely symmetric, migration of either methyl group yields the exact same product: N-methylacetamide ($CH_3CONHCH_3$), which constitutes final compound Z.

Final Answer: The major organic product Z obtained is N-Methylacetamide.

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept: The relationship between enthalpy change and internal energy change for a gaseous chemical system is governed by the ideal gas expression derived from the first law of thermodynamics: $\Delta H = \Delta U + \Delta n_g RT$.

Solution:

(a) The standard chemical equation describing the complete combustion of 1-butene gas (C_4H_8) with oxygen gas to yield carbon dioxide gas and liquid water at 298 K must be written out first.

(b) The balanced combustion equation is:

$$C_4H_8(g) + 6O_2(g) \rightarrow 4CO_2(g) + 4H_2O(l)$$

(c) To find the difference between ΔH and ΔU, we calculate the net change in the number of moles of gaseous species (Δn_g), defined as:

$$\Delta n_g = \sum n_{\text{g(products)}} - \sum n_{\text{g(reactants)}}$$

(d) From the balanced equation, the gaseous product is 4 moles of CO_2. The gaseous reactants are 1 mole of C_4H_8 and 6 moles of O_2. Note that H_2O is a liquid under standard conditions.

(e) Calculating the value gives $\Delta n_g = 4 - (1 + 6) = -3$. Substituting this back into the relation $\Delta H - \Delta U = \Delta n_g RT$ yields a final value of $-3RT$.

Final Answer: The difference is $-3RT$.

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: The equilibrium constant is purely a temperature-dependent state function, whereas the response of a reaction's components to volume alterations depends on Le Chatelier's principle and the stoichiometry of the system.

Solution:

(a) The given reversible reaction is $2A(g) \rightleftharpoons B(g) + C(g)$. The equilibrium constant for this specific temperature condition is designated as K_1.

(b) Because the temperature of the reaction vessel is held strictly constant throughout the volume adjustment, the value of the equilibrium constant remains completely unchanged. Therefore, $K_2 = K_1$.

(c) Next, evaluate the change in the number of moles of gas across the process: $\Delta n_g = n_{\text{products}} - n_{\text{reactants}} = (1 + 1) - 2 = 0$.

(d) According to Le Chatelier's principle, changes in pressure or container volume only shift the position of a gaseous equilibrium if there is a difference in the total number of gas moles between the sides ($\Delta n_g \neq 0$).

(e) Since $\Delta n_g = 0$ for this reaction, halving the volume changes the individual concentrations but does not perturb the balance of species. Thus, the degree of dissociation (α) remains unchanged.

Final Answer: K$_2 = K_1, and\alpha remainsunchanged.$

Answer: (B)

Go Back to Question 6

Q7.

Solution

Concept: A pseudo-first-order reaction behaves kinetics-wise like a true first-order process because the large excess concentration of one reactant remains effectively constant, absorbing into the observed rate constant.

Solution:

(a) For the reaction $A + B \longrightarrow$ Products, the differential rate law expression is given by Rate $= k[A][B]$. Since reactant B is present in vast excess ($[B] \gg [A]$), its concentration stays virtually constant.

(b) The rate expression can be rewritten as Rate $= k_{\text{obs}}[A]$, where $k_{\text{obs}} = k[B]$ represents the pseudo-first-order rate constant.

(c) The half-life equation for a first-order process is defined as:

$$t_{1/2} = \frac{\ln 2}{k_{\text{obs}}} = \frac{\ln 2}{k[B]}$$

(d) This formulation shows that the half-life of reactant A is inversely proportional to the initial concentration of the excess reactant B ($t_{1/2} \propto 1/[B]$).

(e) When the concentration of B is increased fourfold from 0.5 M to 2.0 M, the half-life must drop by a factor of four. Thus, the new half-life is $40 \text{ min}/4 = 10$ min.

Final Answer: The new half-life of A will be 10 min.

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

Go Back to Question 7

Q8.

Solution

Concept: The electromotive force of a non-standard galvanic cell is evaluated by applying the Nernst equation to relate the standard reduction potentials to the operational concentrations of the active ionic species.

Solution:

(a) The galvanic cell consists of a standard hydrogen electrode (SHE) operating as the anode and a copper half-cell operating as the cathode.

(b) The overall spontaneous cell reaction combining these two distinct electrochemical processes can be written as:

$$H_2(g) + Cu^{2+}(aq) \longrightarrow 2H^+(aq) + Cu(s)$$

(c) The standard cell potential (E°_{cell}) is determined entirely by subtracting the anode standard potential from the cathode standard potential:

$$E^\circ_{\text{cell}} = E^\circ(Cu^{2+}/Cu) - E^\circ(H^+/H_2) = 0.34\text{ V} - 0.00\text{ V} = 0.34\text{ V}$$

(d) Under the stated non-standard conditions, the actual electromotive force is computed using the formal Nernst equation at 298 K with $n = 2$ electrons transferred:

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.059}{2}\log\left(\frac{[H^+]^2}{[Cu^{2+}]}\right)$$

(e) Given that the standard hydrogen electrode maintains standard state parameters ($[H^+] = 1$ M and $P_{H_2} = 1$ atm), substituting the values simplifies the expression:

$$E_{\text{cell}} = 0.34 - 0.0295\log\left(\frac{1}{0.01}\right) = 0.34 - 0.0295(2) = 0.34 - 0.059 = 0.281\text{ V}$$

Final Answer: The electromotive force of this cell is 0.28 V.

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: The solubility behavior of a sparingly soluble salt changes in the presence of a strong electrolyte sharing a common ion due to the mass action equilibrium shift described by Le Chatelier's principle.

Solution:

(a) The sparingly soluble salt MX_2 establishes a dynamic heterogeneous equilibrium in aqueous solution, which can be chemically expressed as:

$$MX_2(s) \rightleftharpoons M^{2+}(aq) + 2X^-(aq)$$

(b) Let S represent the molar solubility of MX_2 in this specific mixture. The strong electrolyte NX dissociates fully to contribute a common anion concentration: $[X^-]_{\text{from } NX} = 0.01$ M.

(c) The total equilibrium concentrations of the constituent ions in the solution matrix are therefore expressed as:

$$[M^{2+}] = S \quad \text{and} \quad [X^-] = 2S + 0.01$$

(d) Because the solubility product constant ($K_{sp} = 4.0 \times 10^{-12}$) is exceptionally small, the amount of X^- derived from the dissolution of MX_2 is negligible compared to the strong electrolyte ($2S \ll 0.01$). Thus, $[X^-] \approx 0.01$ M.

(e) Substituting these simplified equilibrium terms directly into the solubility product expression allows us to isolate and calculate S:

$$K_{sp} = [M^{2+}][X^-]^2 \implies 4.0 \times 10^{-12} = S \cdot (0.01)^2 \implies S = 4.0 \times 10^{-8} \text{ M}$$

Final Answer: The solubility of this salt is $4.0 \times 10^{-8} M$.

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

Go Back to Question 9

Q10.

Solution

Concept: Determining magnetic traits and bond orders for homonuclear diatomic molecules requires mapping valence electron counts into formal Molecular Orbital configuration diagrams.

Solution:

(a) Molecular Orbital theory builds electronic frameworks for second-row elements using specific ordering patterns dictated by the extent of $2s - 2p$ orbital mixing.

(b) For the heterogenous set of species, we determine total valence counts and fill molecular orbitals to check for unpaired spins and calculate bond values using:

$$\text{Bond Order} = \frac{\text{Bonding Electrons} - \text{Antibonding Electrons}}{2}$$

(c) The species O_2 has 16 electrons with a stable bond order of 2.0 but possesses an integer bond value, failing the fractional requirement.

(d) The species B_2 contains 10 electrons, yielding a stable bond order of 1.0, which does not satisfy the fractional criteria.

(e) The species O_2^+ has 15 electrons, yielding a bond order of 2.5, while N_2^- possesses 15 electrons, yielding a matching bond order of 2.5.

(f) Looking closely at N_2^-, filling its 15 electrons into the standard molecular orbital scheme $(\sigma^2_{1s}\sigma^{*2}_{1s}\sigma^2_{2s}\sigma^{*2}_{2s}\pi^2_{2p_x}\pi^2_{2p_y}\sigma^2_{2p_z}\pi^{*1}_{2p_x})$ reveals one unpaired electron in the antibonding level, matching both paramagnetic and fractional properties.

Final Answer: The homonuclear diatomic species is N_2^-.

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

Go Back to Question 10

Q11.

Solution

Concept: Crystal Field Theory accounts for the magnetic and structural properties of transition metal complexes by evaluating ligand field strength, oxidation state, and outer d-orbital configurations.

Solution:

(a) In the complex ion $[CoF_6]^{3-}$, fluoride (F^-) carries a -1 charge, meaning the central cobalt ion exists in the +3 formal oxidation state.

(b) The ground state electronic configuration of atomic cobalt $(Z = 27)$ is $[Ar]3d^7 4s^2$. Upon losing three valence electrons, the Co^{3+} ion adopts a stable $3d^6$ configuration.

(c) The measured spin-only magnetic moment of 4.90 BM is interpreted using the fundamental relation $\mu = \sqrt{n(n+2)}$, which confirms the presence of exactly $n = 4$ unpaired electrons.

(d) Because the $3d^6$ ion retains 4 unpaired electrons, the six d-electrons must be arranged across the crystal field splitting levels as $t_{2g}^4 e_g^2$. This high-spin state indicates that F^- behaves as a weak-field ligand.

(e) Since the inner $3d$ orbitals are partially occupied and cannot pair up, the metal ion utilizes its outer vacant shells ($4s$, $4p$, and $4d$) to accommodate incoming ligand pairs, resulting in sp^3d^2 hybridization.

Final Answer: The hybridization and electronic configuration is sp$^3d^2, highspincomplex$.

Answer: (B)

Go Back to Question 11

Q12.

Solution

Concept: Thermal dehydration of orthophosphoric acid causes condensation, forming structural oxygen bridges between phosphorus centers by eliminating water molecules.

Solution:

(a) Heating orthophosphoric acid (H_3PO_4) to approximately 250°C drives an intermolecular dehydration reaction between two distinct acid units.

(b) The balanced chemical equation representing this condensation process is given by:

$$2H_3PO_4 \xrightarrow{\Delta} H_4P_2O_7 + H_2O$$

(c) The condensed oxoacid compound P obtained from this reaction is pyrophosphoric acid, which has the chemical formula $H_4P_2O_7$.

(d) The molecular architecture of pyrophosphoric acid consists of two symmetric, tetrahedral $-PO_3H_2$ structural units linked together symmetrically through a shared central oxygen atom.

(e) Analyzing the chemical bonds shows that the $H_4P_2O_7$ molecule contains exactly one structural $\mathrm{P-O-P}$ ether-like linkage, two terminal $\mathrm{P=O}$ double bonds, and four peripheral $\mathrm{P-OH}$ hydroxyl linkages.

Final Answer: Compound P contains one P-O-P linkage and two P=O bonds.

Answer: (B)

Go Back to Question 12

Q13.

Solution

Concept: Optical isomerism in coordination chemistry requires a non-superimposable mirror image framework, which typically occurs in octahedral complexes that contain chelating bidentate ligands and lack an internal plane of symmetry.

Solution:

(a) Compound cis-$[Pt(NH_3)_2Cl_2]$ adopts a square planar geometry. It contains an internal mirror plane and cannot form non-superimposable enantiomeric pairs.

(b) Octahedral trans-$[Co(en)_2Cl_2]^+$ positions its two unidentate chloride ligands directly opposite to each other. This linear configuration introduces an internal plane of symmetry, making the isomer optically inactive.

(c) Compound $[Co(NH_3)_5Cl]Cl_2$ features a symmetric pentammine arrangement with a single chloride ligand, creating a plane of symmetry that rules out optical activity.

(d) In cis-$[Co(en)_2Cl_2]^+$, the two chloride ligands are located adjacent to one another at a 90° angle. This arrangement forces the two chelating ethylenediamine (en) rings into a skewed orientation.

(e) This skewed structural positioning removes all internal planes and centers of symmetry, creating a chiral molecular configuration that yields non-superimposable right- and left-handed optical enantiomers.

Final Answer: The pair that shows optical isomerism is cis-[Co(en)$_2Cl_2$]$^+$.

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

Go Back to Question 13

Q14.

Solution

Concept: The structural definitions of nucleic acids depend on identifying core differences in pentose sugar ring functionalizations and pyrimidine base pairing preferences.

Solution:

(a) Both DNA and RNA are biopolymers made of nucleotide monomers, but they feature distinct chemical structures that suit their specific roles in genetic information storage and expression.

(b) The pentose sugar in DNA is 2-deoxyribose, which lacks an oxygen atom at the C-2 position. RNA contains ribose, which retains a reactive hydroxyl group at the C-2 position.

(c) Regarding nitrogenous bases, both nucleic acids utilize the identical purines adenine (A) and guanine (G), as well as the pyrimidine cytosine (C).

(d) However, their second pyrimidine bases differ: DNA uses thymine (T), whereas RNA replaces it with uracil (U), which lacks a methyl group.

(e) Structurally, DNA normally exists as a stable, complementary double-stranded right-handed B-helix held together by hydrogen bonds. In contrast, RNA typically functions as a shorter, single-stranded molecule.

Final Answer: DNA is stabilized by hydrogen bonding between complementary base pairs (A-T and G-C) and contains 2-deoxyribose, whereas RNA contains ribose and replaces thymine with uracil.

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

Go Back to Question 14

Q15.

Solution

Concept: The equilibrium partial pressure of a component in a gaseous mixture is determined by finding its equilibrium mole fraction and multiplying it by the total system pressure.

Solution:

(a) The balanced gas-phase equilibrium reaction is written as:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

(b) Assume the initial amounts follow the stated stoichiometric ratio: 2 moles of SO_2 and 1 mole of O_2. The initial total number of gaseous moles is 3.

(c) The problem states that 50% of the initial SO_2 reacts at equilibrium. The change in moles is therefore $\alpha = 0.50 \times 2 = 1$ mole.

(d) Setting up the equilibrium mole table based on the reaction stoichiometry:

$$n(SO_2) = 2 - 1 = 1 \text{ mole}$$

$$n(O_2) = 1 - 0.5 = 0.5 \text{ moles}$$

$$n(SO_3) = 0 + 1 = 1 \text{ mole}$$

(e) The total number of gaseous moles present at equilibrium is $1 + 0.5 + 1 = 2.5$ moles.

(f) Finally, calculate the partial pressure of SO_3 using its mole fraction and the total pressure ($P_{\text{total}} = 3$ atm):

$$P(SO_3) = \left(\frac{1}{2.5}\right) \times 3 \text{ atm} = 1.2 \text{ atm}$$

Final Answer: The partial pressure of $\text{SO}_3 atequilibriumis 1.2 atm.$

Answer: (B)

Go Back to Question 15

Answer Key

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