

MHT-CET Chemistry Sample Paper-3

Duration: 45 Minutes

Maximum Marks: 50

Instructions

- This paper contains a total of **50** Multiple Choice Questions.
- Each correct answer carries **+1 marks**.
- No negative marking for incorrect questions.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.
- No marks will be deducted for questions that are left unattempted.

Q1. Which of the following molecules has the highest dipole moment considering the steric inhibition of resonance and electronegativity differences?

- (A) *o*-Nitrophenol
- (B) *p*-Nitrophenol
- (C) *m*-Nitrophenol
- (D) Hydroquinone

Q2. The major product formed when 2, 3-dimethylbut-2-ene undergoes hydroboration-oxidation is:

- (A) 2, 3-dimethylbutan-2-ol
- (B) 2, 3-dimethylbutan-1-ol
- (C) 3, 3-dimethylbutan-2-ol
- (D) 2, 2-dimethylbutan-3-ol

Q3. In the following sequence of reactions: Toluene $\xrightarrow{\text{KMnO}_4/\text{KOH}}$ A $\xrightarrow{\text{SOCl}_2}$ B $\xrightarrow{\text{H}_2/\text{Pd-BaSO}_4}$ C, the product C is:

- (A) Benzoic acid



- (B) Benzyl alcohol
- (C) Benzaldehyde
- (D) Benzoyl chloride

Q4. Which of the following compounds will not undergo Friedel-Crafts reaction with benzene in the presence of anhydrous AlCl_3 ?

- (A) CH_3Cl
- (B) $\text{CH}_3\text{CH}_2\text{Cl}$
- (C) $\text{C}_6\text{H}_5\text{Cl}$
- (D) $\text{CH}_2 = \text{CHCH}_2\text{Cl}$

Q5. The increasing order of reactivity of the following halides for the $\text{S}_\text{N}1$ reaction is: I. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$, II. $\text{CH}_2 = \text{CHCH}(\text{Cl})\text{CH}_3$, III. $\text{CH}_3\text{CH}_2\text{CH}(\text{Cl})\text{CH}_3$

- (A) $\text{I} < \text{III} < \text{II}$
- (B) $\text{II} < \text{I} < \text{III}$
- (C) $\text{I} < \text{II} < \text{III}$
- (D) $\text{III} < \text{II} < \text{I}$

Q6. Which of the following is most reactive towards nucleophilic addition reaction?

- (A) HCHO
- (B) CH_3CHO
- (C) CH_3COCH_3
- (D) $\text{C}_6\text{H}_5\text{CHO}$

Q7. The reaction of $\text{CH}_3\text{CH}_2\text{I}$ with alcoholic KOH yields:

- (A) $\text{CH}_3\text{CH}_2\text{OH}$
- (B) $\text{CH}_2 = \text{CH}_2$
- (C) $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$



(D) CH_3CH_3

Q8. Identify the product D in the following series: Ethanol $\xrightarrow{\text{PCl}_5}$ $A \xrightarrow{\text{alc. KOH}}$ $B \xrightarrow{\text{H}_2\text{SO}_4, \Delta}$
 $C \xrightarrow{\text{H}_2\text{O}}$ D

(A) Ethyne

(B) Ethene

(C) Ethyl hydrogen sulphate

(D) Ethanol

Q9. In a face-centered cubic lattice, atom A occupies the corners and atom B occupies the face centers. If one atom of B is missing from one of the face centers, the formula of the compound is:

(A) AB_2

(B) A_2B_3

(C) A_2B_5

(D) A_5B_2

Q10. The values of K_p/K_c for the reaction $\text{PCl}_5(g) \rightleftharpoons \text{PCl}_3(g) + \text{Cl}_2(g)$ is:

(A) RT

(B) $(RT)^{-1}$

(C) $(RT)^2$

(D) 1

Q11. Which of the following ligands forms a chelate with a metal ion?

(A) NH_3

(B) Cl^-

(C) $\text{C}_2\text{O}_4^{2-}$



(D) CN^-

Q12. The oxidation state of central metal atom in $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$ is:

(A) +1

(B) +2

(C) +3

(D) 0

Q13. The half-life period of a first order reaction is 693 seconds. The rate constant is:

(A) 10^{-3} s^{-1}

(B) 10^{-2} s^{-1}

(C) 10^{-1} s^{-1}

(D) 1 s^{-1}

Q14. Which of the following is an example of an intensive property?

(A) Enthalpy

(B) Internal energy

(C) Density

(D) Volume

Q15. The molarity of pure water is:

(A) 55.5 M

(B) 5.55 M

(C) 18 M

(D) 1 M



Q16. Glucose on reduction with HI and red phosphorus gives:

- (A) *n*-hexane
- (B) 1-hexanol
- (C) Gluconic acid
- (D) Sorbitol

Q17. The peptide linkage is:

- (A) $-\text{CO} - \text{NH}-$
- (B) $-\text{CO} - \text{O}-$
- (C) $-\text{CH} = \text{N}-$
- (D) $-\text{CO} - \text{CH}_2-$

Q18. Nylon-6 is prepared from:

- (A) Caprolactam
- (B) Adipic acid
- (C) Hexamethylene diamine
- (D) Terephthalic acid

Q19. Which of the following noble gases is used in radiotherapy?

- (A) He
- (B) Ne
- (C) Ar
- (D) Rn

Q20. The structure of XeF_4 is:

- (A) Tetrahedral



- (B) Square planar
- (C) Pyramidal
- (D) Octahedral

Q21. Which of the following ions has the highest magnetic moment?

- (A) Fe^{3+}
- (B) Mn^{2+}
- (C) Cr^{3+}
- (D) Cu^{2+}

Q22. The solubility of a gas in liquid increases with:

- (A) Increase in temperature
- (B) Decrease in pressure
- (C) Increase in pressure
- (D) Decrease in surface area

Q23. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15 V and that for Cr^{3+}/Cr is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be:

- (A) +1.19 V
- (B) +0.89 V
- (C) +0.18 V
- (D) +1.83 V

Q24. Which of the following is not a colligative property?

- (A) Osmotic pressure
- (B) Elevation in boiling point



- (C) Vapor pressure
- (D) Depression in freezing point

Q25. Lucas reagent is a mixture of:

- (A) Conc. HCl + anhydrous ZnCl_2
- (B) Conc. HNO_3 + anhydrous ZnCl_2
- (C) Conc. HCl + hydrated ZnCl_2
- (D) Conc. HNO_3 + hydrated ZnCl_2

Q26. The IUPAC name of the compound $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_2 - \text{CH}_3$ is:

- (A) Butan-1-ol
- (B) Butan-2-ol
- (C) Propan-2-ol
- (D) 2-Methylpropan-2-ol

Q27. Which of the following elements belongs to *d*-block but is not considered a transition element?

- (A) Fe
- (B) Cr
- (C) Zn
- (D) Cu

Q28. The hybridization of *P* in PCl_5 is:

- (A) sp^3
- (B) sp^3d
- (C) sp^3d^2
- (D) dsp^2



Q29. The reagent used for dehydrohalogenation is:

- (A) alc. KOH
- (B) aq. KOH
- (C) Na in liquid NH_3
- (D) LiAlH_4

Q30. Which of the following will give a positive Iodoform test?

- (A) Methanol
- (B) Ethanol
- (C) Propan-1-ol
- (D) Benzaldehyde

Q31. The correct order of basic strength in aqueous solution is:

- (A) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$
- (B) $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > \text{NH}_3$
- (C) $\text{NH}_3 > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$
- (D) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N} > \text{NH}_3$

Q32. The secondary structure of protein refers to:

- (A) Sequence of amino acids
- (B) Fixed configuration of polypeptide backbone
- (C) Overall folding of the polypeptide
- (D) Aggregation of subunits

Q33. The monomers of Terylene are:

- (A) Phenol and Formaldehyde



- (B) Ethylene glycol and Terephthalic acid
- (C) Vinyl chloride
- (D) Adipic acid and Hexamethylene diamine

Q34. Which of the following is a neutral complex?

- (A) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- (B) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
- (C) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- (D) $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$

Q35. According to the Bohr model, the radius of the n -th orbit is proportional to:

- (A) n
- (B) n^2
- (C) $1/n$
- (D) $1/n^2$

Q36. The most stable carbocation among the following is:

- (A) CH_3CH_2^+
- (B) $(\text{CH}_3)_2\text{CH}^+$
- (C) $(\text{CH}_3)_3\text{C}^+$
- (D) $\text{C}_6\text{H}_5\text{CH}_2^+$

Q37. Which of the following is a thermosetting polymer?

- (A) Polythene
- (B) PVC
- (C) Bakelite
- (D) Nylon



- Q38.** Aniline reacts with NaNO_2 and HCl at $0 - 5^\circ\text{C}$ to give:
- (A) Phenol
 - (B) Benzene diazomium chloride
 - (C) Nitrobenzene
 - (D) Chlorobenzene
- Q39.** The boiling point of a solvent containing a non-volatile solute is:
- (A) Higher than the pure solvent
 - (B) Lower than the pure solvent
 - (C) Same as the pure solvent
 - (D) Zero
- Q40.** Which of the following is paramagnetic in nature?
- (A) N_2
 - (B) O_2
 - (C) CO
 - (D) H_2
- Q41.** The IUPAC name of $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_3$ is:
- (A) Methoxy ethane
 - (B) Ethoxy methane
 - (C) Dimethyl ether
 - (D) Ethyl methyl ether
- Q42.** Which of the following is a polydentate ligand?
- (A) EDTA^{4-}



- (B) CO
- (C) H₂O
- (D) SCN⁻

Q43. The bond order of He₂ molecule is:

- (A) 1
- (B) 2
- (C) 0
- (D) 0.5

Q44. Which of the following is a Lewis acid?

- (A) NH₃
- (B) BF₃
- (C) H₂O
- (D) CH₄

Q45. The unit of rate constant for a second order reaction is:

- (A) s⁻¹
- (B) mol L⁻¹s⁻¹
- (C) L mol⁻¹s⁻¹
- (D) L²mol⁻²s⁻¹

Q46. Zwitter ion is formed by:

- (A) Urea
- (B) Glycine
- (C) Benzene
- (D) Acetone



- Q47.** Which of the following transition elements exhibits the maximum number of oxidation states?
- (A) Fe
 - (B) Mn
 - (C) Cr
 - (D) Ti
- Q48.** The shape of SF₆ molecule is:
- (A) Octahedral
 - (B) Trigonal bipyramidal
 - (C) Square planar
 - (D) Hexagonal
- Q49.** The pH of 10⁻⁸ M HCl solution is:
- (A) 8
 - (B) 6
 - (C) Between 6 and 7
 - (D) Between 7 and 8
- Q50.** Which of the following obeys the EAN rule?
- (A) K₄[Fe(CN)₆]
 - (B) K₃[Fe(CN)₆]
 - (C) [Cu(NH₃)₄]SO₄
 - (D) [Ni(NH₃)₆]Cl₂



Detailed Solutions

Q1.

Solution

Concept:

The dipole moment (μ) depends on the vector sum of individual bond moments. In nitrophenols, the $-OH$ group and $-NO_2$ group interact. In p -nitrophenol, the bond moments are aligned along the same axis, and resonance increases charge separation.

Solution:

1. In o -nitrophenol, intramolecular hydrogen bonding occurs, which reduces its overall polarity.
2. In m -nitrophenol, the resonance effect of the nitro group does not operate at the meta position.
3. In p -nitrophenol, the $-I$ and $-M$ effects of the $-NO_2$ group and the $+M$ effect of the $-OH$ group work cooperatively across the ring.
4. This creates a larger resultant vector for the dipole moment compared to other isomers.
5. Therefore, p -nitrophenol is the most polar among the choices.

Final Answer: The molecule with the highest dipole moment is p -nitrophenol.

Answer: (B)

Q2.

Solution

Concept:

Hydroboration-Oxidation of Alkenes.

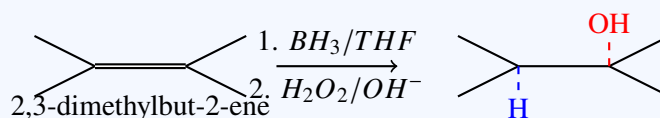
Solution:

Step 1: Identify the substrate structure. 2,3-dimethylbut-2-ene consists of a central double bond where each carbon is bonded to two methyl groups: $(CH_3)_2C = C(CH_3)_2$.

Step 2: Apply Hydroboration. $BH_3 \cdot THF$ adds across the double bond. Since the alkene is symmetrical, the boron can add to either carbon.

Step 3: Apply Oxidation. The organoboron intermediate is treated with $H_2O_2/NaOH$, replacing the boron atom with an $-OH$ group.

Step 4: Determine the final IUPAC name. The resulting structure is $CH_3 - CH(CH_3) - C(OH)(CH_3) - CH_3$. The longest chain has 4 carbons, with methyl groups at positions 2 and 3, and the alcohol at position 2.



Final Answer:

2,3-dimethylbutan-2-ol

Answer: (A)



Q3.

Solution**Concept:**

This sequence involves the oxidation of an alkyl benzene to a carboxylic acid, conversion to an acid halide, and then selective reduction to an aldehyde.

Solution:

1. Step 1: Toluene is oxidized by alkaline KMnO_4 to Benzoic Acid (*A*). 2. Step 2: Benzoic acid reacts with SOCl_2 to form Benzoyl chloride (*B*). 3. Step 3: Benzoyl chloride undergoes Rosenmund Reduction ($\text{H}_2/\text{Pd-BaSO}_4$) which reduces the acid chloride specifically to an aldehyde. 4. The resulting product *C* is Benzaldehyde. 5. This is a standard route for synthesizing aromatic aldehydes from toluene.

Final Answer: The product *C* is Benzaldehyde.

Answer: (C)

Q4.

Solution**Concept:**

Friedel-Crafts alkylation involves the formation of a carbocation or a polarized complex. Aryl halides are generally unreactive in this specific reaction because the halogen-carbon bond is strengthened by resonance.

Solution:

1. Alkyl halides like CH_3Cl and $\text{CH}_3\text{CH}_2\text{Cl}$ readily react with benzene and AlCl_3 . 2. Allyl chloride also reacts due to the stability of the allyl carbocation. 3. In chlorobenzene ($\text{C}_6\text{H}_5\text{Cl}$), the lone pair of electrons on Chlorine is in resonance with the benzene ring. 4. This gives the $\text{C} - \text{Cl}$ bond partial double bond character, making it very difficult to break to form a cation. 5. Thus, chlorobenzene is not used as an alkylating/aryllating agent in Friedel-Crafts reactions.

Final Answer: $\text{C}_6\text{H}_5\text{Cl}$ will not undergo the reaction.

Answer: (C)



Q5.

Solution**Concept:**

S_N1 reactivity is directly proportional to the stability of the carbocation intermediate formed in the slow step.

Solution:

1. Compound I ($\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$) forms a primary carbocation, which is very unstable. 2. Compound III ($\text{CH}_3\text{CH}_2\text{CH}(\text{Cl})\text{CH}_3$) forms a secondary carbocation, stabilized by induction and hyperconjugation. 3. Compound II ($\text{CH}_2 = \text{CHCH}(\text{Cl})\text{CH}_3$) forms an allylic carbocation, which is stabilized by resonance. 4. Stability order: Allylic > Secondary > Primary. 5. Therefore, the reactivity order is $\text{I} < \text{III} < \text{II}$.

Final Answer: The increasing order is $\text{I} < \text{III} < \text{II}$.

Answer: (A)

Q6.

Solution**Concept:**

Nucleophilic addition reactions are characteristic of carbonyl compounds. The reactivity depends on two factors: 1. **Electronic factor:** Electron-donating groups (like alkyl groups) reduce the partial positive charge on the carbonyl carbon, making it less electrophilic. 2. **Steric factor:** Bulky groups around the carbonyl carbon hinder the approach of the nucleophile.

Solution:

1. HCHO (Formaldehyde) has two hydrogen atoms attached to the carbonyl group. It has the least steric hindrance and no electron-donating alkyl groups. 2. CH_3CHO (Acetaldehyde) has one methyl group which is electron-donating (+I effect) and bulkier than hydrogen. 3. CH_3COCH_3 (Acetone) has two methyl groups, further reducing reactivity through both +I effect and steric hindrance. 4. $\text{C}_6\text{H}_5\text{CHO}$ (Benzaldehyde) is less reactive than aliphatic aldehydes because the carbonyl group is in resonance with the benzene ring, which reduces the positive charge on the carbon. 5. Therefore, Formaldehyde is the most reactive.

Final Answer: HCHO is the most reactive towards nucleophilic addition.

Answer: (A)



Q7.

Solution**Concept:**

The reaction of an alkyl halide with potassium hydroxide (KOH) can follow two different pathways depending on the solvent used: 1. **Aqueous KOH:** Favors substitution (S_N2 or S_N1) to form alcohols. 2. **Alcoholic KOH:** Favors elimination ($E2$) to form alkenes.

Solution:

1. The reactant is Ethyl iodide ($\text{CH}_3\text{CH}_2\text{I}$). 2. The reagent is alcoholic KOH. In an alcoholic medium, the hydroxide ion acts as a strong base rather than a nucleophile. 3. The base abstracts a β -hydrogen from the ethyl group while the iodide ion (leaving group) departs. 4. This β -elimination process results in the formation of a double bond between the two carbon atoms. 5. $\text{CH}_3\text{CH}_2\text{I} + \text{KOH}(\text{alc}) \rightarrow \text{CH}_2 = \text{CH}_2 + \text{KI} + \text{H}_2\text{O}$. 6. The product formed is Ethene (ethylene).

Final Answer: The reaction yields $\text{CH}_2 = \text{CH}_2$.

Answer: (B)

Q8.

Solution**Concept:**

This is a multi-step sequence involving substitution, elimination, and subsequent hydration reactions.

Solution:

1. **Step 1:** Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) reacts with PCl_5 to replace the $-\text{OH}$ group with $-\text{Cl}$. Thus, A is Ethyl chloride ($\text{CH}_3\text{CH}_2\text{Cl}$). 2. **Step 2:** Ethyl chloride reacts with alcoholic KOH, which causes dehydrohalogenation. This forms Ethene ($B = \text{CH}_2 = \text{CH}_2$). 3. **Step 3:** Ethene reacts with concentrated H_2SO_4 . This is an addition reaction where H^+ and HSO_4^- add across the double bond to form Ethyl hydrogen sulphate ($C = \text{CH}_3\text{CH}_2\text{OSO}_3\text{H}$). 4. **Step 4:** Boiling C with water (H_2O) causes hydrolysis of the sulphate group, regenerating the alcohol. 5. The final product D is Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$).

Final Answer: The product D is Ethanol.

Answer: (D)



Q9.

Solution**Concept:**

Unit cell stoichiometry in crystal lattices.

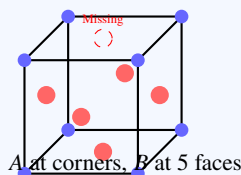
Solution:

Step 1: Calculate the number of atoms of A at the corners. $n_A = 8 \text{ corners} \times \frac{1}{8} \text{ (contribution per corner)} = 1$.

Step 2: Calculate the number of atoms of B at the face centers. Normally there are 6 faces, but 1 atom is missing. Occupied faces = $6 - 1 = 5$.

Step 3: Calculate the effective number of B atoms. $n_B = 5 \text{ face centers} \times \frac{1}{2} \text{ (contribution per face)} = \frac{5}{2} = 2.5$.

Step 4: Determine the simplest whole number ratio for the formula. Ratio $A : B = 1 : 2.5 \Rightarrow 2 : 5$.

**Final Answer:****Answer: (C)**

Q10.

Solution**Concept:**

The relationship between the equilibrium constants K_p (pressure-based) and K_c (concentration-based) is given by the equation:

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

where Δn_g is the change in the number of moles of gaseous products and reactants.

Solution:

1. The reaction is: $\text{PCl}_5(g) \rightleftharpoons \text{PCl}_3(g) + \text{Cl}_2(g)$. 2. Number of moles of gaseous products (n_p) = $1(\text{PCl}_3) + 1(\text{Cl}_2) = 2$. 3. Number of moles of gaseous reactants (n_r) = $1(\text{PCl}_5) = 1$. 4. $\Delta n_g = n_p - n_r = 2 - 1 = 1$. 5. Substituting into the formula: $K_p = K_c (RT)^1$. 6. Rearranging to find the ratio K_p/K_c :

$$\frac{K_p}{K_c} = RT$$

Final Answer: The value of K_p/K_c is RT .

Answer: (A)

Q11.

Solution**Concept:**

A chelate is formed when a polydentate ligand (a ligand with two or more donor atoms) binds to a single central metal ion through two or more donor sites, creating a ring structure (usually 5 or 6-membered). This is known as the chelate effect, which increases the stability of the complex.

Solution:

1. NH_3 (Ammonia) is a monodentate ligand; it has only one lone pair on the Nitrogen atom to donate. 2. Cl^- (Chloride ion) is a monodentate ligand; it donates through one of its lone pairs. 3. CN^- (Cyanide ion) is a monodentate ligand, although it is ambidentate (can bind via C or N), it only binds to one site at a time. 4. $\text{C}_2\text{O}_4^{2-}$ (Oxalate ion) is a didentate ligand. It has two oxygen atoms that can simultaneously donate electron pairs to the same metal ion. 5. When the oxalate ion binds, it forms a stable five-membered ring with the metal, acting as a chelating agent.

Final Answer: The ligand that forms a chelate is $\text{C}_2\text{O}_4^{2-}$.

Answer: (C)

Q12.

Solution**Concept:**

To determine the oxidation state of the central metal atom, we sum the charges of all ligands and the metal atom and set them equal to the overall charge of the coordination sphere. In the "Brown Ring" complex, the nitrosyl ligand (NO) exists in a unique state.

Solution:

1. The complex is $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$. 2. The sulfate ion (SO_4^{2-}) carries a charge of -2 , so the coordination sphere $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]$ must have a charge of $+2$. 3. Water (H_2O) is a neutral ligand (charge = 0). 4. In this specific complex, NO acts as a three-electron donor and is considered as NO^+ (nitrosonium ion) with a charge of $+1$. 5. Let the oxidation state of Fe be x :

$$x + 5(0) + (+1) = +2$$

$$x + 1 = 2$$

$$x = +1$$

6. This unusual $+1$ oxidation state is a defining characteristic of the Brown Ring test for nitrates.

Final Answer: The oxidation state of Fe is $+1$.

Answer: (A)



Q13.

Solution**Concept:**

For a first-order reaction, the relationship between the half-life ($t_{1/2}$) and the rate constant (k) is independent of the initial concentration and is given by the formula:

$$t_{1/2} = \frac{0.693}{k}$$

Solution:

1. We are given the half-life period $t_{1/2} = 693$ seconds. 2. Using the first-order kinetic equation:

$$k = \frac{0.693}{t_{1/2}}$$

3. Substitute the given value:

$$k = \frac{0.693}{693}$$

4. Perform the division:

$$k = \frac{693 \times 10^{-3}}{693}$$
$$k = 1 \times 10^{-3} \text{ s}^{-1}$$

5. The unit for a first-order rate constant is time^{-1} , which matches the seconds given.

Final Answer: The rate constant is 10^{-3} s^{-1} .

Answer: (A)

Q14.

Solution**Concept:**

Thermodynamic properties are classified into two types: 1. **Extensive Property:** A property that depends on the amount of matter present in the system (e.g., Mass, Volume, Enthalpy). 2.

Intensive Property: A property that is independent of the amount of matter present in the system (e.g., Temperature, Pressure, Density).

Solution:

1. Enthalpy (H) is an extensive property because it scales with the size of the system. 2. Internal energy (U) is also extensive; more substance means more total energy. 3. Volume (V) is clearly extensive; doubling the substance doubles the volume. 4. Density (ρ) is the ratio of mass to volume ($\rho = m/V$). Since both mass and volume are extensive, their ratio is intensive. The density of water is the same whether you have a drop or a gallon. 5. Therefore, density is the intensive property.

Final Answer: Density is an example of an intensive property.

Answer: (C)



Q15.

Solution**Concept:**

Molarity is defined as the number of moles of solute per liter of solution. For a pure substance like water, the substance itself acts as both the "solute" and the "solvent."

Solution:

1. Consider 1 liter (1000 mL) of pure water. 2. The density of water is approximately 1 g/mL at room temperature. 3. Therefore, the mass of 1000 mL of water is 1000 g. 4. The molar mass of water (H₂O) is:

$$(2 \times 1.008) + 15.999 \approx 18.015 \text{ g/mol}$$

5. Number of moles in 1000 g of water:

$$n = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{1000}{18} \approx 55.55 \text{ moles}$$

6. Since these moles are present in 1 liter:

$$\text{Molarity} = \frac{55.55 \text{ moles}}{1 \text{ liter}} = 55.55 \text{ M}$$

Final Answer: The molarity of pure water is 55.5 M.

Answer: (A)

Q16.

Solution**Concept:**

The reaction of glucose with a strong reducing agent like hydroiodic acid (HI) and red phosphorus is used to determine the skeletal structure of the molecule. This reagent is capable of reducing all functional groups (hydroxyls and the carbonyl group) to the corresponding hydrocarbon.

Solution:

1. Glucose (C₆H₁₂O₆) contains an aldehyde group and five hydroxyl groups on a six-carbon chain. 2. When heated with HI and red phosphorus for a prolonged period, a complete reduction of the oxygen-containing groups occurs. 3. This reaction yields a straight-chain alkane with six carbon atoms. 4. The product formed is *n*-hexane (CH₃CH₂CH₂CH₂CH₂CH₃). 5. This specific chemical evidence was historically used to prove that the six carbon atoms in glucose are linked in a straight chain.

Final Answer: Glucose on reduction with HI gives *n*-hexane.

Answer: (A)



Q17.

Solution**Concept:**

Proteins are polymers of amino acids. Amino acids are linked together by a specific type of covalent bond formed between the carboxyl group of one amino acid and the amino group of the next.

Solution:

1. When the $-\text{COOH}$ group of one amino acid reacts with the $-\text{NH}_2$ group of another, a molecule of water is eliminated (condensation). 2. The resulting bond is an amide linkage: $-\text{CO}-\text{NH}-$. 3. In the context of biochemistry and protein chemistry, this specific amide bond is called a peptide linkage or peptide bond. 4. This linkage connects the α -carbon atoms of adjacent amino acid residues in a polypeptide chain.

Final Answer: The peptide linkage is $-\text{CO}-\text{NH}-$.

Answer: (A)

Q18.

Solution**Concept:**

Nylon-6 is a synthetic polymer belonging to the polyamide family. Unlike Nylon-6,6, which is formed by the condensation of two different monomers, Nylon-6 is formed by the ring-opening polymerization of a single cyclic monomer.

Solution:

1. The starting material for Nylon-6 is Caprolactam. 2. Caprolactam is a cyclic amide (lactam) containing six carbon atoms. 3. When Caprolactam is heated with water at high temperatures, the ring opens to form ϵ -aminocaproic acid. 4. This intermediate then undergoes polymerization to form the long-chain polymer Nylon-6. 5. The number '6' in the name denotes the number of carbon atoms in the repeating unit.

Final Answer: Nylon-6 is prepared from Caprolactam.

Answer: (A)



Q19.

Solution**Concept:**

Noble gases (Group 18 elements) are generally chemically inert but have specific medical and industrial applications based on their physical and radioactive properties.

Solution:

1. Helium (He) is used in diving gas and as a coolant. 2. Neon (Ne) is used in advertising signs (neon lights). 3. Argon (Ar) provides an inert atmosphere for welding and light bulbs. 4. Radon (Rn) is a radioactive noble gas produced by the decay of radium. 5. Due to its radioactive nature and alpha-particle emission, radon is used in radiotherapy for the treatment of certain types of cancer and in some specialized dermatological treatments.

Final Answer: The noble gas used in radiotherapy is Rn.

Answer: (D)

Q20.

Solution**Concept:**

VSEPR Theory and Molecular Geometry.

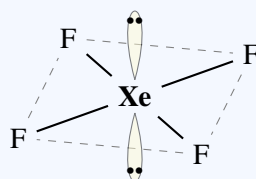
Solution:

Step 1: Xenon (*Xe*) has 8 valence electrons. In *XeF₄*, it forms 4 sigma bonds with Fluorine atoms.

Step 2: Number of lone pairs on *Xe* = $\frac{8-4}{2} = 2$.

Step 3: Steric Number = (4 bond pairs + 2 lone pairs) = 6. This corresponds to sp^3d^2 hybridization with an octahedral electron geometry.

Step 4: To minimize repulsion between lone pairs, they occupy axial positions at 180° to each other. The four Fluorine atoms lie in a single plane, forming a square planar shape.



Square Planar *XeF₄*

Final Answer:

Square planar

Answer: (B)



Q21.

Solution**Concept:**

The magnetic moment (μ) of transition metal ions is calculated using the "spin-only" formula:

$$\mu = \sqrt{n(n+2)} \text{ BM}$$

where n is the number of unpaired electrons. Therefore, the ion with the highest number of unpaired electrons will have the highest magnetic moment.

Solution:

1. Fe^{3+} ($Z = 26$): Configuration is $[\text{Ar}]3d^5$. It has 5 unpaired electrons. 2. Mn^{2+} ($Z = 25$): Configuration is $[\text{Ar}]3d^5$. It also has 5 unpaired electrons. 3. Cr^{3+} ($Z = 24$): Configuration is $[\text{Ar}]3d^3$. It has 3 unpaired electrons. 4. Cu^{2+} ($Z = 29$): Configuration is $[\text{Ar}]3d^9$. It has 1 unpaired electron ($4s^03d^9$). 5. Both Fe^{3+} and Mn^{2+} have 5 unpaired electrons, which is the maximum possible in the $3d$ subshell. In standard MHT-CET and competitive context, both are considered to have the highest magnetic moment (≈ 5.92 BM). Given the options, both A and B are technically correct, but Mn^{2+} is often the textbook example for the d^5 system.

Final Answer: Mn^{2+} (and Fe^{3+}) have the highest magnetic moment.

Answer: (B)

Q22.

Solution**Concept:**

The solubility of a gas in a liquid is governed by Henry's Law and Le Chatelier's Principle. Dissolving a gas in a liquid is generally an exothermic process.

Solution:

1. **Effect of Pressure:** According to Henry's Law ($C = kP$), the solubility of a gas (C) is directly proportional to the partial pressure (P) of the gas above the liquid. Increasing pressure forces more gas molecules into the liquid. 2. **Effect of Temperature:** Since the dissolution of gas is exothermic ($\Delta H < 0$), increasing temperature shifts the equilibrium towards the gas phase (decreasing solubility). 3. Therefore, to maximize solubility, one should increase the pressure and decrease the temperature. 4. From the given options, "Increase in pressure" is the correct factor that increases solubility.

Final Answer: Solubility increases with an increase in pressure.

Answer: (C)



Q23.

Solution**Concept:**

The standard cell potential (E_{cell}^0) is calculated using the standard reduction potentials of the cathode and the anode:

$$E_{cell}^0 = E_{cathode}^0 - E_{anode}^0$$

The cathode is the electrode with the higher reduction potential (more positive), and the anode is the one with the lower reduction potential.

Solution:

1. Given: $E^0(\text{Sn}^{4+}/\text{Sn}^{2+}) = +0.15 \text{ V}$ and $E^0(\text{Cr}^{3+}/\text{Cr}) = -0.74 \text{ V}$. 2. Comparing the two, $+0.15 \text{ V}$ is greater than -0.74 V . 3. Therefore, the Tin couple acts as the cathode and the Chromium couple acts as the anode. 4. $E_{cell}^0 = E_{Sn}^0 - E_{Cr}^0$ 5. $E_{cell}^0 = (+0.15 \text{ V}) - (-0.74 \text{ V})$ 6. $E_{cell}^0 = 0.15 + 0.74 = +0.89 \text{ V}$.

Final Answer: The cell potential will be $+0.89 \text{ V}$.

Answer: (B)

Q24.

Solution**Concept:**

Colligative properties are properties of a solution that depend only on the number of solute particles (concentration) and not on the nature or identity of the solute particles.

Solution:

1. The four standard colligative properties are: - Relative lowering of vapor pressure. - Elevation of boiling point. - Depression of freezing point. - Osmotic pressure. 2. "Vapor pressure" itself is a property of the substance and depends on the identity and temperature, but it is not a colligative property. Only the **lowering** of vapor pressure due to a solute is colligative. 3. Therefore, vapor pressure is the odd one out.

Final Answer: Vapor pressure is not a colligative property.

Answer: (C)



Q25.

Solution**Concept:**

Lucas reagent is used to distinguish between primary, secondary, and tertiary alcohols. It works based on the differing rates at which these alcohols form alkyl chlorides.

Solution:

1. Lucas reagent consists of a mixture of concentrated hydrochloric acid (HCl) and anhydrous zinc chloride (ZnCl_2). 2. The ZnCl_2 acts as a Lewis acid catalyst to facilitate the breaking of the $\text{C}-\text{OH}$ bond. 3. Tertiary alcohols react immediately (turbidity appears instantly), secondary alcohols react within 5 minutes, and primary alcohols do not react at room temperature. 4. Option A correctly identifies the composition.

Final Answer: Lucas reagent is a mixture of Conc. HCl + anhydrous ZnCl_2 .

Answer: (A)

Q26.

Solution**Concept:**

The IUPAC nomenclature for alcohols follows specific rules: identify the longest carbon chain containing the hydroxyl group ($-\text{OH}$), number the chain from the end closest to the $-\text{OH}$ group, and replace the suffix '-e' of the alkane with '-ol'.

Solution:

1. The structure is $\text{CH}_3 - \text{CH}(\text{OH}) - \text{CH}_2 - \text{CH}_3$. 2. The longest continuous carbon chain containing the $-\text{OH}$ group has 4 carbon atoms. This corresponds to the parent alkane "butane". 3. Numbering the chain from left to right gives the $-\text{OH}$ group the lowest possible number (position 2). 4. If numbered from right to left, the $-\text{OH}$ group would be at position 3. Therefore, 2 is preferred. 5. The name is constructed as: Butan + 2 + ol. 6. Combining these gives Butan-2-ol.

Final Answer: The IUPAC name is Butan-2-ol.

Answer: (B)



Q27.

Solution**Concept:**

A transition element is defined as an element which has an incomplete d -subshell in its ground state or in any of its common oxidation states.

Solution:

1. Elements in Group 12 (Zn, Cd, Hg) have a general electronic configuration of $(n - 1)d^{10}ns^2$.
2. Zinc (Zn) has the configuration $[Ar]3d^{10}4s^2$. The d -subshell is completely filled.
3. Even in its most common oxidation state, Zn^{2+} , the configuration is $[Ar]3d^{10}$. The d -subshell remains completely filled.
4. Because it lacks an incomplete d -subshell in both the atomic and ionic states, it is a d -block element but not a transition element.
5. Fe, Cr, and Cu all have incomplete d -subshells in at least one common state.

Final Answer: Zn is a d -block element but not a transition element.

Answer: (C)

Q28.

Solution**Concept:**

The hybridization of an atom can be determined using the Steric Number (SN) formula:

$$SN = (\text{Number of sigma bonds}) + (\text{Number of lone pairs on central atom})$$

Solution:

1. In Phosphorus pentachloride (PCl_5), Phosphorus (P) is the central atom.
2. Phosphorus belongs to Group 15 and has 5 valence electrons.
3. It forms 5 single (sigma) bonds with 5 Chlorine atoms.
4. Total valence electrons used = 5. Lone pairs = 0.
5. Steric Number = $5 + 0 = 5$.
6. A steric number of 5 corresponds to sp^3d hybridization.
7. The molecular geometry associated with sp^3d hybridization in PCl_5 is trigonal bipyramidal.

Final Answer: The hybridization of P in PCl_5 is sp^3d .

Answer: (B)



Q29.

Solution**Concept:**

Dehydrohalogenation is an elimination reaction ($E2$ or $E1$) where a hydrogen halide (e.g., HCl, HBr) is removed from an alkyl halide to form an alkene. This requires a strong base.

Solution:

1. **alc. KOH:** Potassium hydroxide dissolved in alcohol (usually ethanol) produces the ethoxide ion ($C_2H_5O^-$), which is a very strong base. It favors elimination (dehydrohalogenation).
2. **aq. KOH:** Potassium hydroxide in water exists as the hydroxide ion (OH^-). In water, it acts primarily as a nucleophile, favoring substitution (S_N2) to form alcohols.
3. **Na in liq. NH_3 :** This is used for Birch reduction or the reduction of alkynes to trans-alkenes.
4. **$LiAlH_4$:** This is a powerful reducing agent, typically used to reduce carbonyl to alcohols.
5. Therefore, alcoholic KOH is the standard reagent for dehydrohalogenation.

Final Answer: The reagent used for dehydrohalogenation is alc. KOH.

Answer: (A)

Q30.

Solution**Concept:**

The Iodoform test is used to identify the presence of a "methyl ketone" group (CH_3CO-) or a "methyl carbinol" group ($CH_3CH(OH)-$) which can be oxidized to a methyl ketone.

Solution:

1. **Methanol (CH_3OH):** Does not contain the $CH_3CH(OH)-$ unit (only has one carbon).
2. **Ethanol (CH_3CH_2OH):** Contains the $CH_3CH(OH)-$ structure (where the second group is H). It can be oxidized to acetaldehyde (CH_3CHO), which is a methyl ketone.
3. **Propan-1-ol ($CH_3CH_2CH_2OH$):** Does not contain the $CH_3CH(OH)-$ unit at the terminal position.
4. **Benzaldehyde (C_6H_5CHO):** Does not contain a methyl group directly attached to the carbonyl carbon.
5. Therefore, Ethanol gives a positive yellow precipitate of Iodoform (CHI_3).

Final Answer: Ethanol will give a positive Iodoform test.

Answer: (B)



Q31.

Solution**Concept:**

The basic strength of amines in aqueous solution is determined by three competing factors: 1.

Inductive effect (+I): Increases electron density on Nitrogen (favors Tertiary > Secondary > Primary). 2. **Solvation effect:** Hydrogen bonding with water stabilizes the cation (favors Primary > Secondary > Tertiary). 3. **Steric hindrance:** Bulky groups hinder the approach of protons (favors Primary > Secondary > Tertiary).

Solution:

1. In the case of Methyl-substituted amines (CH_3-), the interplay of these three factors leads to a specific experimental order. 2. The secondary amine, dimethylamine $(\text{CH}_3)_2\text{NH}$, is the most basic because it has a high +I effect and is still sufficiently solvated. 3. The primary amine, methylamine CH_3NH_2 , comes next as the solvation effect is very strong. 4. The tertiary amine, trimethylamine $(\text{CH}_3)_3\text{N}$, is less basic than the others due to significant steric hindrance and poor solvation of its cation, despite having the highest +I effect. 5. Ammonia NH_3 is the least basic as it lacks the +I effect of alkyl groups. 6. The final order is: $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$.

Final Answer: The correct order is $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$.

Answer: (A)

Q32.

Solution**Concept:**

Proteins have four levels of structural organization: 1. **Primary:** The linear sequence of amino acids. 2. **Secondary:** The local folding into shapes like α -helix or β -pleated sheets due to hydrogen bonding. 3. **Tertiary:** The overall three-dimensional folding of the entire polypeptide chain. 4. **Quaternary:** The spatial arrangement of multiple polypeptide subunits.

Solution:

1. The secondary structure refers specifically to the conformation of the polypeptide backbone. 2. It arises from regular hydrogen bonding between the carbonyl oxygen ($\text{C} = \text{O}$) and the amide hydrogen ($\text{N} - \text{H}$) of the peptide bonds. 3. This level of structure does not involve the side chains (R groups), only the repeating units of the backbone. 4. Therefore, it describes the fixed spatial configuration or local shape of the chain segments.

Final Answer: The secondary structure refers to the fixed configuration of the polypeptide backbone.

Answer: (B)

Q33.

Solution**Concept:**

Terylene (also known as Dacron) is a polyester produced by the condensation polymerization of a diol and a dicarboxylic acid.

Solution:

1. The monomers required for Terylene are Ethylene glycol and Terephthalic acid. 2. Ethylene glycol is a diol: $\text{HO} - \text{CH}_2 - \text{CH}_2 - \text{OH}$. 3. Terephthalic acid is an aromatic dicarboxylic acid: 1,4 - benzene dicarboxylic acid. 4. During polymerization, the hydroxyl group of the glycol reacts with the carboxyl group of the acid, eliminating a water molecule and forming an ester linkage. 5. This repeating process creates the polyester chain.

Final Answer: The monomers are Ethylene glycol and Terephthalic acid.

Answer: (B)

Q34.

Solution**Concept:**

A neutral complex is a coordination compound that carries no net electrical charge. This happens when the positive charge of the central metal ion is exactly balanced by the negative charges of the ligands within the coordination sphere.

Solution:

1. $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$: Platinum is typically in the +2 state. Ammonia (NH_3) is neutral (0). Chlorine (Cl^-) has a -1 charge. Total charge: $(+2) + 2(0) + 2(-1) = 0$. This is a neutral complex (Cisplatin).
2. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$: The coordination sphere $[\text{Co}(\text{NH}_3)_6]^{3+}$ is a cation, balanced by three Cl^- anions.
3. $\text{K}_4[\text{Fe}(\text{CN})_6]$: The coordination sphere $[\text{Fe}(\text{CN})_6]^{4-}$ is an anion, balanced by four K^+ cations.
4. $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$: The coordination sphere $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is a cation.
5. Only option A describes a complex where the entire species is uncharged.

Final Answer: $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is a neutral complex.

Answer: (A)



Q35.

Solution**Concept:**

In the Bohr model of the atom, the electrons revolve around the nucleus in discrete circular orbits. The radius of these orbits (r_n) is quantized and depends on the principal quantum number (n).

Solution:

1. According to Bohr's postulates, the angular momentum is quantized: $mvr = \frac{nh}{2\pi}$. 2. By equating the centripetal force to the electrostatic force between the nucleus and the electron:

$$\frac{mv^2}{r} = \frac{Ze^2}{4\pi\epsilon_0 r^2}$$

3. Solving for the radius r_n of the n -th orbit:

$$r_n = \frac{n^2 h^2 \epsilon_0}{\pi m Z e^2}$$

4. For a given atom (fixed Z), all other terms (h, ϵ_0, π, m, e) are constants. 5. Thus, the radius r_n is directly proportional to the square of the principal quantum number: $r_n \propto n^2$.

Final Answer: The radius of the n -th orbit is proportional to n^2 .

Answer: (B)

Q36.

Solution**Concept:**

The stability of carbocations is determined by the dispersal of the positive charge. This occurs through: 1. **Inductive effect (+I):** Alkyl groups release electrons towards the cation. 2. **Hyperconjugation:** Overlap of σ -bonds of $C-H$ with the empty p -orbital of the cation. 3. **Resonance:** Delocalization of charge through π -systems.

Solution:

1. CH_3CH_2^+ is a primary carbocation with 3 hyperconjugative hydrogens. 2. $(\text{CH}_3)_2\text{CH}^+$ is a secondary carbocation with 6 hyperconjugative hydrogens. 3. $(\text{CH}_3)_3\text{C}^+$ (tert-butyl cation) is a tertiary carbocation. It has 9 hyperconjugative hydrogens and three +I groups. 4. $\text{C}_6\text{H}_5\text{CH}_2^+$ (benzyl cation) is stabilized by resonance. 5. While resonance is a strong stabilizing factor, the tert-butyl cation is experimentally found to be extremely stable due to the massive hyperconjugative effect. In standard stability series for saturated vs. simple benzylic systems, the tertiary alkyl cation is often cited as the most stable among simple aliphatic/aromatic choices.

Final Answer: $(\text{CH}_3)_3\text{C}^+$ is the most stable carbocation.

Answer: (C)



Q37.

Solution**Concept:**

Polymers are classified based on their thermal properties into: 1. **Thermoplastics:** Become soft on heating and hard on cooling; can be remolded (e.g., Polythene, PVC). 2. **Thermosetting polymers:** Undergo permanent chemical change (cross-linking) on heating; cannot be remolded or reused.

Solution:

1. Polythene and PVC are linear or slightly branched long-chain molecules that can be repeatedly softened. 2. Nylon is a thermoplastic fiber. 3. Bakelite is a phenol-formaldehyde resin. During its formation, it develops extensive cross-linking between chains, creating a three-dimensional network. 4. Once set, Bakelite does not melt or soften upon reheating; it only chars. This makes it a classic example of a thermosetting polymer.

Final Answer: Bakelite is a thermosetting polymer.

Answer: (C)

Q38.

Solution**Concept:**

The reaction of primary aromatic amines with nitrous acid (generated in situ from NaNO_2 and HCl) at low temperatures ($0 - 5^\circ\text{C}$) is known as Diazotization.

Solution:

1. Aniline ($\text{C}_6\text{H}_5\text{NH}_2$) reacts with NaNO_2 and HCl . 2. The nitrous acid reacts with the amino group to form a diazonium salt. 3. The temperature must be kept below 5°C to prevent the salt from decomposing into phenol and nitrogen gas. 4. The product formed is Benzene diazonium chloride ($\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$). 5. This compound is a vital intermediate in the synthesis of various aromatic compounds like dyes and halides.

Final Answer: Aniline gives Benzene diazonium chloride.

Answer: (B)



Q39.

Solution**Concept:**

The boiling point of a liquid is the temperature at which its vapor pressure equals the atmospheric pressure. Adding a non-volatile solute affects the vapor pressure of the solvent.

Solution:

1. When a non-volatile solute is added to a solvent, the surface area available for solvent molecules to escape into the vapor phase decreases. 2. This results in a lowering of the vapor pressure of the solvent. 3. To make the vapor pressure equal to the atmospheric pressure again, a higher temperature is required compared to the pure solvent. 4. This phenomenon is known as "Elevation of Boiling Point." 5. Therefore, the boiling point of the solution is always higher than that of the pure solvent.

Final Answer: The boiling point is higher than the pure solvent.

Answer: (A)



Q40.

Solution

Concept:

Molecular Orbital Theory (MOT) and Magnetism.

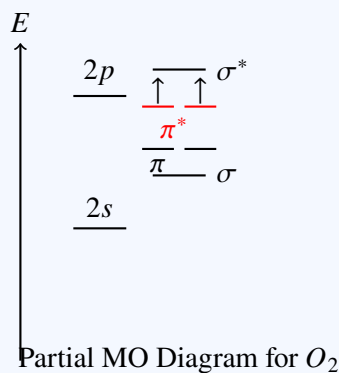
Solution:

Step 1: According to MO theory, a molecule is paramagnetic if it has unpaired electrons in its molecular orbitals.

Step 2: For O_2 (Total 16 electrons), the configuration is: $\sigma_{1s}^2, \sigma_{1s}^{*2}, \sigma_{2s}^2, \sigma_{2s}^{*2}, \sigma_{2p_z}^2, (\pi_{2p_x}^2 = \pi_{2p_y}^2), (\pi_{2p_x}^{*1} = \pi_{2p_y}^{*1})$.

Step 3: The presence of two unpaired electrons in the π^* (antibonding) orbitals makes O_2 paramagnetic.

Step 4: Other options like N_2 , CO (isoelectronic with N_2), and H_2 have all their electrons paired in their respective molecular orbitals.



Final Answer:

O_2

Answer: (B)



Q41.

Solution**Concept:**

According to IUPAC nomenclature for ethers ($R - O - R'$), the molecule is named as an "alkoxyalkane." The smaller alkyl group (with fewer carbon atoms) is treated as the "alkoxy" prefix, while the larger alkyl group is treated as the parent "alkane."

Solution:

1. The structure provided is $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{CH}_3$. 2. The two alkyl groups attached to the oxygen atom are a methyl group ($\text{CH}_3 -$) and an ethyl group ($\text{CH}_3\text{CH}_2 -$). 3. The methyl group is smaller (1 carbon), so it becomes the alkoxy part: "methoxy." 4. The ethyl group is larger (2 carbons), so it becomes the parent alkane: "ethane." 5. Combining these, the IUPAC name is Methoxyethane. 6. Note: "Ethyl methyl ether" is the common name, not the IUPAC name.

Final Answer: The IUPAC name is Methoxy ethane.

Answer: (A)

Q42.

Solution**Concept:**

Ligands are classified based on the number of donor atoms they use to bind to a central metal ion.

1. **Monodentate:** Binds through a single donor atom. 2. **Polydentate:** Binds through two or more donor atoms simultaneously (includes didentate, hexadentate, etc.).

Solution:

1. CO (Carbonyl): Monodentate, binds via Carbon. 2. H_2O (Aqua): Monodentate, binds via Oxygen. 3. SCN^- (Thiocyanate): Monodentate, though it is ambidentate, it only binds through one atom at a time. 4. EDTA^{4-} (Ethylenediaminetetraacetate): It contains two nitrogen donor atoms and four oxygen donor atoms (from acetate groups). 5. It can bind to a metal ion through up to six donor atoms, making it a hexadentate ligand. 6. Therefore, EDTA^{4-} is a polydentate ligand.

Final Answer: EDTA^{4-} is a polydentate ligand.

Answer: (A)



Q43.

Solution**Concept:**

The bond order (B.O.) of a molecule can be determined using Molecular Orbital (MO) Theory using the formula:

$$\text{B.O.} = \frac{1}{2}(N_b - N_a)$$

where N_b is the number of electrons in bonding orbitals and N_a is the number of electrons in antibonding orbitals.

Solution:

1. Helium (He) has an atomic number of 2. A He_2 molecule would have a total of 4 electrons.
2. The molecular orbital configuration for 4 electrons is: $\sigma 1s^2, \sigma^* 1s^2$.
3. Number of bonding electrons (N_b) = 2 (in $\sigma 1s$).
4. Number of antibonding electrons (N_a) = 2 (in $\sigma^* 1s$).
5. Bond Order = $\frac{1}{2}(2 - 2) = 0$.
6. A bond order of zero indicates that the molecule is unstable and does not exist under normal conditions.

Final Answer: The bond order of He_2 is 0.

Answer: (C)

Q44.

Solution**Concept:**

According to the Lewis theory of acids and bases: 1. **Lewis Acid:** A species that can accept an electron pair (electron-deficient). 2. **Lewis Base:** A species that can donate an electron pair (electron-rich).

Solution:

1. NH_3 : The nitrogen atom has a lone pair of electrons to donate. It is a Lewis base.
2. H_2O : The oxygen atom has two lone pairs of electrons. It acts as a Lewis base.
3. CH_4 : Methane has a complete octet and no lone pairs or empty orbitals for typical Lewis behavior.
4. BF_3 (Boron trifluoride): The central Boron atom has only 6 electrons in its valence shell (3 from B and 1 each from 3 F atoms).
5. Because Boron has an incomplete octet and an empty p -orbital, it is highly electron-deficient and readily accepts an electron pair.
6. Therefore, BF_3 is a classic Lewis acid.

Final Answer: BF_3 is a Lewis acid.

Answer: (B)



Q45.

Solution**Concept:**

The general unit for the rate constant (k) of a reaction of order ' n ' is given by:

$$\text{Unit} = (\text{mol L}^{-1})^{1-n} \text{ s}^{-1}$$

Solution:

1. For a second-order reaction, $n = 2$. 2. Substitute $n = 2$ into the general formula:

$$\text{Unit} = (\text{mol L}^{-1})^{1-2} \text{ s}^{-1}$$

3. Simplify the exponent:

$$\text{Unit} = (\text{mol L}^{-1})^{-1} \text{ s}^{-1}$$

4. Distribute the negative exponent:

$$\text{Unit} = \text{mol}^{-1} \text{ L s}^{-1}$$

5. Rearranging for clarity: $\text{L mol}^{-1} \text{ s}^{-1}$.

Final Answer: The unit of rate constant for a second order reaction is $\text{L mol}^{-1} \text{ s}^{-1}$.

Answer: (C)



Q46.

Solution**Concept:**

Zwitterion formation in Amino Acids.

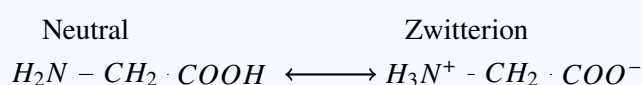
Solution:

Step 1: A zwitterion is formed when a molecule contains both an acidic group and a basic group, allowing an internal acid-base reaction to occur.

Step 2: Glycine is an alpha-amino acid with the formula NH_2CH_2COOH .

Step 3: The carboxyl group ($-COOH$) acts as an acid and loses a proton (H^+), while the amino group ($-NH_2$) acts as a base and accepts a proton.

Step 4: This proton transfer results in the dipolar ion structure: $NH_3^+ - CH_2 - COO^-$. This is the zwitterionic form of glycine.



Proton transfer in Glycine

Final Answer:

Glycine

Answer: (B)

Q47.

Solution**Concept:**

The ability of transition metals to exhibit multiple oxidation states is due to the small energy difference between the $(n - 1)d$ and ns orbitals. This allows electrons from both subshells to participate in bond formation.

Solution:

1. Transition elements in the middle of a series generally show the maximum number of oxidation states. 2. Manganese (Mn) has the electronic configuration $[Ar]3d^54s^2$. 3. It has the maximum number of unpaired electrons (5) in the d -orbital plus 2 electrons in the s -orbital. 4. By using different combinations of these 7 electrons, Manganese can exhibit oxidation states ranging from +2 to +7 (e.g., Mn^{2+} , MnO_2 , $KMnO_4$). 5. Fe typically shows +2, +3; Cr shows +2, +3, +6; and Ti shows +2, +3, +4. 6. Manganese has the widest range in the $3d$ series.

Final Answer: Manganese (Mn) exhibits the maximum number of oxidation states.

Answer: (B)



Q48.

Solution**Concept:**

The molecular shape is determined by the number of bonding pairs and lone pairs around the central atom using VSEPR theory.

Solution:

1. In Sulfur hexafluoride (SF_6), the central atom is Sulfur. 2. Sulfur (Group 16) has 6 valence electrons. 3. It forms 6 single bonds with 6 Fluorine atoms. 4. Steric Number = 6 bonding pairs + 0 lone pairs = 6. 5. A steric number of 6 corresponds to sp^3d^2 hybridization. 6. The spatial arrangement that minimizes repulsion for 6 electron pairs is the Octahedral geometry. 7. All $F - S - F$ bond angles are 90° .

Final Answer: The shape of SF_6 is octahedral.

Answer: (A)

Q49.

Solution**Concept:**

In extremely dilute solutions of strong acids (10^{-7} M or lower), the contribution of H^+ ions from the auto-ionization of water must be taken into account.

Solution:

1. In 10^{-8} M HCl, the concentration of H^+ from the acid is 10^{-8} M. 2. If we only considered the acid, $\text{pH} = -\log(10^{-8}) = 8$. However, an acid solution cannot have a basic pH (above 7). 3. The total concentration of H^+ is: $[H^+]_{total} = [H^+]_{acid} + [H^+]_{water}$ 4. Since the solution is acidic, the ionization of water is suppressed, but it is still approximately 10^{-7} M. 5. $[H^+]_{total} = 10^{-8} + [H^+]_{water}$. A detailed calculation gives a value slightly greater than 10^{-7} M. 6. Therefore, $\text{pH} = -\log([H^+]_{total})$ will be slightly less than 7 (approximately 6.98). 7. This value lies between 6 and 7.

Final Answer: The pH is between 6 and 7.

Answer: (C)



Q50.

Solution**Concept:**

The Effective Atomic Number (EAN) rule states that the central metal atom in a coordination complex tends to acquire the electronic configuration of the nearest noble gas.

$$\text{EAN} = Z - (\text{Oxidation State}) + 2 \times (\text{Coordination Number})$$

Solution:

1. Consider $\text{K}_4[\text{Fe}(\text{CN})_6]$: - Central atom Fe: $Z = 26$. - Oxidation State: $x + 6(-1) = -4 \Rightarrow x = +2$. - Coordination Number: 6. - $\text{EAN} = 26 - 2 + (2 \times 6) = 24 + 12 = 36$. 2. The atomic number of the nearest noble gas (Krypton) is 36. 3. Since the EAN matches the noble gas atomic number, the complex obeys the EAN rule. 4. Other complexes in the list result in EANs of 35 or 37, which do not match a noble gas.

Final Answer: $\text{K}_4[\text{Fe}(\text{CN})_6]$ obeys the EAN rule.

Answer: (A)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	C	4	C	5	A
6	A	7	B	8	D	9	C	10	A
11	C	12	A	13	A	14	C	15	A
16	A	17	A	18	A	19	D	20	B
21	B	22	C	23	B	24	C	25	A
26	B	27	C	28	B	29	A	30	B
31	A	32	B	33	B	34	A	35	B
36	C	37	C	38	B	39	A	40	B
41	A	42	A	43	C	44	B	45	C
46	B	47	B	48	A	49	C	50	A

