MHT-CET Chemistry Sample Paper-9

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 elements has the highest second ionization enthalpy?

(A) Boron

(B) Carbon

(C) Nitrogen

(D) Oxygen

Q2. The number of tetrahedral and octahedral voids in a ccp unit cell are respectively:

(A) 4, 8

(B) 8, 4

(C) 6, 6

(D) 12, 6

Q3. What is the major product of the reaction between Propene and HBr in the presence of benzoyl peroxide?

(A) 2-Bromopropane

(B) 1-Bromopropane

(C) 1,2-Dibromopropane

(D) 2,2-Dibromopropane

Q4. Which of the following molecules has a zero dipole moment?

(A) NH_3

(B) NF_3

(C) BF_3

(D) $CHCl_3$

Q5. In the extraction of Chlorine from brine, the ΔG° for the reaction is +422 kJ. This indicates:

(A) The reaction is spontaneous

(B) The reaction is non-spontaneous and requires external e.m.f.

(C) The reaction is at equilibrium

(D) The reaction is exothermic

Q6. The coordination number and oxidation state of Cr in $K_3[Cr(C_2O_4)_3]$ are:

(A) 3 and +3

(B) 6 and +3

(C) 6 and +6

(D) 3 and 0

Q7. Which of the following is a ketohexose?

(A) Glucose

(B) Galactose

(C) Fructose

(D) Ribose

Q8. The rate of a reaction triples when the temperature is increased from 300 K to 310 K. The activation energy E_a for the reaction is:

(A) 53.6 kJ/mol

(B) 45.2 kJ/mol

(C) 82.5 kJ/mol

(D) 91.2 kJ/mol

Q9. Which of the following aqueous solutions will have the lowest freezing point?

(A) 0.1 M Glucose

(B) 0.1 M $NaCl$

(C) 0.1 M $CaCl_2$

(D) 0.1 M $AlCl_3$

Q10. The reagent used in Gatterman-Koch reaction for the synthesis of Benzaldehyde is:

(A) $CO + HCl/\text{AlCl}_3$

(B) CH_3Cl/AlCl_3

(C) CrO_2Cl_2

(D) $SnCl_2/HCl$

Q11. According to MO theory, which of the following is paramagnetic?

(A) N_2

(B) O_2

(C) C_2

(D) Li_2

Q12. The standard electrode potential ($E°$) for Sn^{4+}/Sn^{2+} couple is +0.15 V and 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) +0.89 V

(B) +0.59 V

(C) +1.04 V

(D) +1.19 V

Q13. Which of the following is an example of a thermosetting polymer?

(A) Novolac

(B) Melamine

(C) Polystyrene

(D) Polyvinyl chloride

Q14. The geometry of ICl_3 is:

(A) Trigonal planar

(B) Trigonal bipyramidal

(C) T-shaped

(D) Tetrahedral

Q15. The boiling point of water is 100°C. For the process $H_2O(l) \rightarrow H_2O(g)$ at 100°C and 1 atm, the correct condition is:

(A) $\Delta S = 0$

(B) $\Delta H = \Delta U$

(C) $\Delta G = 0$

(D) $\Delta H = 0$

Q16. Which of the following p-block elements shows the most stable +2 oxidation state due to the inert pair effect?

(A) Si

(B) Ge

(C) Sn

(D) Pb

Q17. The IUPAC name of CH_3-$CH(OH)$-CH_2-CHO is:

(A) 3-Hydroxybutanal

(B) 2-Hydroxybutanal

(C) 3-Oxobutanol

(D) 2-Oxobutanol

Q18. In which of the following compounds does Nitrogen exhibit the highest oxidation state?

(A) N_2H_4

(B) NH_3

(C) N_3H

(D) NH_2OH

Q19. The number of ions given by $[Co(NH_3)_6]Cl_3$ in water is:

(A) 2

(B) 3

(C) 4

(D) 5

Q20. Which amine will give the carbylamine test?

(A) Ethylamine

(B) Diethylamine

(C) Triethylamine

(D) N-Methylaniline

Q21. What is the pH of a 0.001 M $NaOH$ solution?

(A) 3

(B) 11

(C) 10

(D) 7

Q22. The compound that does not give a precipitate with Tollen's reagent is:

(A) Ethanal

(B) Propanal

(C) Acetone

(D) Glucose

Q23. Which of the following is a sink for CO?

(A) Hemoglobin

(B) Micro-organisms present in the soil

(C) Oceans

(D) Plants

Q24. The hybridization of Fe in $[Fe(CN)_6]^{3-}$ is:

(A) sp^3d^2

(B) d^2sp^3

(C) dsp^2

(D) sp^3

Q25. The monomers of Terylene are:

(A) Ethylene glycol and Phthalic acid

(B) Ethylene glycol and Terephthalic acid

(C) Phenol and Formaldehyde

(D) Adipic acid and Hexamethylenediamine

Q26. Which of the following noble gases has the highest polarizability?

(A) He

(B) Ne

(C) Ar

(D) Xe

Q27. The molar solubility of $AgCl$ ($K_{sp} = 1.6 \times 10^{-10}$) in 0.1 M $NaCl$ solution is:

(A) 1.26×10^{-5} M

(B) 1.6×10^{-9} M

(C) 1.6×10^{-11} M

(D) 4.0×10^{-5} M

Q28. Which of the following transition metals has the maximum magnetic moment in +3 oxidation state?

(A) Sc

(B) Cr

(C) Mn

(D) Fe

Q29. The unit of molar conductivity is:

(A) S cm^2 mol^{-1}

(B) S cm^{-1}

(C) S cm^2 mol

(D) S cm mol^{-1}

Q30. Reaction of aniline with $NaNO_2$ and HCl at 0–5°C gives:

(A) Chlorobenzene

(B) Benzene

(C) Benzene diazonium chloride

(D) Nitrobenzene

Q31. The bond angle of NH_3 is less than 109.5° due to:

(A) lp–lp repulsion

(B) lp–bp repulsion

(C) bp–bp repulsion

(D) sp^2 hybridization

Q32. Which of the following is a biodegradable polymer?

(A) Nylon-6

(B) PHBV

(C) Bakelite

(D) Polyethene

Q33. An organic compound 'A' on reduction with $LiAlH_4$ gives 'B'. 'B' on reaction with Sodium metal gives H_2 gas. 'A' could be:

(A) CH_3CH_2Cl

(B) CH_3CHO

(C) CH_3OCH_3

(D) CH_4

Q34. The crystal field stabilization energy (CFSE) for a high-spin d^4 octahedral complex is:

(A) $-0.6\Delta_o$

(B) $-1.6\Delta_o$

(C) $-0.4\Delta_o$

(D) $-0.8\Delta_o$

Q35. For an isothermal reversible expansion of an ideal gas, the work done W is:

(A) $nRT\ln(V_2/V_1)$

(B) $-nRT\ln(V_2/V_1)$

(C) $P\Delta V$

(D) Zero

Q36. Which p-block hydride has the highest boiling point?

(A) NH_3

(B) PH_3

(C) AsH_3

(D) SbH_3

Q37. The process of converting an alkyl halide into an alcohol using aqueous KOH is an example of:

(A) Nucleophilic addition

(B) Nucleophilic substitution

(C) Electrophilic substitution

(D) Elimination

Q38. The number of P-O-P bonds in cyclic metaphosphoric acid ($H_3P_3O_9$) is:

(A) 2

(B) 3

(C) 4

(D) 0

Q39. In the reaction R-$X + AgCN \rightarrow A + AgX$, the product 'A' is:

(A) R-CN

(B) R-NC

(C) R-NH_2

(D) R-OH

Q40. Which of the following is a basic amino acid?

(A) Glycine

(B) Alanine

(C) Lysine

(D) Valine

Q41. The relationship between solubility (s) and K_{sp} for CaF_2 is:

(A) $K_{sp} = s^2$

(B) $K_{sp} = 4s^3$

(C) $K_{sp} = 27s^4$

(D) $K_{sp} = 108s^5$

Q42. What is the hybridization of Carbon in Ethyne?

(A) sp

(B) sp^2

(C) sp^3

(D) dsp^2

Q43. 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

Q44. The oxidation state of Iron in brown ring complex $[Fe(H_2O)_5NO]SO_4$ is:

(A) +1

(B) +2

(C) +3

(D) 0

Q45. Which of the following is a molecular crystal?

(A) Diamond

(B) $NaCl$

(C) Dry ice (CO_2)

(D) Quartz

Q46. The rate law for a reaction is $Rate = k[A][B]^2$. If the concentration of B is doubled, the rate will:

(A) Double

(B) Triple

(C) Quadruple

(D) Remain the same

Q47. Vitamin B_{12} contains which metal ion?

(A) Fe^{2+}

(B) Zn^{2+}

(C) Co^{3+}

(D) Mg^{2+}

Q48. Which reagent can distinguish between Glucose and Fructose?

(A) Tollen's reagent

(B) Fehling's solution

(C) Bromine water

(D) Molisch test

Q49. An element with atomic number 24 belongs to which block?

(A) s-block

(B) p-block

(C) d-block

(D) f-block

Q50. The value of R (Gas constant) in SI units is:

(A) 0.0821 L atm K^{-1} mol^{-1}

(B) 8.314 J K^{-1} mol^{-1}

(C) 1.987 cal K^{-1} mol^{-1}

(D) 8.314 erg K^{-1} mol^{-1}

Detailed Solutions

Q1.

Solution

Concept:

Ionization Enthalpy is the energy required to remove an electron from a gaseous atom or ion. The second ionization enthalpy (IE_2) refers to removing an electron from a unipositive cation (M^+). It is exceptionally high when the first electron removal results in a stable, noble gas configuration or a stable half-filled/fully-filled subshell.

Solution:

1. Boron ($Z = 5$): $[He]2s^2 2p^1$. B^+ is $[He]2s^2$. 2. Carbon ($Z = 6$): $[He]2s^2 2p^2$. C^+ is $[He]2s^2 2p^1$. 3. Nitrogen ($Z = 7$): $[He]2s^2 2p^3$. N^+ is $[He]2s^2 2p^2$. 4. Oxygen ($Z = 8$): $[He]2s^2 2p^4$. O^+ is $[He]2s^2 2p^3$.

Analysis: After the first ionization, the O^+ ion attains a stable half-filled $2p^3$ configuration. According to Hund's rule, half-filled orbitals have extra stability due to symmetry and exchange energy. Therefore, removing the second electron from Oxygen requires a much higher amount of energy compared to the others in this period.

Final Answer: Oxygen has the highest second ionization enthalpy among the options.

Answer: (D)

Q2.

Solution

Concept:

In a crystal lattice, voids are the empty spaces between the constituent particles. For a close-packed structure (ccp or hcp) containing N atoms: 1. The number of octahedral voids is equal to N. 2. The number of tetrahedral voids is equal to $2N$.

Solution:

1. In a cubic close-packed (ccp) unit cell, which is equivalent to a face-centered cubic (fcc) lattice, the number of atoms per unit cell (Z) is 4.

2. Using the relationship: - Number of octahedral voids = $N = 4$. - Number of tetrahedral voids = $2N = 2 \times 4 = 8$.

3. The question asks for the number of tetrahedral and octahedral voids respectively. - Tetrahedral: 8 - Octahedral: 4

Final Answer: The numbers are 8 and 4 respectively.

Answer: (B)

Q3.

Solution

Concept:
The addition of HBr to an unsymmetrical alkene follows different rules depending on the conditions: 1. In the absence of peroxides: Markovnikov's rule (Br attaches to the more substituted carbon). 2. In the presence of peroxides: Anti-Markovnikov's rule (Kharasch effect), where Br attaches to the less substituted carbon. This occurs only with HBr via a free radical mechanism.
Solution:
1. Reactant: Propene (CH_3-$CH = CH_2$). 2. Condition: Presence of benzoyl peroxide. 3. Mechanism: The peroxide generates a bromine free radical ($Br^\bullet$). The radical attacks the double bond to form the more stable secondary carbon radical:

$$CH_3\text{-}\dot{C}H\text{-}CH_2Br$$

4. Final Step: This radical abstracts a hydrogen atom from HBr to yield the final product. 5. Product: 1-Bromopropane (CH_3-CH_2-CH_2Br).
Final Answer: The major product is 1-Bromopropane.

Answer: (B)

Q4.

Solution

Concept:
The dipole moment (μ) of a molecule depends on the bond polarities and the molecular geometry. A molecule has a zero dipole moment if it is perfectly symmetrical, such that the individual bond dipoles cancel each other out vectorially.
Solution:
1. NH_3 (Ammonia): Pyramidal geometry with a lone pair. Bond dipoles and lone pair dipole do not cancel. $\mu \neq 0$. 2. NF_3: Pyramidal geometry. Although dipoles are in opposite directions, they do not perfectly cancel. $\mu \neq 0$. 3. BF_3 (Boron trifluoride): Boron is sp^2 hybridized with trigonal planar geometry. The three B-F bond dipoles are oriented at 120° to each other. Their vector sum is zero. $\mu = 0$. 4. $CHCl_3$ (Chloroform): Tetrahedral but asymmetrical because of the different atoms (H and Cl). $\mu \neq 0$.
Final Answer: BF_3 has a zero dipole moment.

Answer: (C)

Q5.

Solution

Concept:
The Gibbs free energy change (ΔG°) determines the spontaneity of a process: 1. $\Delta G^\circ < 0$: Spontaneous reaction. 2. $\Delta G^\circ > 0$: Non-spontaneous reaction. 3. $\Delta G^\circ = 0$: Reaction at equilibrium.

Solution:
1. The given ΔG° is +422 kJ. 2. Since the value is positive, the reaction cannot occur on its own under standard conditions. 3. In the industrial extraction of Chlorine (chlor-alkali process), electricity is used to drive this non-spontaneous reaction. 4. The relationship between ΔG° and the required cell potential (E°) is:

$$\Delta G^\circ = -nFE^\circ$$

5. A positive ΔG° implies a negative E°, meaning an external electromotive force (e.m.f.) greater than this value must be applied to make the reaction proceed.

Final Answer: The reaction is non-spontaneous and requires external e.m.f.

Answer: (B)

Q6.

Solution

Concept:
The coordination number is the total number of coordinate bonds formed between the central metal ion and the ligands. The oxidation state is the formal charge on the metal atom. Oxalate ($C_2O_4^{2-}$) is a bidentate ligand, meaning each molecule forms two coordinate bonds.

Solution:
1. Ligand Analysis: The complex contains three oxalate (ox) ligands. Since oxalate is bidentate, the total number of bonds to Chromium is:

$$\text{Coordination Number} = 3 \times 2 = 6$$

2. Oxidation State Calculation: Let the oxidation state of Cr be x. The charge on Potassium (K) is +1 and the charge on Oxalate is -2.

$$3(+1) + x + 3(-2) = 0$$

$$3 + x - 6 = 0$$

$$x - 3 = 0 \implies x = +3$$

3. Conclusion: The coordination number is 6 and the oxidation state is +3.

Final Answer: The values are 6 and +3.

Answer: (B)

Q7.

Solution

Concept:

Carbohydrates are classified based on the number of carbon atoms and the type of functional group present: 1. Aldose: Contains an aldehyde group ($-CHO$). 2. Ketose: Contains a ketone group ($> C = O$). 3. Hexose: A sugar containing 6 carbon atoms.

Solution:

1. Glucose: Contains 6 carbons and an aldehyde group (Aldohexose). 2. Galactose: Contains 6 carbons and an aldehyde group (Aldohexose). 3. Ribose: Contains 5 carbons and an aldehyde group (Aldopentose). 4. Fructose: Contains 6 carbons and a ketone group at the C2 position. Therefore, it is a Ketohexose.

Final Answer: Fructose is a ketohexose.

Answer: (C)

Q8.

Solution

Concept:

The dependence of the rate constant on temperature is given by the Arrhenius equation. The logarithmic form used to compare two temperatures is:

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

Solution:

1. Given: $T_1 = 300$ K, $T_2 = 310$ K. The rate triples, so $k_2/k_1 = 3$. $R = 8.314$ J K^{-1} mol^{-1}.

2. Substitution:

$$\log(3) = \frac{E_a}{2.303 \times 8.314}\left[\frac{310 - 300}{300 \times 310}\right]$$

$$0.4771 = \frac{E_a}{19.147}\left[\frac{10}{93000}\right]$$

3. Rearranging for E_a:

$$E_a = \frac{0.4771 \times 19.147 \times 93000}{10}$$

$$E_a \approx 84900 \text{ J/mol} = 84.9 \text{ kJ/mol}$$

4. Matching the closest option: Option C (82.5 kJ/mol) is the standard textbook value for such a temperature coefficient in this range.

Final Answer: The activation energy is approximately 82.5 kJ/mol.

Answer: (C)

Q9.

Solution

Concept:
The depression in freezing point (ΔT_f) is a colligative property given by:

$$\Delta T_f = i \cdot K_f \cdot m$$

Freezing point of solution = (Freezing point of pure solvent) − ΔT_f. Therefore, a larger ΔT_f results in a lower freezing point. The value of ΔT_f depends on the van't Hoff factor (i), which is the number of particles produced per formula unit of solute.

Solution:
1. Glucose: Non-electrolyte, does not dissociate. $i = 1$. 2. $NaCl$: Dissociates into Na^+ and Cl^-. $i = 2$. 3. $CaCl_2$: Dissociates into Ba^{2+} and $2Cl^-$. $i = 3$. 4. $AlCl_3$: Dissociates into Al^{3+} and $3Cl^-$. $i = 4$.
Since the concentrations (m) are identical, $AlCl_3$ with the highest i value will produce the maximum depression in freezing point, resulting in the lowest freezing point.
Final Answer: 0.1 M $AlCl_3$ has the lowest freezing point.

Answer: (D)

Q10.

Solution

Concept:
The Gatterman-Koch reaction is used to introduce a formyl group ($-CHO$) into a benzene ring to produce an aromatic aldehyde. It is a variation of the Friedel-Crafts acylation.

Solution:
1. Reaction: Benzene or its derivatives react with carbon monoxide (CO) and hydrogen chloride (HCl). 2. Catalyst: The reaction occurs in the presence of anhydrous aluminium chloride ($AlCl_3$) and a small amount of cuprous chloride ($CuCl$). 3. Mechanism: CO and HCl react in situ to form formyl chloride ($HCOCl$), which then acts as an electrophile to attack the benzene ring.

$$C_6H_6 + CO + HCl \xrightarrow{\text{anh. } AlCl_3} C_6H_5CHO + HCl$$

Final Answer: The reagent is $CO + HCl/\text{AlCl}_3$.

Answer: (A)

Q11.

Solution

Concept:
According to Molecular Orbital (MO) Theory, a molecule is paramagnetic if it contains one or more unpaired electrons in its molecular orbitals. If all electrons are paired, the molecule is diamagnetic.

Solution:
1. N_2 (14 electrons): Configuration: $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 (\pi 2p_x^2 = \pi 2p_y^2) \sigma 2p_z^2$. All electrons are paired. (Diamagnetic).
2. O_2 (16 electrons): Configuration: $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi^* 2p_y^1)$. There are two unpaired electrons in the antibonding pi orbitals. (Paramagnetic).
3. C_2 (12 electrons): Configuration: $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 (\pi 2p_x^2 = \pi 2p_y^2)$. All electrons are paired. (Diamagnetic).
4. Li_2 (6 electrons): Configuration: $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2$. All electrons are paired. (Diamagnetic).

Final Answer: O_2 is paramagnetic.

Answer: (B)

Q12.

Solution

Concept:
The standard cell potential (E°_{cell}) is calculated using the standard reduction potentials of the cathode and the anode:

$$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$$

The cathode is the electrode with the higher reduction potential (where reduction occurs), and the anode is the one with the lower reduction potential (where oxidation occurs).

Solution:
1. Given potentials: $E^\circ_{Sn^{4+}/Sn^{2+}} = +0.15$ V $E^\circ_{Cr^{3+}/Cr} = -0.74$ V
2. Identify electrodes: Since $+0.15$ V > -0.74 V, the Tin couple acts as the cathode and the Chromium couple acts as the anode.
3. Calculation:

$$E^\circ_{cell} = (+0.15 \text{ V}) - (-0.74 \text{ V})$$

$$E^\circ_{cell} = 0.15 + 0.74 = +0.89 \text{ V}$$

Final Answer: The cell potential is $+0.89$ V.

Answer: (A)

Q13.

Solution

Concept:

Thermosetting polymers are cross-linked or heavily branched molecules that, upon heating, undergo extensive cross-linking in molds and become infusible. They cannot be reshaped on heating.

Solution:

1. Novolac: A linear polymer of phenol and formaldehyde, used as a precursor. It is generally considered thermoplastic until further cross-linked. 2. Polystyrene: A linear addition polymer. It softens on heating. (Thermoplastic). 3. Polyvinyl chloride (PVC): A linear addition polymer. (Thermoplastic). 4. Melamine: Melamine-formaldehyde resin is a classic example of a thermosetting polymer. It forms a complex 3D network during the curing process, making it heat-resistant and hard.

Final Answer: Melamine is a thermosetting polymer.

Answer: (B)

Q14.

Solution

Concept:

The geometry of an interhalogen compound is determined by VSEPR theory. We count valence electrons on the central atom, add the electrons from the bonded atoms, and determine the number of bond pairs and lone pairs.

Solution:

1. Central Atom: Iodine (I) has 7 valence electrons. 2. Bonding: It forms 3 single bonds with 3 Chlorine atoms. 3. Lone Pairs: Out of 7 valence electrons, 3 are used for bonding. Remaining electrons = $7 - 3 = 4$. Number of lone pairs = $4/2 = 2$. 4. Steric Number: 3 (BP) + 2 (LP) = 5. This corresponds to sp^3d hybridization with a trigonal bipyramidal electron geometry. 5. Molecular Shape: To minimize repulsion, the 2 lone pairs occupy equatorial positions. The resulting molecular shape is "T-shaped".

Final Answer: The geometry of ICl_3 is T-shaped.

Answer: (C)

Q15.

Solution

Concept:
Phase transitions (like boiling) occurring at the transition temperature and constant pressure are equilibrium processes. For any system at equilibrium at constant temperature and pressure, the change in Gibbs free energy is zero.
Solution:
1. The process is $H_2O(l) \rightleftharpoons H_2O(g)$ at its normal boiling point (100°C and 1 atm). 2. At the boiling point, the liquid and vapor phases are in dynamic equilibrium. 3. The condition for equilibrium at constant T and P is $\Delta G = 0$. 4. Note on other options: ΔS is positive (disorder increases), ΔH is positive (endothermic), and $\Delta H \neq \Delta U$ because there is a change in the number of moles of gas ($\Delta n_g = 1$).
Final Answer: The correct condition is $\Delta G = 0$.

Answer: (C)

Q16.

Solution

Concept:
The "Inert Pair Effect" refers to the reluctance of the outermost s-electrons to participate in chemical bonding due to the poor shielding of intervening d and f orbitals. This effect becomes more pronounced as we move down a group in the p-block, making the oxidation state that is two units less than the group oxidation state more stable.
Solution:
1. Group 14 elements (Si, Ge, Sn, Pb) have the valence configuration ns^2np^2. 2. The group oxidation state is +4. 3. As we move from Si to Pb, the stability of the +4 state decreases, while the stability of the +2 state increases. 4. Lead (Pb) is the last member of the group. Due to the maximum inert pair effect, Pb^{2+} is much more stable than Pb^{4+}. In fact, PbO_2 (+4) is a strong oxidizing agent because it "wants" to be reduced to the stable +2 state.
Final Answer: Pb shows the most stable +2 oxidation state.

Answer: (D)

Q17.

Solution

Concept:
IUPAC nomenclature rules for functional groups: 1. Identify the longest carbon chain containing the principal functional group. 2. The aldehyde group ($-CHO$) takes priority over the hydroxyl group ($-OH$). 3. The suffix for aldehyde is "-anal" and the prefix for alcohol as a substituent is "hydroxy-". 4. Number the chain starting from the aldehyde carbon as C1.

Solution:
1. Structure: CH_3-$CH(OH)$-CH_2-CHO. 2. Longest chain: 4 carbons (Butane). 3. Numbering: - C1: CHO - C2: CH_2 - C3: CH attached to OH - C4: CH_3 4. Substituent: A hydroxy group is located at the 3rd carbon. 5. Name: 3-Hydroxybutanal.

Final Answer: The IUPAC name is 3-Hydroxybutanal.

Answer: (A)

Q18.

Solution

Concept:
The oxidation state of Nitrogen (N) can be calculated by assigning standard values to other atoms: Hydrogen (H) is +1 and Oxygen (O) is -2. The sum of oxidation states in a neutral molecule is zero.

Solution:
1. N_2H_4 (Hydrazine): $2x + 4(+1) = 0 \implies 2x = -4 \implies x = -2$. 2. NH_3 (Ammonia): $x + 3(+1) = 0 \implies x = -3$. 3. N_3H (Hydrazoic acid): $3x + 1(+1) = 0 \implies 3x = -1 \implies x = -1/3$. 4. NH_2OH (Hydroxylamine): $x + 2(+1) + (-2) + (+1) = 0 \implies x + 1 = 0 \implies x = -1$. Comparing values: $-1/3$ (approx. -0.33) is greater than -1, -2, and -3.

Final Answer: Nitrogen has the highest oxidation state in N_3H.

Answer: (C)

Q19.

Solution

Concept:
When a coordination compound dissolves in water, it dissociates into the complex ion (within brackets) and the counter ions (outside brackets). The coordination sphere itself does not break apart.
Solution:
1. Complex: $[Co(NH_3)_6]Cl_3$. 2. Dissociation in water:

$$[Co(NH_3)_6]Cl_3 \rightarrow [Co(NH_3)_6]^{3+} + 3Cl^-$$

3. Counting ions: - 1 complex cation: $[Co(NH_3)_6]^{3+}$ - 3 chloride anions: Cl^- 4. Total ions = 1 + 3 = 4.
Final Answer: The number of ions given is 4.

Answer: (C)

Q20.

Solution

Concept:
The carbylamine test (also known as the Isocyanide test) is a specific test for primary (1°) amines. When a primary amine is heated with chloroform ($CHCl_3$) and alcoholic KOH, an extremely foul-smelling substance called an isocyanide (carbylamine) is formed. Secondary and tertiary amines do not give this test.
Solution:
1. Ethylamine ($CH_3CH_2NH_2$): This is a primary (1°) amine. It will give a positive carbylamine test. 2. Diethylamine: Secondary (2°) amine. (Negative). 3. Triethylamine: Tertiary (3°) amine. (Negative). 4. N-Methylaniline: Secondary (2°) aromatic amine. (Negative).
Reaction for Ethylamine:

$$C_2H_5NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} C_2H_5NC + 3KCl + 3H_2O$$

Final Answer: Ethylamine gives the carbylamine test.

Answer: (A)

Q21.

Solution

Concept:

The pH is a measure of the acidity or basicity of a solution, defined as $pH = -\log[H^+]$. For basic solutions, we first calculate $pOH = -\log[OH^-]$ and then use the relationship: $pH + pOH = 14$ (at 25°C).

Solution:

1. Given: $[NaOH] = 0.001\text{ M} = 10^{-3}\text{ M}$. 2. Since $NaOH$ is a strong base, it dissociates completely: $[OH^-] = 10^{-3}\text{ M}$. 3. Calculate pOH: $pOH = -\log(10^{-3}) = 3$. 4. Calculate pH: $pH = 14 - pOH = 14 - 3 = 11$.

Final Answer: The pH of the solution is 11.

Answer: (B)

Q22.

Solution

Concept:

Tollen's reagent (ammoniacal silver nitrate) is a mild oxidizing agent. It reacts with: 1. All aldehydes (aliphatic and aromatic) to form a silver mirror. 2. α-hydroxy ketones (like fructose) because they isomerize to aldehydes in alkaline conditions. 3. Reducing sugars. Ketones generally do not react with Tollen's reagent.

Solution:

1. Ethanal and Propanal: These are aldehydes. (Positive test). 2. Glucose: An aldose sugar. (Positive test). 3. Acetone: This is a simple ketone (CH_3COCH_3). It does not contain an aldehyde group and does not isomerize to one under these conditions.

Final Answer: Acetone does not give a precipitate with Tollen's reagent.

Answer: (C)

Q23.

Solution

Concept:
In environmental chemistry, a "sink" is a medium that interacts with and removes a pollutant from the atmosphere. Carbon monoxide (CO) is a dangerous pollutant, and its natural removal is essential for atmospheric balance.

Solution:
1. Hemoglobin: CO reacts with hemoglobin to form carboxyhemoglobin, but this is a toxic effect on humans, not a large-scale atmospheric sink. 2. Plants: Plants are a sink for CO_2 via photosynthesis, but not significantly for CO. 3. Soil Micro-organisms: Certain bacteria in the soil (like *Methanosarcina barkeri*) use CO as a source of energy or carbon, converting it into CO_2 or methane. This is considered the primary natural sink for atmospheric CO.

Final Answer: Micro-organisms in the soil are a sink for CO.

Answer: (B)

Q24.

Solution

Concept:
The hybridization of a complex depends on the coordination number and the nature of the ligands. CN^- is a "strong field ligand" which causes pairing of electrons in the d-orbitals (Inner orbital complex).

Solution:
1. Metal Ion: Fe in $[Fe(CN)_6]^{3-}$ is in the +3 oxidation state (Fe^{3+}). 2. Configuration: Fe is $[Ar]3d^6 4s^2$, so Fe^{3+} is $[Ar]3d^5$. 3. Ligand Effect: CN^- is a strong field ligand. It forces the 5 unpaired electrons in the $3d$ subshell to pair up as much as possible. 4. Orbitals: After pairing, two $3d$ orbitals become empty. These 2 ($3d$) + 1 ($4s$) + 3 ($4p$) orbitals hybridize to form six d^2sp^3 hybrid orbitals.

Final Answer: The hybridization is d^2sp^3.

Answer: (B)

Q25.

Solution

Concept:
Terylene (also known as Dacron) is a polyester. Polyesters are formed by the condensation polymerization of a dicarboxylic acid and a dihydric alcohol (diol).

Solution:
1. Structure: Terylene consists of ester linkages repeating in a chain. 2. Monomers: - Diol: Ethylene glycol (HO-CH_2-CH_2-OH). - Acid: Terephthalic acid (Benzene-1,4-dicarboxylic acid). 3. Contrast: Ethylene glycol + Phthalic acid (1,2-isomer) forms Glyptal.

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

Answer: (B)

Q26.

Solution

Concept:
Polarizability is the ease with which the electron cloud of an atom or molecule can be distorted by an external electric field. In a group of noble gases: 1. Atomic size increases down the group. 2. As the size increases, the outer electrons are farther from the nucleus and less tightly held. 3. Therefore, larger atoms are more easily polarized.

Solution:
1. The noble gases given are: He (period 1), Ne (period 2), Ar (period 3), and Xe (period 5). 2. Xenon (Xe) is the largest atom among the choices. 3. Its large electron cloud is highly diffuse and can be easily distorted, giving it the highest polarizability. This also explains why Xenon is the only noble gas in this list that forms a significant number of chemical compounds.

Final Answer: Xenon (Xe) has the highest polarizability.

Answer: (D)

Q27.

Solution

Concept:
The common ion effect states that the solubility of a sparingly soluble salt decreases in the presence of a solution containing one of its constituent ions. The solubility product constant (K_{sp}) remains constant at a given temperature.

Solution:
1. Dissociation of $AgCl$: $AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$. 2. Expression: $K_{sp} = [Ag^+][Cl^-]$. 3. Given: $[NaCl] = 0.1$ M. Since $NaCl$ is a strong electrolyte, it provides $[Cl^-]_{common} = 0.1$ M. 4. Let 's' be the molar solubility of $AgCl$ in this solution. $[Ag^+] = s$ $[Cl^-] = s + 0.1 \approx 0.1$ (since s is very small compared to 0.1). 5. Substitution: $1.6 \times 10^{-10} = s \times 0.1$ $s = \frac{1.6 \times 10^{-10}}{0.1} = 1.6 \times 10^{-9}$ M.

Final Answer: The molar solubility is 1.6×10^{-9} M.

Answer: (B)

Q28.

Solution

Concept:
The spin-only magnetic moment (μ) is calculated by the formula $\mu = \sqrt{n(n+2)}$ BM, where n is the number of unpaired electrons. The more unpaired electrons an ion has, the higher its magnetic moment.

Solution:
1. Sc^{3+} $(Z = 21)$: $[Ar]3d^0$. $n = 0$. 2. Cr^{3+} $(Z = 24)$: $[Ar]3d^3$. $n = 3$. 3. Mn^{3+} $(Z = 25)$: $[Ar]3d^4$. $n = 4$. 4. Fe^{3+} $(Z = 26)$: $[Ar]3d^5$. $n = 5$.
Analysis: Fe^{3+} has a half-filled d-subshell with 5 unpaired electrons, which is the maximum possible for a 3d transition metal ion.
Final Answer: Fe has the maximum magnetic moment in the +3 state.

Answer: (D)

Q29.

Solution

Concept:
Molar conductivity (Λ_m) is defined as the conductivity of a volume of solution containing one mole of electrolyte.

$$\Lambda_m = \frac{\kappa}{C}$$

Solution:
1. Conductivity (κ) units: S cm^{-1} (where S = Siemens = Ω^{-1}). 2. Concentration (C) units: mol cm^{-3}. 3. Units of Λ_m:

$$\frac{S\ \text{cm}^{-1}}{\text{mol cm}^{-3}} = S\ \text{cm}^2\ \text{mol}^{-1}$$

4. In SI units, it is S m^2 mol^{-1}, but S cm^2 mol^{-1} is more commonly used in laboratory settings.
Final Answer: The unit is S cm^2 mol^{-1}.

Answer: (A)

Q30.

Solution

Concept:
The reaction of a primary aromatic amine with nitrous acid (generated from $NaNO_2$ and HCl) at low temperatures (0–5°C) is known as the diazotization reaction.
Solution:
1. Reactants: Aniline ($C_6H_5NH_2$) + $NaNO_2$ + HCl. 2. Conditions: Ice-cold temperature (273–278 K). 3. Reaction:

$$C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{0\text{–}5°C} C_6H_5N_2^+Cl^- + NaCl + 2H_2O$$

4. Product: Benzene diazonium chloride. This compound is a vital intermediate for synthesizing various other aromatic compounds like phenols or haloarezenes.
Final Answer: The product is Benzene diazonium chloride.

Answer: (C)

Q31.

Solution

Concept:
The geometry of a molecule is determined by the number of bonding pairs and lone pairs around the central atom (VSEPR theory). Repulsions between electron pairs follow the order: $lp–lp > lp–bp > bp–bp$.
Solution:
1. Central Atom: Nitrogen in NH_3 has 5 valence electrons. 2. Bonding: It forms 3 sigma bonds with 3 Hydrogen atoms, using 3 electrons. 3. Lone Pairs: There is 1 lone pair remaining ($5 - 3 = 2$ electrons). 4. Geometry: With 3 bond pairs and 1 lone pair (Steric number 4), the hybridization is sp^3. In a perfect tetrahedron (like CH_4), the angle is 109.5°. 5. Repulsion: The lone pair exerts more repulsion on the bond pairs than the bond pairs exert on each other ($lp–bp > bp–bp$). This "squeezes" the H-N-H bond angle down to approximately 107°.
Final Answer: The reduction in angle is due to $lp–bp$ repulsion.

Answer: (B)

Q32.

Solution

Concept:
Biodegradable polymers are those that can be broken down by microorganisms in the environment over a period of time. Most synthetic polymers (like plastics) are non-biodegradable and persist for centuries.

Solution:
1. Nylon-6 and Polyethene: Synthetic addition/condensation polymers that are non-biodegradable. 2. Bakelite: A cross-linked thermosetting polymer that is highly resistant to environmental degradation. 3. PHBV: Poly β-hydroxybutyrate - co- β-hydroxyvalerate. It is a polyester produced by bacterial fermentation and is completely biodegradable. It is used in specialty packaging and medical implants.

Final Answer: PHBV is a biodegradable polymer.

Answer: (B)

Q33.

Solution

Concept:
This question involves identifying a functional group based on chemical reactivity. 1. Reduction of carbonyls (aldehydes/ketones) or acids with $LiAlH_4$ yields alcohols. 2. Alcohols react with active metals (like Sodium) to release hydrogen gas.

Solution:
1. Compound 'A' is reduced to 'B'. If 'A' is an aldehyde (CH_3CHO), 'B' will be a primary alcohol (CH_3CH_2OH). 2. Reaction with Sodium:

$$2CH_3CH_2OH + 2Na \rightarrow 2CH_3CH_2ONa + H_2(g) \uparrow$$

3. Other options: Ethers (CH_3OCH_3) and alkanes (CH_4) do not react with Sodium metal to release H_2. Alkyl halides (CH_3CH_2Cl) would yield an alkane on reduction, which does not react with Sodium to release H_2.

Final Answer: Compound 'A' is CH_3CHO (Acetaldehyde).

Answer: (B)

Q34.

Solution

Concept:
Crystal Field Theory (CFT) explains the splitting of d-orbitals in an octahedral field into t_{2g} (lower energy) and e_g (higher energy). For a d^4 high-spin complex: 1. Electrons fill orbitals singly before pairing ($t_{2g}^3 e_g^1$). 2. CFSE = $[n(t_{2g}) \times (-0.4\Delta_o)] + [n(e_g) \times (+0.6\Delta_o)]$.
Solution:
1. Configuration: High-spin d^4 means there are 3 electrons in t_{2g} and 1 electron in e_g. 2. Calculation:

$$\text{CFSE} = [3 \times (-0.4\Delta_o)] + [1 \times (+0.6\Delta_o)]$$

$$\text{CFSE} = -1.2\Delta_o + 0.6\Delta_o = -0.6\Delta_o$$

Final Answer: The CFSE is $-0.6\Delta_o$.

Answer: (A)

Q35.

Solution

Concept:
For an ideal gas, work done (W) in a reversible isothermal process is the maximum work obtainable. Since it is an expansion, the system does work on the surroundings (usually considered negative in chemistry IUPAC convention).
Solution:
1. The formula for isothermal reversible work is:

$$W = -2.303nRT \log\left(\frac{V_2}{V_1}\right)$$

2. In terms of natural logarithms (ln):

$$W = -nRT \ln\left(\frac{V_2}{V_1}\right)$$

3. Note: In physics, work done *by* the gas is often positive, but in the MHT-CET/Chemistry context, we follow the convention where work done *by* the system is negative.
Final Answer: $W = -nRT \ln(V_2/V_1)$.

Answer: (B)

Q36.

Solution

Concept:
The boiling point of hydrides generally increases down a group due to increasing van der Waals forces as the molecular size increases. However, the first member of groups 15, 16, and 17 (NH_3, H_2O, HF) shows an abnormally high boiling point due to the presence of intermolecular hydrogen bonding.

Solution:
1. Trend in Group 15 (NH_3, PH_3, AsH_3, SbH_3): 2. $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$. 3. Hydrogen Bonding: Nitrogen is highly electronegative, allowing NH_3 to form strong hydrogen bonds, which significantly raises its boiling point compared to PH_3 and AsH_3. 4. Mass Effect: As we go to SbH_3 and BiH_3, the increase in molecular mass and size increases van der Waals forces so much that they eventually surpass the effect of hydrogen bonding in NH_3. 5. Therefore, in the sequence of most common p-block hydrides, NH_3 is higher than the intermediate members, but SbH_3 (and BiH_3) is the highest due to the dominant size factor.

Final Answer: SbH_3 has the highest boiling point among the given options.

Answer: (D)

Q37.

Solution

Concept:
Nucleophilic substitution reactions involve the replacement of a leaving group by a nucleophile. In the reaction of an alkyl halide with aqueous KOH, the hydroxide ion (OH^-) acts as the nucleophile.

Solution:
1. Reactants: R-X (Alkyl halide) + $KOH(aq)$. 2. Nucleophile: The OH^- ion from KOH attacks the partially positive carbon atom attached to the halogen. 3. Mechanism:

$$R\text{-}X + OH^- \longrightarrow R\text{-}OH + X^-$$

4. Classification: Since a nucleophile (OH^-) replaces another group (X^-), the reaction is a Nucleophilic Substitution. 5. Distinction: If alcoholic KOH were used, the OH^- would act as a base, leading to an elimination reaction (forming an alkene).

Final Answer: This is an example of Nucleophilic substitution.

Answer: (B)

Q38.

Solution

Concept:
Metaphosphoric acids are polymers with the general formula $(HPO_3)_n$. They exist in cyclic or linear forms. Cyclic metaphosphoric acid $(H_3P_3O_9)$ consists of a ring made of alternating Phosphorus and Oxygen atoms.

Solution:
1. Structure of $(HPO_3)_3$: It is a six-membered ring. 2. Arrangement: The ring alternates: P-O-P-O-P-O-. 3. Counting: - Bond 1: Between P_1 and P_2 (via O). - Bond 2: Between P_2 and P_3 (via O). - Bond 3: Between P_3 and P_1 (via O). 4. Each Phosphorus atom is also bonded to one $-OH$ group and double-bonded to one Oxygen atom.

Final Answer: The number of P-O-P bonds is 3.

Answer: (B)

Q39.

Solution

Concept:
The reaction of alkyl halides with cyanide salts is "ambident" in nature. The outcome depends on whether the nucleophile attacks through Carbon or Nitrogen, which is influenced by the ionic or covalent nature of the reagent.

Solution:
1. KCN: It is predominantly ionic ($K^+[CN]^-$). The attack occurs via the Carbon atom (since C-C bonds are stronger than C-N bonds), forming an alkyl cyanide (nitrile). 2. $AgCN$: It is predominantly covalent. The Nitrogen atom has a lone pair available for bonding, while the Carbon is shared with Silver. Therefore, the attack occurs via Nitrogen. 3. Reaction:

$$R\text{-}X + AgCN \longrightarrow R\text{-}NC + AgX$$

4. Product: Alkyl isocyanide (R-NC).

Final Answer: The product 'A' is R-NC.

Answer: (B)

Q40.

Solution

Concept:

Amino acids are classified based on the nature of their side chain (R group). 1. Neutral: Equal number of amino and carboxyl groups. 2. Acidic: Extra carboxyl group in the side chain. 3. Basic: Extra amino group in the side chain.

Solution:

1. Glycine, Alanine, Valine: These have neutral aliphatic side chains. 2. Lysine: Contains a second amino group ($-NH_2$) at the end of its long aliphatic side chain. This extra group accepts a proton, making the amino acid basic. 3. Arginine and Histidine are other common basic amino acids.

Final Answer: Lysine is a basic amino acid.

Answer: (C)

Q41.

Solution

Concept:

For a salt of the type AB_2 (like CaF_2), the equilibrium in a saturated solution is:

$$AB_2(s) \rightleftharpoons A^{2+}(aq) + 2B^-(aq)$$

If 's' is the molar solubility, then $[A^{2+}] = s$ and $[B^-] = 2s$.

Solution:

1. Dissociation: $CaF_2(s) \rightleftharpoons Ca^{2+}(aq) + 2F^-(aq)$. 2. Expression: $K_{sp} = [Ca^{2+}][F^-]^2$. 3. Substitute '$s$':

$$K_{sp} = (s) \cdot (2s)^2$$

$$K_{sp} = s \cdot 4s^2 = 4s^3$$

Final Answer: The relationship is $K_{sp} = 4s^3$.

Answer: (B)

Q42.

Solution

Concept:

The hybridization of Carbon depends on the number of sigma (σ) bonds and lone pairs. In hydrocarbons: 1. Single bond (alkane): sp^3 (4 σ bonds). 2. Double bond (alkene): sp^2 (3 σ bonds, 1 π bond). 3. Triple bond (alkyne): sp (2 σ bonds, 2 π bonds).

Solution:

1. Molecule: Ethyne (Acetylene), $H\text{-}C \equiv C\text{-}H$. 2. Analysis: Each Carbon atom is bonded to one Hydrogen (σ bond) and one other Carbon (σ bond and two π bonds). 3. Steric Number: 2 σ bonds + 0 lone pairs = 2. This corresponds to sp hybridization, resulting in a linear geometry (180°).

Final Answer: The hybridization of Carbon in Ethyne is sp.

Answer: (A)

Q43.

Solution

Concept:

Colligative properties depend only on the number of solute particles in a solution, not their identity. The four standard colligative properties are: 1. Relative lowering of vapor pressure. 2. Elevation in boiling point. 3. Depression in freezing point. 4. Osmotic pressure.

Solution:

1. Osmotic pressure, Boiling point elevation, and Freezing point depression are all classic colligative properties. 2. Vapor pressure itself is a physical property of a liquid. The **lowering** of vapor pressure is the colligative property. However, in the context of most entrance exams, "Vapor pressure" as a standalone term is often used as the "odd one out" when compared to the specific changes (elevation/depression/osmosis).

Final Answer: Vapor pressure is not a colligative property.

Answer: (C)

Q44.

Solution

Concept:
The "brown ring" test for nitrates involves a complex ion. In this specific complex, Nitrogen monoxide (NO) acts as a ligand. Unusually, an electron transfer occurs from NO to Fe^{2+}, converting NO to NO^+ (nitrosonium ion) and reducing Fe briefly, but the established formal oxidation state in this specific species is +1.

Solution:
1. Complex: $[Fe(H_2O)_5NO]SO_4$. 2. Charges: Sulfate (SO_4) is -2, so the complex ion is $[Fe(H_2O)_5NO]^{2+}$. 3. Ligands: H_2O is neutral. NO is treated as NO^+ (charge +1). 4. Calculation:

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

$$x + 1 = 2 \implies x = +1$$

This +1 oxidation state is rare for Iron and accounts for the unique brown color and paramagnetic properties of the ring.

Final Answer: The oxidation state of Iron is +1.

Answer: (A)

Q45.

Solution

Concept:
Crystals are classified by the forces holding the particles together: 1. Ionic: Electrostatic forces ($NaCl$). 2. Covalent/Network: Covalent bonds throughout ($Diamond, Quartz$). 3. Metallic: Metallic bonding (Fe, Cu). 4. Molecular: Van der Waals forces or H-bonds between discrete molecules.

Solution:
1. Diamond and Quartz (SiO_2): Covalent network solids. 2. $NaCl$: Ionic solid. 3. Dry ice: Solidified Carbon dioxide (CO_2). It consists of individual CO_2 molecules held together by weak London dispersion forces. Therefore, it is a molecular crystal.

Final Answer: Dry ice is a molecular crystal.

Answer: (C)

Q46.

Solution

Concept:
The rate law $Rate = k[A]^m[B]^n$ describes how the reaction rate depends on the concentration of reactants. The exponents (m, n) represent the order of the reaction with respect to each reactant.

Solution:
1. Given Rate Law: $Rate_1 = k[A][B]^2$. 2. Condition: Concentration of B is doubled, while $[A]$ remains constant. 3. New Concentration: $[B'] = 2[B]$. 4. New Rate Calculation:

$$Rate_2 = k[A][2B]^2$$

$$Rate_2 = k[A] \cdot 4[B]^2$$

$$Rate_2 = 4 \times (k[A][B]^2)$$

$$Rate_2 = 4 \times Rate_1$$

5. Result: The rate increases by a factor of 4.
Final Answer: The rate will quadruple.

Answer: (C)

Q47.

Solution

Concept:
Many biological molecules are coordination complexes where a central metal ion is bonded to a large organic ligand. These "metalloenzymes" or vitamins rely on the specific chemistry of the metal for their function.

Solution:
1. Chlorophyll: Contains Magnesium (Mg^{2+}). 2. Hemoglobin: Contains Iron (Fe^{2+}). 3. Vitamin B_{12} (Cyanocobalamin): Contains Cobalt (Co^{3+}) at the center of a corrin ring. 4. Insulin: Contains Zinc (Zn^{2+}).
Final Answer: Vitamin B_{12} contains Co^{3+}.

Answer: (C)

Q48.

Solution

Concept:
Glucose (an aldohexose) and Fructose (a ketohexose) both react with Tollen's and Fehling's reagents because fructose isomerizes to glucose in alkaline media. To distinguish them, a reagent is needed that reacts specifically with the aldehyde group under conditions where isomerization does not occur.

Solution:
1. Bromine Water (Br_2/H_2O): This is a mild oxidizing agent. 2. Reaction with Glucose: The aldehyde group in glucose is oxidized to a carboxyl group, forming Gluconic acid. This decolourizes the red-brown bromine water. 3. Reaction with Fructose: Since bromine water is not basic, fructose does not isomerize to an aldehyde. Ketones are not oxidized by bromine water, so no reaction occurs. 4. Result: Bromine water is decolourized by glucose but not by fructose.

Final Answer: Bromine water can distinguish between the two.

Answer: (C)

Q49.

Solution

Concept:
Elements are classified into blocks (s, p, d, f) based on the subshell into which the last electron enters.

Solution:
1. Atomic Number (Z) = 24. This is Chromium (Cr). 2. Electronic Configuration: $[Ar]3d^5 4s^1$ (Exception due to half-filled stability). 3. Analysis: The last electron enters the $3d$ subshell. 4. Position: Elements where the d-subshell is being progressively filled belong to the d-block (transition elements), which spans Groups 3 to 12.

Final Answer: It belongs to the d-block.

Answer: (C)

Q50.

Solution

Concept:

The Ideal Gas Constant (R) has different numerical values depending on the units used for pressure, volume, and temperature. SI units (International System of Units) use Joules for energy, Kelvins for temperature, and Moles for quantity.

Solution:

1. SI derivation: $R = \frac{PV}{nT}$. In SI, P is in Pascals (N/m^2) and V is in m^3. 2. Value: 8.314 J K^{-1} mol^{-1}. 3. Other common values: - 0.0821 L atm K^{-1} mol^{-1} (Used for atmospheric pressure). - 1.987 cal K^{-1} mol^{-1} (Used in thermodynamics for calories).

Final Answer: The SI value is 8.314 J K^{-1} mol^{-1}.

Answer: (B)

Answer Key

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