Time: 3 Hours **Total Marks: 70**

General Instructions:

i. The question paper is divided into four sections.
ii. **Section A:** Q.No.1 contains Ten multiple choice type of questions carrying One mark each.
Q.No.2 contains Eight very short answer type of questions carrying One mark each.
iii. **Section B:** Q.No.3 to Q. No. 14 contains Twelve short answer type of questions carrying Two marks each
iv. **Section C:** Q.No.15 to Q. No. 26 contains Twelve short answer type of questions carrying Three marks each.
v. **Section D:** Q.No. 27 to Q. No. 31 contains Five long answer type of questions carrying Four marks each
vi. Use of log table is allowed. Use of calculator is not allowed.
vii. Figures to the right indicate full marks.
viii. Answers to the questions of section A, B, C and D should be written in the same answer book.
ix. For each MCQ, correct answer must be written along with its alphabet.
E.g., (a)……/(b)……/(c)……../(d)…… Only first attempt will be considered for evaluation.
x. Draw well labeled diagrams and write balanced equations wherever necessary.
xi. Every new section must be started on a new page.
xii. Given data:
Atomic mass of C = 12, H = 1, O = 16, Cl = 35.5, Ca = 40
Atomic number (Z): Mn = 25, Fe = 26, Ce = 58, Ar = 18, No = 102
R = 8.314 J K^{-1} mol^{-1} or 0.08205 dm^3 atm K^{-1} mol^{-1}

SECTION A

Q.1. Select and write the correct answer: **[10]**

i. Vapour pressure of a solution is _____.
(A) directly proportional to the mole fraction of the solute
(B) inversely proportional to the mole fraction of the solute
(C) inversely proportional to the mole fraction of the solvent
(D) directly proportional to the mole fraction of the solvent

ii. In which case change in entropy is negative?
(A) Expansion of a gas at constant temperature
(B) Sublimation of solid to gas
(C) $2H_{(g)} \longrightarrow H_{2(g)}$
(D) Evaporation of water

iii. Deacon process is used in the manufacture of _____.
(A) bleaching powder (B) sulfuric acid
(C) nitric acid (D) chlorine

iv. Elements with atomic number greater than _____ are called 'transuranium'.
(A) 90 (B) 91 (C) 92 (D) 93

v. Hybridization of cobalt in $[Co(NH_3)_6]^{3+}$ complex ion is _____.
(A) sp^3d^2 (B) sp^2d^3 (C) d^2sp^3 (D) d^3sp^2

vi. Identify the weakest acidic compound amongst the following:
(A) p-Nitrophenol (B) p-Chlorophenol
(C) p-Cresol (D) p-Aminophenol

vii. Mendius reaction involves the reduction of _____.
(A) cyanoalkanes (B) ketoximes
(C) amides (D) nitroalkanes

viii. Rate law for the reaction A + 2B $\longrightarrow$ C is found to be
Rate = k $[A]^2$ [B]
Concentration of reactant A is doubled, keeping concentration of 'B' constant, the value of rate constant will be _____.
(A) the same (B) doubled (C) quadrupled (D) halved

ix. For the cell reaction, $2Fe^{3+}_{(aq)} + 2I^-_{(aq)} \longrightarrow 2Fe^{2+}_{(aq)} + I_{2(aq)}$, $E^\circ_{cell} = 0.24$ V at 298 K. The standard Gibbs energy ($\Delta_r G^\circ$) of the cell reaction is _____.
[Given that Faraday constant F = 96500 C mol^{-1}]
(A) –23.16 kJ mol^{-1} (B) 46.32 kJ mol^{-1} (C) 23.16 kJ mol^{-1} (D) –46.32 kJ mol^{-1}

x. The number of carbon atoms present in the ring of ε-caprolactam is _____.
(A) five (B) two (C) seven (D) six

Q.2. Answer the following: **[8]**

i. What are cationic complexes?

ii. What is formalin?

iii. Write the relationship between molar solubility (S) and solubility product (K_{sp}) for CaF_2.

iv. Give two examples of basic α-amino acids.

v. An element (x) has a bcc structure with unit cell edge length of 288 pm. What is the radius of atom 'x' ?

vi. Identify product 'X'.
2-Bromobutane $\xrightarrow{\text{alc.KOH}}$ X

vii. Write the equation relating freezing point depression to the concentration of solution.

viii. Define gangue.

SECTION B (Attempt any Eight) **[16]**

Q.3. Draw neat and labelled diagram of lead storage cell.

Q.4. Explain the term isomorphous with examples.

Q.5. What is the action of:
i. phenylhydrazine on propanone?
ii. sodium hypoiodite on acetaldehyde?

Q.6. Define:
i. Nanoscience ii. Sustainable development

Q.7. Convert: Propanoic acid into ethanamine

Q.8. How are primary secondary and tertiary alcohols identified by using Lucas reagent?

Q.9. Write different types of oxides with one example each.

Q.10. Sketch qualitatively crystal field d orbital energy level diagrams for $[Fe(H_2O)_6]^{2+}$.

Q.11. 3.4 g of $CaCl_2$ is dissolved in 2.5 L of water at 300 K. What is the osmotic pressure of the solution? van't Hoff factor for $CaCl_2$ is 2.47.

Q.12. Write the chemical reaction for the conversion of Propene to 1-nitropropane.

Q.13. Three moles of an ideal gas are expanded isothermally from 15 dm^3 to 20 dm^3 at constant external pressure of 1.2 bar. Estimate the amount of work in dm^3 bar and J.

Q.14. What are the advantages and drawbacks of using hydrogen-oxygen fuel cells?

SECTION C (Attempt any Eight) [24]

Q.15. i. What are interstitial compounds?
ii. Why chromium has electronic configuration [Ar] $3d^5\ 4s^1$ and not [Ar] $3d^4\ 4s^2$?

Q.16. i. Give the classification of aliphatic ketones.
ii. Write the chemical equation for reaction of acetic acid with thionyl chloride ($SOCl_2$).

Q.17. What is the action of the following reagents on glucose?
i. Acetic anhydride ii. Hydroxylamine
iii. Hydrogen cyanide

Q.18. i. How will you illustrate the principle, Designing safer chemicals?
ii. Write the balanced chemical equation for the following reaction:
H_2S gas is passed through acidified $K_2Cr_2O_7$ solution.

Q.19. Explain geometrical isomerism in octahedral complexes. Give examples.

Q.20. i. Write the following conversion: Ethoxyethane into ethanol
ii. Explain: Friedel craft acylation of anisole

Q.21. i. Write the order of the thermal stability of hydrogen halides.
ii. Give reason: Xenon forms compounds showing higher oxidation states.

Q.22. i. Arrange the following compounds in order of increasing boiling points: bromoform, chloromethane, dibromomethane, bromomethane.
ii. Write the chemical reaction of aniline with benzoyl chloride and the name of the product obtained.

Q.23. How are polymers classified on the basis of the source or origin? Give two examples of each.

Q.24. Aqueous solution of sodium carbonate is alkaline whereas aqueous solution of ammonium chloride is acidic. Explain.

Q.25. Calculate ΔG for the reaction at 25 °C, $CO_{(g)} + 2\ H_{2(g)} \longrightarrow CH_3OH_{(g)}$, $\Delta G° = -24.8\ kJ\ mol^{-1}$.
The partial pressures of gases are $P_{CO} = 4$ bar, $P_{H_2} = 2$ bar and $P_{CH_3OH} = 2$ bar.

Q.26. A first order reaction takes 40 minutes for 30% decomposition. Calculate its half life.

SECTION D (Attempt any Three) [12]

Q.27. i. Describe substitutional impurity defect with an example.
ii. Nobelium is the only actinoid with +2 oxidation state. Explain.

Q.28. i. Explain first law of thermodynamics for an isochoric process.
ii. A weak monobasic acid is 0.02% dissociated in 0.01 M solution. Calculate dissociation constant of the acid.

Q.29. i. How does a catalyst increase the rate of reaction? Draw a potential energy diagram for catalyzed and uncatalyzed reactions.
ii. What is cell constant? Write its SI unit.

Q.30. i. Define the terms:
a. Osmosis b. Hypotonic solution
ii. What is the action of chlorine on the following?
a. Al b. S_8

Q.31. i. Write the reaction for sulfonation of chlorobenzene.
ii. What is the action of sodium in dry ether on ethyl bromide?
iii. How can you distinguish water soluble carboxylic acids and phenols using sodium bicarbonate test?