



Time: 3 Hours

Total Marks: 70

General Instructions:

- The question paper is divided into four sections.
- 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.
- Section B:** Q.No.3 to Q. No. 14 contains Twelve short answer type of questions carrying Two marks each
- Section C:** Q.No.15 to Q. No. 26 contains Twelve short answer type of questions carrying Three marks each.
- Section D:** Q.No. 27 to Q. No. 31 contains Five long answer type of questions carrying Four marks each
- Use of log table is allowed. Use of calculator is not allowed.
- Figures to the right indicate full marks.
- Answers to the questions of section A, B, C and D should be written in the same answer book.
- 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.
- Draw well labeled diagrams and write balanced equations wherever necessary.
- Every new section must be started on a new page.
- Given data:
Atomic mass of C = 12, H = 1, O = 16,
Atomic number (Z): Mn = 25, Fe = 26, Ce = 58, Ar = 18,
R = $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ or $0.083 \text{ L bar K}^{-1} \text{ mol}^{-1}$

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

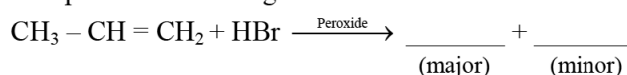
- The number of atoms per unit cell of body centred cube is:
(A) 1 (B) 2 (C) 4 (D) 6
- Isotonic solutions have _____.
(A) equal temperature (B) equal osmotic pressure
(C) equal volume (D) equal amount of solute
- The enthalpy of formation for all elements in their standard states is _____.
(A) unity (B) zero
(C) less than zero (D) more than zero
- The formula of magnetite is _____.
(A) Fe_3O_4 (B) Fe_2O_3 (C) FeCO_3 (D) FeS_2
- The crystal field splitting energy for octahedral (Δ_o) and tetrahedral complexes (Δ_t) complexes is related as _____.
(A) $\Delta_t = 4/9 \Delta_o$ (B) $\Delta_t = 1/2 \Delta_o$ (C) $\Delta_t = -2 \Delta_o$ (D) $\Delta_t = -4/9 \Delta_o$
- When vapours of a secondary alcohol are passed over heated copper at 573 K, the product formed is _____.
(A) an alkene (B) a carboxylic acid
(C) an aldehyde (D) a ketone
- Lotus effect is the basis of _____.
(A) sunscreen lotions (B) medieval pottery
(C) self-cleaning windows (D) water-purification techniques
- Which one of the following compounds does NOT react with acetyl chloride?
(A) $\text{CH}_3 - \text{CH}_2 - \text{NH}_2$ (B) $(\text{CH}_3 - \text{CH}_2)_2\text{NH}$
(C) $(\text{CH}_3 - \text{CH}_2)_3\text{N}$ (D) $\text{C}_6\text{H}_5 - \text{NH}_2$



- ix. Which of the following expressions represent molar conductivity of $\text{Al}_2(\text{SO}_4)_3$?
- (A) $3\lambda_{\text{Al}^{3+}}^0 + 2\lambda_{\text{SO}_4^{2-}}^0$ (B) $2\lambda_{\text{Al}^{3+}}^0 + 3\lambda_{\text{SO}_4^{2-}}^0$
(C) $1/3\lambda_{\text{Al}^{3+}}^0 + 1/2\lambda_{\text{SO}_4^{2-}}^0$ (D) $\lambda_{\text{Al}^{3+}}^0 + \lambda_{\text{SO}_4^{2-}}^0$
- x. The solubility product for a salt of the type AX is 4×10^{-8} . What is the molarity of its saturated solution?
- (A) 4×10^{-4} M (B) 2×10^{-4} M (C) 16×10^{-16} M (D) 2×10^{-16} M

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

- i. Complete the following reaction:



- ii. Write the chemical reaction for Rosenmund reduction of benzoyl chloride.
- iii. Define the term: Monomer
- iv. Rate constant for the reaction $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$ is $4.98 \times 10^{-4} \text{ s}^{-1}$. Find the order of reaction.
- v. Why oxygen cannot exhibit higher oxidation state?
- vi. Write the type of isomerism exhibited by $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ and $[\text{Co}(\text{NH}_3)_5\text{ONO}]^{2+}$ pair of complex ion.
- vii. Which alloy is used in the Fischer-Tropsch process in the synthesis of gasoline?
- viii. The vapour pressure of a pure liquid is 0.043 bar at a certain temperature. When a nonvolatile solute is dissolved into it, the vapour pressure of the solution is found to be 0.041 bar. What is the relative lowering of vapour pressure?

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

- Q.3. Differentiate between order and molecularity of a reaction.
- Q.4. What is its effect of Frenkel defect on density and electrical neutrality of the crystal?
- Q.5. What is Wurtz-Fittig reaction? Give an example.
- Q.6. Give reason: On complete hydrolysis, DNA gives equimolar quantities of adenine and thymine.
- Q.7. Derive the mathematical expression between molar mass of a non-volatile solute and elevation of boiling point.
- Q.8. Calculate the EAN of the following complexes and identify which obey EAN rule and which do not.
- i. $[\text{Fe}(\text{CN})_6]^{3-}$ ii. $\text{Cr}(\text{CO})_6$
- Q.9. Bond dissociation enthalpy of F_2 ($158.8 \text{ kJ mol}^{-1}$) is lower than that of Cl_2 ($242.6 \text{ kJ mol}^{-1}$). Why?
- Q.10. Explain Dow's process for the preparation of phenol.
- Q.11. Write a short note on carbylamines test.
- Q.12. Explain the preparation of carboxylic acids by alkaline hydrolysis of esters.
- Q.13. Calculate the standard enthalpy of:
- $$\text{N}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$$
- if $\Delta H^\circ (\text{N-H}) = 389 \text{ kJ mol}^{-1}$, $\Delta H^\circ (\text{H-H}) = 435 \text{ kJ mol}^{-1}$, $\Delta H^\circ (\text{N-N}) = 159 \text{ kJ mol}^{-1}$
- Q.14. What current strength in amperes will be required to produce 2.4 g of Cu from CuSO_4 solution in 1 hour? Molar mass of Cu = 63.5 g mol^{-1} .

**SECTION C (Attempt any Eight)****[24]**

- Q.15. Draw structures of XeO_3 , XeOF_4 and XeF_2 .
- Q.16. Write the names of the monomers used in the preparation of nylon 6,6. Draw the structure of polymer nylon 6,6 and write its uses.
- Q.17. Write the information obtained about nanomaterials with the help of following techniques.
- Scanning Electron Microscopy (SEM)
 - Transmission Emission Microscopy (TEM)
 - Fourier Transform Infrared Spectroscopy (FTIR)
- Q.18. i. Write the reaction for the preparation of Propan-1-amine from butanamide.
ii. Draw a neat diagram for the Haworth formula of maltose.
- Q.19. i. How is anisole prepared from phenol?
ii. Give two uses of alcohols.
- Q.20. Using VBT, explain the structure of square planar complex: $[\text{Ni}(\text{CN})_4]^{2-}$
- Q.21. Write reactions involved in preparation of potassium dichromate from chrome iron ore.
- Q.22. i. Why is Sc^{3+} ion colourless? ii. Write a note on silver mirror test.
- Q.23. i. What is Stephen's reaction?
ii. Draw the structure of 4-Chloropentan-2-one.
- Q.24. The half life of a first order reaction is 900 min at 820 K. Estimate its half life at 720 K if the activation energy is 250 kJ mol^{-1} .
- Q.25. What can be said about the spontaneity of reactions when:
- ΔH and ΔS are both negative?
 - ΔH and ΔS are both positive?
 - ΔH is negative and ΔS is positive?
- Q.26. Calculate the pH of buffer solution containing 0.06 mol NaF per litre and 0.018 mol HF per litre. [$K_a = 7.2 \times 10^{-4}$ for HF]

SECTION D (Attempt any Three)**[12]**

- Q.27. i. State and explain Henry's law.
ii. How is dioxygen prepared in laboratory from following compounds?
a. Ag_2O b. PbO_2
- Q.28. i. Derive the equation: $W = -P_{\text{ext}} \Delta V$
ii. Explain conjugate acid-base pair with an example.
- Q.29. i. Write Nernst equation.
ii. What part of Nernst equation represents the correction factor for nonstandard state conditions?
iii. Derive the relation between Gibbs energy change and emf of a cell.
- Q.30. i. What is lanthanoid contraction?
ii. Write the electronic configuration of gadolinium ($Z=64$).
iii. Cu crystallizes in fcc unit cell with edge length of 495 pm. What is the radius of Cu atom?
- Q.31. i. Define: Optical activity
ii. Draw structures of enantiomers of 2-bromobutane using wedge formula.
iii. Convert the following using appropriate reagent:
a. Iodomethane to nitromethane
b. Ethyl bromide to ethanol

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