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Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)

Sub_Code: 23BS1003

2nd Semester Regular/Back Examination: 2024-25

SUBJECT: Chemistry

BRANCH(S): AE, AEIE, AERO, AUTO, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSIT, CST, ECE, EEE, ELECTRICAL, ELECTRICAL & C.E, ETC, MANUTECH, MECH, METTA, MINING, PLASTIC

Time: 3 Hours

Max Marks: 100

Q.Code: S385

Answer Q1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions: (2 x 10)

- What is penetration power? Compare the penetration power of different orbitals with a probability density plot.
- What is the metallic radius of an atom 'X' if the distance between two adjacent 'X' atoms in solid form is 270 pm?
- Calculate the entropy change when 2 moles of lead is heated from 25 °C to 30 °C. The Specific heat of lead over this temperature range is 0.03 cal.gm⁻¹, and the atomic weight of lead is 207.
- Calculate the free energy change when 4 moles of an ideal gas expand from a pressure of 100 to 10 atm at 25 °C.
- Arrange the following in increasing order of energy and wavelength:
X-ray, Visible, Gamma ray, Infrared, Microwave, Radiowave, Ultraviolet
- State the reason for a molecule being infrared active. Which of the following molecules will show a vibrational spectrum: HCl, Br₂, CH₂Cl₂, CO₂
- Draw the Saw horse projection and Newman projection of Ethane.
- Which of the conformations of cyclohexane is more stable and why?
- Write the difference between α- and β-eliminations.
- Which type of SN reaction gives an inverted product and why?

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)

- What is shielding/screening effect? How does it affect the Z_{eff}? How does the shielding effect vary within a period and across a group?
- Define polarization and polarizing power of ions. What is the trend in polarising power for cations Be²⁺, Mg²⁺, Ca²⁺, Sr²⁺, and Ba²⁺? Justify your answer.
 - How does polarization affect the covalent character? State Fajan's rule. What are the limitations of Fajan's rules in predicting covalent character?
- Derive the integrated form of Claypeyron – Clausius equation for liquid – vapor equilibrium. Write the significance of this equation.

- d) Describe Gibbs free energy as a criterion of equilibrium and spontaneous change. Enthalpy and entropy changes of a reaction are $40.63 \text{ kJ mol}^{-1}$ and $108.8 \text{ J K}^{-1} \text{ mol}^{-1}$, respectively. Predict the feasibility of the reaction at 27°C .
- e) Derive the expression for entropy of mixing. 1 mole of H_2 and 9 moles of N_2 are mixed at 298 K and 1 atmosphere. Assuming the ideal behavior of the gas, calculate the entropy of mixing per mole of the mixture formed.
- f) The equilibrium constant for the reaction $\text{H}_2(\text{g}) + \text{S}(\text{s}) \leftrightarrow \text{H}_2\text{S}(\text{g})$ is 18.5 at 925 K and 9.25 at 1000 K. Calculate standard enthalpy of the reaction. Also, calculate ΔG° and ΔS° at 925 K.
- g) Write the principle of Microwave spectroscopy. Which of the following molecules will show a microwave rotational spectrum: H_2 , HCl , CH_4 , CH_3Cl , CH_2Cl_2 , SF_6 , CS_2 , SO_2 , CO , and OCS . Derive the expression for radius of a diatomic molecule using the application of microwave spectroscopy.
- h) Discuss the basic principle of UV-Visible spectroscopy, giving a detailed description of different types of transitions.
- i) Explain electrophilic substitution reactions and discuss the mechanism of Friedel-Crafts reaction.
- j) Differentiate between
 - I) Enantiomers and diastereomers.
 - II) Racemic Mixture and Meso-compounds.
- k) Compare and contrast elimination reactions with substitution reactions.
- i) Explain the factors affecting the stability of free radicals, including ease of formation, hyperconjugation, and resonance taking suitable example.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

(16 x 2)

- Q3 a) Define electronegativity, and describe its periodicity. Discuss the different scales to express the electronegativity of elements. (8 x 2)
- b) List the different applications of electronegativity with a detailed description of any four.
- Q4 What are Maxwell's relations? Write the significance. Derive the various forms of Maxwell's relations. (16)
- Q5 a) State Beer's Law. Derive an expression for the intensity of transmitted radiation when light is passed through a homogeneous solution. (4)
- b) At a definite wavelength, an absorber, when placed in a cell of 1 cm path length, absorbs 20% of the incident light. If the absorptivity of the absorber at this wavelength is 2. Find out its concentration. (4)
- c) Write the basic principle of IR spectroscopy and write the expression for vibrational frequency. Mention the factors affecting the vibrational frequency. Also, describe the different types of vibration. (8)
- Q6 a) What is conformational isomerism? Discuss the conformational isomerism of n-butane using a potential energy diagram for various conformations of n-butane. (8 x 2)
- b) Compare the stability of free radicals, carbocations, and carbanions based on their structural features.