

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: B.SC.
BRANCH: CHEMISTRY

SEMESTER : V
SESSION : MO/2025

SUBJECT: CH331 PHYSICAL CHEMISTRY-I

TIME: 3 HOURS

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a)	What is a buffer solution? Derive the Henderson equation for determination of pH of an acidic buffer mixture.	[2+3] 1	2
Q.1(b)	What is the common ion effect? Calculate the solubility of $\text{Al}(\text{OH})_3$ in grams per litre in water at 25°C . K_{sp} of $\text{Al}(\text{OH})_3 = 8.5 \times 10^{-32}$.	[5] 1	3
Q.2(a)	What is chemical potential of pure substance? Explain, the chemical potential vs. temperature curve for solid, liquid and gas phases under one atmospheric pressure.	[5] 2	2
Q.2(b)	What is partial molar Gibbs Free energy? Determine the total volume of solution when 54 g of water is mixed with 54 g of ethanol. [$V_{pm, \text{EtOH}} = 56.56$ cc/mole and $V_{pm, \text{H}_2\text{O}} = 17.37$ cc/mole at 50 mass % solution of ethanol in water at 25°C .]	[5] 2	3
Q.3(a)	From phase diagram, derive the expression of colligative property of depression in freezing point of a solvent in a solution, i.e. $\Delta T_f = K_f m$.	[5] 3	2
Q.3(b)	What is osmotic pressure (π)? Derive the equation, $\pi = cRT$ from chemical potential approach.	[5] 3	2
Q.4(a)	List various elements of symmetry present in a cubic crystal. Calculate the Miller indices of crystal planes which cut through the crystal axes at $(-3a, 2b, -3c)$.	[2+3] 4	2
Q.4(b)	Derive Bragg equation. The first order reflection of X-rays of wavelength 1.54\AA from the (100) planes of a cubic crystal occur at an angle of 11.29° . Calculate the length of the unit cell.	[2+3] 4	3
Q.5(a)	What are the differences between adsorption and absorption? Why does adsorption take place? What are physisorption and chemisorption? Prove that adsorption is an exothermic process.	[5] 5	2
Q.5(b)	What is Freundlich adsorption isotherm? What is Langmuir theory of adsorption? Derive the Langmuir adsorption isotherm.	[5] 5	1

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