Reg. No ..... Name **22P1035**

M. Sc. DEGREE END SEMESTER EXAMINATION : OCTOBER 2022

SEMESTER 1 : CHEMISTRY / PHARMACEUTICAL CHEMISTRY

COURSE : **21P1CHET03 / 21P1CPHT03: PHYSICAL CHEMISTRY - I**

(For Regular - 2022 Admission and Supplementary - 2021 Admission)

Duration : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1. Applying the concept of chemical potential, prove that gases spontaneously mixes into each other. (A, CO 2)
2. Derive the relation: $\left(\frac{\partial P}{\partial T}\right)_V = \left(\frac{\partial S}{\partial V}\right)_T$ (R)
3. Draw the phase diagram of a ternary liquid system A-B-C, where A-C and B-C are completely miscible pairs and A-B is is a partially miscible pair. (U, CO 2)
4. Explain plait points in two heterogeneous systems? (U, CO 3)
5. Define average velocity and give its expression. (U, CO 3)
6. Explain the significance of Lagrange's method of undetermined multipliers as applied in the derivation of the distribution laws. (R, CO 4)
7. State and explain Stirling's approximation. (R, CO 1)
8. Give the relation between thermodynamic probability and entropy. Mention its significance. (U, CO 4)
9. What are higher-order phase transitions? Give examples. (U, CO 4)
10. What is thermionic emission? Which statistics is applied to it? (U, CO 4)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. Calculate the activity and activity co-efficient for CS_2 in an equimolar CS_2-acetone solution. Given, partial pressure of CS_2 at this composition is 404.1 Torr and that of pure CS_2 is 512.3 Torr. (A, CO 2)
12. Explain the phases and degrees of freedom in the phase diagram of a double salt formation. (U, CO 2)
13. Calculate the mean free path of a gas taking the diameter of a molecule as 2×10^{-8} cm. At NTP, one mole of a gas occupies 22.4 liters and Avogadro's number is 6.02×10^{23}. (U, CO 3)
14. Derive the expression for the rotational partition function of a molecule at a condition of characteristic rotational temperature (Θr) smaller compared to 'T'. (U, CO 4)

15.	Four Fermions are distributed in 3 compartments, having degeneracies 5, 8 and 7 respectively. Find the thermodynamic probability of the macrostates a) (1, 2, 1) and b) (4, 0, 0) and c) (0, 1 3).	(U, CO 4)
16.	Derive the expression for the partition function of an ideal monoatomic gas that contains N molecules confined to a vessel of volume 'V'.	(A, CO 4)
17.	Obtain an expression for the most probable distribution of Bosons.	(U, CO 4)
18.	Calculate the critical temperature (T_0) for Bose-Einstein condensation of ^4He, if its molar volume is 27.6×10^{-6} m^3.	(R, CO 4)
		(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19.	Derive Gibbs-Duhem-Margules equation and prove Konovalov's laws.	(U, CO 2)
20.	Derive the Maxwell's law for distribution of molecular velocities of gases and explain its graphical representation.	(U, CO 3)
21.	a) Derive the expression for the vibrational partition function of a diatomic molecule. b) Give a short account of the electronic partition function for a molecule.	(R, CO 4)
22.	a) Derive an expression relating equilibrium constant of a reversible reaction and partition function. b) Deduce the statistical interpretations of classical thermodynamics path functions heat and work done.	(U)
		(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 1	Explain the fundamental principles of classical and statistical thermodynamics.	U	7	1
CO 2	Apply methods of chemical thermodynamics and mathematical tools to describe equilibrium processes.	A	1, 3, 11, 12, 19	11
CO 3	Describe the collision parameters and transport phenomena of gases.	U	4, 5, 13, 20	9
CO 4	Correlate the macroscopic properties of a system with microscopic behaviour by applying the principles of statistical thermodynamics.	A	6, 8, 9, 10, 14, 15, 16, 17, 18, 21	19

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;