Reg. No……..…….. Name……

M. Sc. DEGREE END SEMESTER EXAMINATION OCT.2020: FEBRUARY 2021

SEMESTER **–1: CHEMISTRY/PHARMACEUTICAL CHEMISTRY**

COURSE**: P1CHET04/P1CPHT04 - CLASSICAL AND STATISTICAL THERMODYNAMICS**

(*For Supplementary - 2015 Admission*)

Time: Three Hours Max. Marks: 75

SECTION A

Answer any Ten questions. Each question carries 2 marks

1. Heat (Q) and work (w) are not state functions but become so under certain conditions. Why?
2. Prove that

$$\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$$

3. Define thermodynamically the term "partial molar free energy"
4. What is the need for non-equilibrium thermodynamics?
5. State third law of thermodynamics.
6. Explain the exergonic nature of ATP hydrolysis.
7. Write Debye's third power law. What is its significance?
8. Give Onsager reciprocal relationship.
9. Define the term 'symmetry number' used in statistical mechanics with suitable example
10. Represent a three-component system (ABC), where the composition is 60% A, 20% B and 20% C.
11. State the Boltzmann Planck equation and explain the terms.
12. The translational partition function for CO and N_2 are the same at the same temperature. Why?
13. What is characteristic Einstein temperature of an atomic crystal? Explain its significance.

(2 × 10 = 20)

SECTION B

Answer any five questions by attempting not more than 3 questions from each bunch.

Each question carries 5 marks

Bunch 1 (Short essay type)

14. What is meant by fugacity? Provide the method of determination.
15. Draw the triangular phase diagram of a three component system of three liquids, one pair of which is partially miscible, the other pair being completely miscible. Mark in the diagram the important features and explain them.
16. Derive the expression for vibrational partition function.
17. Derive the Sackur-Tetrode equation and comment on its importance.

Bunch 2 (Problem type)

18. Calculate ΔS (mixing) when two moles of H_2, 3 moles of He and 2 moles of O_2 are mixed at fixed T assuming ideal behavior and no chemical change.

19. Find the molar change in internal energy, enthalpy, entropy, Gibbs free energy and Helmholtz free energy, in expanding 1 liter of an ideal gas at 25°C to 100 liters at the same temperature
20. The wave numbers of the three modes of H_2O are 3656.7, 1594.8 and 3755.8 cm^{-1}. Evaluate the vibrational partition function at 1500 K.
21. The characteristic Debye temperature of diamond is 1860 K. Calculate its heat capacity at 100K.

(5 x 5 = 25)

SECTION C

Answer any two questions. Each question carries 15 marks

22. Define thermodynamic excess functions. What is their significance? Derive expressions for excess free energy, excess enthalpy, excess entropy and excess volume.
23. What is meant by partial molar property? Explain its significance. Provide the method of intercepts for determining the parameter.
24. Critically discuss the significant features of any 3 component system.
25. Derive Maxwell's relations. Discuss any two of their applications

(15 x 2 = 30)

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