Reg. No ..... Name **20P1033**

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

SEMESTER 1 : CHEMISTRY / PHARMACEUTICAL CHEMISTRY

COURSE : **16P1CHET03 / 16P1CPHT03 : PHYSICAL CHEMISTRY - I**

(For Regular - 2020 Admission and Supplementary - 2016/2017/2018/2019 Admissions)

Time : Three Hours Max. Marks: 75

PART A

Answer any 10 (2 marks each)

1. Calculate the most probable velocity of SO_2 molecule at 700 K.
2. Comment on the effect of pressure on viscosity of gases.
3. Calculate the temperature at which the average velocity of H_2 gas becomes 1.69×10^3 m/s.
4. Arrange root mean square, most probable and average speeds in the order of increasing value. Discuss the effect of temperature and pressure on these speeds.
5. Show the different arrangements of 2 particles in a triply degenerate energy level, according to Bose-Einstein and Fermi-Dirac statistics.
6. Give a brief explanation of Bose-Einstein condensation.
7. What is characteristic Einstein temperature of an atomic crystal? Explain its significance.
8. Give the structure of ATP and justify the selection of ATP as the universal currency of free energy in biological processes.
9. What do you meant by phosphate group transfer potential?
10. Define the term uncompensated heat and explain its significance.
11. Draw the phase diagram of a ternary liquid system A-B-C, where all the three are partially miscible pairs.
12. Show that, for ideal gases $\Delta V_{mix} = 0$.
13. State and explain Henry's law.

(2 x 10 = 20)

PART B

Answer any 5 questions attempting not more than 3 questions from each of the following bunches (5 marks each)

Bunch 1 (Short Essay Type)

14. Derive an expression for thermal conductivity of gases.
15. Derive the Sackur Tetrode equation for the entropy of an ideal monoatomic gas.
16. Illustrate the idea of equipartiton of energy for the various modes of motion associated with a molecule using partition function.
17. Derive Saxen's relation for a system showing electrokinetic effect.

Bunch 2 (Problem Type)

18. A gas diffuses through an opening at a rate one third as fast as that of Helium gas. What is the molar mass of the unknown gas?
19. An argon atom is confined to a cubical box of side 1 cm. Estimate its partition function at (a) 100 K, (b) 298 K, (c) 0 K and (d) 10^4 K.
20. Calculate the thermal de Broglie wavelength of hydrogen atom confined to a vessel of volume 2.494×10^5 cm^3 at 3000 K. Given the translational partition function is 7.58×10^{30}.

21. Calculate the entropy change when 5 moles of an ideal gas is changed from the initial state of 1.013×10^5 Nm^{-2} and 300 K to the final state of 10.13×10^5 Nm^{-2} and 600 K. The molar heat capacity at constant pressure Cp = 29.10 JK^{-1}. Assume that Cp is independent of temperature.

(5 x 5 = 25)

PART C

Answer any 2 (15 marks each)

22. (a) Write a note on partition function. (b)Derive the expression for the vibrational partition function of a diatomic molecule.

23. Derive the Boltzmann distribution law for a system of N distinguishable particles having a total energy E with allowed energy levels E_1, E_2…..having degeneracies g_1, g_2……

24. Explain the phenomena of entropy production in:
    a) a system with temperature gradient as driving force and
    b) chemical reactions.

25. Derive Gibbs-Duhem-Margules equation and prove Konovalov's laws.

(15 x 2 = 30)