B.Sc. DEGREE END SEMESTER EXAMINATION : OCTOBER 2022
SEMESTER **5** : CHEMISTRY

COURSE: **19U5CRCHE07: PHYSICAL CHEMISTRY - I**

(*For Regular - 2020 Admission and Supplementary - 2019 Admission*)

Time: Three Hours   Max. Marks: 60

PART A
Answer All the questions (1 mark each)

1. What is the change in internal energy when an ideal gas expands isothermally?
2. State whether entropy increases or decreases during the following changes (a) dissolution of sugar in water (b) Sublimation of iodine.
3. What is the work done during the free expansion of one mole of an ideal gas at 300 K to twice its original volume?
4. How entropy of fusion of a substance related to its enthalpy of fusion?
5. Mention any one application of Gibbs-Helmholtz equation.
6. How is standard free energy change related to equilibrium constant?
7. What is meant by optimum temperature of an enzyme?
8. What is the variance of an equilibrium system of two immiscible liquids in contact with vapour?

(1 × 8 = 8)

PART B
Answer any 6 (2 marks each)

9. What is the difference between exact and inexact differential in thermodynamics?
10. How does chemical potential vary with temperature and pressure?
11. K_p for the reaction at 298K is $N_2O_2 \rightleftharpoons 2NO_2$ is 1.4×10^{-1}. Calculate ΔG^0 for the reaction.
12. Give an example for a fractional order reaction and state its order.
13. What is meant by steady state approximation?
14. The rate constant of a first order reaction is 7×10^{-4} s^{-1}. What is the time taken for the reactant to be reduced to one-fourth of the initial concentration?
15. Determine the number of components and variance of the following system
    ice $\rightleftharpoons$ water $\rightleftharpoons$ water vapour
16. Represent clausius clapeyron equation and give 2 applications.

(2 × 6 = 12)

PART C
Answer any 4 (5 marks each)

17. (a)Calculate the entropy change involved in raising the temperature of 1 mole of helium gas from 298 K to 1000 K at constant pressure. Assume that the gas is ideal and C_V= 1.5 R.
    (b) Calculate the work of reversible expansion of 2 moles of ideal gas at 273 K from 3.25 to 22.5 L.

18. Show that q_V = ΔU and q_P= ΔH.

19. Derive an expression connecting *Joule-Thomson coefficient* and *inversion temperature* with *van der Waals constants*.

20. Explain the term chemical potential. Derive the value of chemical potential of a mixture of ideal gases.

21. Explain the term *parallel reaction* with suitable examples.

22. Discuss the *Lindemann theory* of unimolecular reaction.

(5 × 4 = 20)

PART D
Answer any 2 (10 marks each)

23. Describe the Carnot's cycle and derive an expression for the efficiency of a heat engine.

24. (a) Derive Gibbs-Duhem equation. What is the relevance of this equation.
    (b) Explain the free energy criteria for (i) a spontaneous change and (ii) an equilibrium state.

25. Draw and explain the labelled phase diagram of the Sulphur system and indicate the invariant point in it.

26. (a) Explain the influence of temperature on reaction rate.
    (b) The activation energy for a reaction is 94.14 kJ/mol and the value of rate constant at 313 K is 1.8×10^{-5} s^{-1}. Calculate the frequency factor A.

(10 × 2 = 20)

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