Reg. No ..... Name **24U542**

B.Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2024

SEMESTER 5 : CHEMISTRY

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

(For Regular 2022 Admission and Supplementary 2021/ 2020 / 2019 Admissions)

Time : Three Hours Max. Marks: 60

PART A

Answer All (1 mark each)

1. Mention the conditions at which the efficiency of a heat engine can be 1.
2. Define residual entropy of a system.
3. Define activity of a substance.
4. For a reaction of the type A + B + C going to product, the following observations are made: Doubling the concentration of A doubles the rate, doubling concentration of B has no effect on the rate, and tripling the concentration of C increases the rate by a factor of 9. What is the rate law for the reaction?
5. F=3-P is the phase rule for ----- component system.
6. What are spontaneous process?
7. Give an expression relating ΔH and ΔU of a process taking place at constant pressure.
8. What will be the sign of Joule-Thomson coefficient of a gas when cooling is observed by Joule-Thomson expansion?

(1 x 8 = 8)

PART B

Answer any 6 (2 marks each)

9. Explain why a function '*F*' can be called a state function, if *dF* is an exact differential.
10. Explain the reason for Joule-Thomson cooling in real gases.
11. Obtain an expression for work done in an expansion process against a constant external pressure.
12. State Gibbs phase rule. State the number of (a) components, and (b) phases in the following systems :
    (i) Water in a beaker at room temperature.
    (ii) Solution of sugar in a beaker at room temperature.
13. Calculate the Gibbs free energy change accompanying the expansion of 3 moles of an ideal gas at 25 ^{0}C from 100 L to 300 L.
14. Show that $dA = -PdV - SdT$.
15. General phase rule and reduced phase rule are used to deal with gaseous systems and condensed systems respectively. Justify.
16. Represent Carnot's cycle on a P-V diagram.

(2 x 6 = 12)

PART C
Answer any 4 (5 marks each)

17. Prove that the entropy criteria of the universe for reversible and irreversible processes is $\Delta S_{universe} \geq 0$.
18. One mole of an ideal gas at 273 K and 1 atm undergoes reversible isothermal expansion by absorbing 4 kJ of heat. Calculate its final volume.
19. Discuss in details the factors which influence the rate of reactions. Explain the role of catalyst in detail for determining the rate of reaction.
20. State Hess's law and illustrate it with an example.
21. The enthalpy of formation of $CO_2(g)$, $H_2O(l)$ and $CH_4(g)$ are -393.5, -285.8 and -74.8 kJ mol^{-1} respectively. Calculate the enthalpy of combustion of methane.
22. Calculate the entropy change involved when 2 moles of an ideal gas expands reversibly and isothermally from 0.05 m^3 to 0.5 m^3 at 300K.

(5 x 4 = 20)

PART D
Answer any 2 (10 marks each)

23. Bring out clearly the main features of the collision theory of reaction rates. How do you correlate Arrhenius equation and collision theory? Explain the limitations of collision theory.
24. a) Obtain an expression for the efficiency of a heat engine.
    b) Calculate the amount of heat supplied to a Carnot's engine working between 373 K and 293 K, if the maximum work derived from the engine is 900 J
25. Derive expressions that show temperature-volume & pressure-temperature relationships in a reversible adiabatic expansion of one mole of an ideal gas.
26. State and explain phase rule. Draw and explain the phase diagram for lead-silver system. Discuss the practical application of this phase diagram.

(10 x 2 = 20)