BACHELOR'S DEGREE (C.B.C.S) EXAMINATION, MARCH 2024
2021 ADMISSIONS REGULAR
SEMESTER VI - CORE COURSE (CHEMISTRY)
CH6B11B18 - Physical Chemistry – III

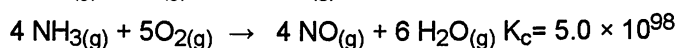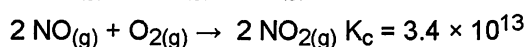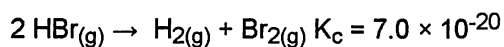**Time : 3 Hours**   **Maximum Marks : 60**

Part A

I. Answer any Ten questions. Each question carries 1 mark   **(10x1=10)**

1. Name the property of the universe that always increases in the course of every spontaneous change.

2. Heat capacity is a state function. State true or false.

3. Relate entropy to thermodynamic probability using a suitable equation.

4. Predict whether it is possible to liquefy an ideal gas by Joule Thomson effect.

5. State Ostwald's dilution law.

6. Predict which of the following reactions will proceed farthest towards completion.

$$2\,HBr_{(g)} \rightarrow H_{2(g)} + Br_{2(g)} \quad K_c = 7.0 \times 10^{-20}$$

$$2\,NO_{(g)} + O_{2(g)} \rightarrow 2\,NO_{2(g)} \quad K_c = 3.4 \times 10^{13}$$

$$4\,NH_{3(g)} + 5O_{2(g)} \rightarrow 4\,NO_{(g)} + 6\,H_2O_{(g)} \quad K_c = 5.0 \times 10^{98}$$

7. Write the limitations of Ostwald's dilution law.

8. Calculate the maximum number of phases that can co-exist in equilibrium in (a) a one-component system and (b) two component system.

9. Determine the number of phases, number of components and variance of the system in equilibrium:
$$NH_4Cl_{(s)} \Leftrightarrow NH_{3(g)} + HCl_{(g)}$$

10. Explain the condensed system involved in phase equilibria.

11. Define half-life period of a reaction.

12. Calculate the time for half -life change of a first order reaction of rate constant 0.078 hr^{-1}.

Part B

II. Answer any Six questions. Each question carries 5 marks   **(6x5=30)**

13. Describe the relation between T and P in a reversible adiabatic expansion of an ideal gas by deriving an equation.

14. Write down the expression for the Joule Thomson coefficient for a real gas. Illustrate how its sign change affects the temperature of the gas during Joule Thomson expansion.

15. Explain why N_2 gets cooled when it undergoes adiabatic expansion through a porous plug at room temperature while H_2 gets warmed under the same conditions.

16. Joule Thomson expansion is an isoenthalpic process. Illustrate.

17. Explain the factors that influence the relative strengths of acids and bases.

18. Explain the phase diagram using lead-silver system.

19. a) All the four phases of sulphur cannot coexist in equilibrium under any condition. Why? b) Explain the following terms i) Phase ii) Component and iii) Variance.

20. Write Arrhenius equation and explain its significance. The activation energy of a reaction is 94.14 KJ mol^{-1} at 313 K. The value of rate constant is 1.8×10^{-5} s^{-1}. Calculate the frequency factor A.

21. Discuss briefly with example a) Chain reactions and b) Consecutive reaction.

Part C

III. Answer any Two questions. Each question carries 10 marks (2x10=20)

22. Explain the following a) thermodynamic, thermal, chemical, mechanical equilibriums b) isothermal, adiabatic, isobaric and isochoric processes.

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

24. a) Explain Buffer action and its applications. (b) Calculate K_c and K_x for the decomposition of N_2O_4 to NO_2 for which K_p is 0.157 atm at 27 °C and 1 atm pressure.

25. Discuss the integrated rate equation for second order reaction when the two reactants have different initial concentrations with graphical representation.