12/12/2024 (E)

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B.A./B.Sc. (General) 3rd Semester

(2124)

CHEMISTRY

Paper—XI : (Physical Chemistry-A)

(Same for B.Sc. Microbial & Food Technology)

Time Allowed : Three Hours] **[Maximum Marks : 22**

Note :— (1) The students are required to attempt **FIVE** questions in all, **ONE** question from each Section and the compulsory question.

(2) Compulsory question carries **6** marks and remaining all questions carry **4** marks each.

SECTION—A

1. (a) What are Intermolecular Forces ? Briefly describe the three types of Intermolecular Forces. Give one example of each type.

   (b) Describe the application of Liquid Crystals in Electronic Industry. What types of Liquid Crystals are used ?

2. (a) What are Liquid Crystals ? Briefly describe the different types of Liquid Crystals.

   (b) Write a short note on "Thermography".

SECTION—B

3. (a) Write expressions for equilibrium constant (in terms of K_p and K_c) for the following reactions :

(i) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(ii) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(b) In a reaction between H_2 and I_2 at a certain temperature, the amounts of H_2, I_2 and HI at equilibrium were found to be 0.45 mole, 0.39 mole and 3.0 moles respectively. Calculate the equilibrium constant for the reaction at the given temperature.

4. (a) With the help of Le-Chatelier Principle, explain the effect of temperature and pressure on the solubility of gases in liquids.

(b) The value of equilibrium constant K_p for the reaction $N_2O_4 \rightleftharpoons 2NO_2$ at 25 °C is 0.14. Calculate standard free energy change ΔG° for the reaction.

SECTION—C

5. (a) Derive an expression for the calculation of the entropy change of an ideal gas when the temperature changes from T_1 to T_2 and volume changes from V_1 to V_2.

(b) Calculate the maximum efficiency of a steam engine operating between 110°C and 25°C. What would be the efficiency of the engine if the boiler temperature is raised to 140°C, the temperature of the sink remaining same ?

6. (a) Derive an expression for entropy change on mixing of ideal gases. From the expression, explain the effect of temperature on entropy change of mixing.

(b) Calculate the entropy change when one mole of hydrogen is mixed with two moles of oxygen at room temperature, assuming that the gases behave ideally.

SECTION—D

7. (a) State 'Third Law of Thermodynamics'. How does this law help in determination of absolute entropies of chemical compounds at any desired temperature ?

(b) Derive thermodynamically the relationships :

$$\Delta G = RT\ln\frac{P_2}{P_1} = RT\ln\frac{V_1}{V_2}$$

8. (a) What is residual entropy ? How the concept of residual entropy originated ? How can it be calculated ?

(b) Prove that :

$$\left(\frac{\partial U}{\partial S}\right)_V = T \text{ and } \left(\frac{\partial U}{\partial V}\right)_S = -P.$$

SECTION—E (Compulsory)

9. (a) Define Nemectic Liquid Crystals. Give one example.

(b) State Law of Mass Action.

(c) What are the limitations of first law of Thermodynamics and why there is need of second law of Thermodynamics ?

(d) What is the significance of work function and Gibb's free energy ?

(e) State Le-Chatelier's Principle. What is the effect of addition of inert gas at the Equilibrium ?

(f) State Carnot Theorem.