Exam. Code : 103203
Subject Code : 1310

B.A./B.Sc. 3rd Semester

CHEMISTRY

(Physical Chemistry–B)

Time Allowed—3 Hours] [Maximum Marks—35

Note :— Part–A : All questions are compulsory. Each question carries **1** mark.

Part–B : Attempt **SIX** questions in all, selecting **TWO** questions from each section. Each question carries **4½** marks. Log Tables may be asked for.

PART—A

All questions are compulsory.

1. Differentiate between intensive and extensive properties.
2. Enlist limitations of the classical thermodynamics.
3. State third law of thermodynamics. Is this law applicable to supercooled liquids ?
4. Mention important characteristics of chemical equilibrium.
5. Write down Kirchhoff's equation and mention its significance.

6. Chemical equilibrium is also called dynamic equilibrium. Comment on this statement.

7. What are the merits of steam distillation over other methods of distillation ?

8. Calculate the efficiency of an engine operating between 55°C and the boiling point of water. 8×1

PART—B

*Attempt **SIX** questions in all, selecting **TWO** questions from each section. Each question carries **4½** marks.*

SECTION—I

9. (a) For an ideal gas, show that PV^r = Constant.

   (b) Show that Joule-Thomson coefficient for an ideal gas is zero. 2½,2

10. (a) Calculate the bond enthalpy of HCl(g). Given that the bond enthalpies of H_2 and Cl_2 as 430 and 242 kJ mol^{-1} respectively and $\Delta H°f$ for HCl as –91 kJ mol^{-1}.

    (b) Show that for an ideal gas, dw is not an exact differential. 2½,2

11. Five moles of an ideal gas expand reversibly and isothermally at 27°C from a volume of 0.5 dm^3 to 1.5 dm^3. Calculate q, w, ΔU and ΔH for the process. ($R = 8.314$ J K^{-1} mol^{-1}) 4½

SECTION—II

12. (a) State and explain Carnot's theorem. What are the consequences of this theorem ?

(b) Heat supplied to a Carnot engine is 454 k cal. How much useful work can be done by the engine between 0°C and 100°C ? 3,1½

13. (a) Deduce the following relationships :

(i) $\left(\frac{\partial G/T}{\partial T}\right)_P = -\frac{H}{T^2}$

(ii) $\left(\frac{\partial A/T}{\partial T}\right)_V = -\frac{E}{T^2}$

(b) At N.T.P., 2.8 litres of oxygen were mixed with 19.6 litres of hydrogen. Calculate the increase in entropy. ($R = 8.314\ J\ K^{-1}\ mol^{-1}$) 2,2½

14. (a) Taking entropy as a function of V and T, show that :

$$\left(\frac{\partial S}{\partial V}\right)_T = \frac{R}{V}.$$

(b) How will you determine the absolute entropies of gases and liquids by means of third law of thermodynamics ? 2,2½

SECTION—III

15. Sketch and explain the phase diagrams of the following systems :

    (a) Water

    (b) Sulphur. 2,2½

16. Derive Clausius-Clapeyron equation and discuss its applications. 4½

17. (a) Give thermodynamic derivation of law of mass action.

    (b) Explain the phase diagrams of compounds involving congruent and incongruent melting points. 1½,3