Roll No. 2131123000080 Exam Code : J-22

Subject Code—56815

B.Sc. EXAMINATION

(Main & Reappear) (Batch 2018 Onwards)

(Second Semester)

CHEMISTRY-PHYSICAL-CHEMISTRY—I

CCL-204

Chemical Energetics and Equilibria

Time : 3 *Hours* *Maximum Marks :* 80

Note : Q. No. **1** is compulsory. Out of remaining eight questions (divided in 4 Units), attempt *four* questions by selecting Either *one* question from each Unit Or by selecting *two* questions from any one Unit and remaining *two* questions from two different Units out of remaining three Units.

(Compulsory Question)

1. (a) Distinguish between state function and path function. 2

(b) Derive the relationship between heat of reaction at constant pressure and constant volume. 2

(c) What is common ion effect ? 2

(d) State the law of mass action. 2

(e) Explain the term solubility product. 2

(f) Derive the relationship between K_p and K_c. 2

(g) Calculate the enthalpy change for the reaction, $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$. Given that bond energies of H–H, Br–Br and H–Br are 437, 194 and 366 kJ mol^{-1} respectively. 2

Unit I

2. (a) Describe the Carnot cycle and prove that maximum work can be obtained from a heat engine working in reversible conditions. 6

(b) Calculate ΔU° at 298 K for the reaction C (graphite) + $H_2O(g) \rightarrow CO_2(g) + H_2(g)$. Given that standard enthalpies of formation of $H_2O(g)$ and $CO_2(g)$ are -241.8 kJ and -110.5 kJ respectively. 4

(c) Derive Gibbs Helmholtz equation. 6

3. (a) What is the Nernst Heat Theorem. How does it lead to third law of thermodynamics. 8

(b) State first law of thermodynamics. Give its mathematical expression. 6

(c) Derive the relationship between ΔH and ΔU. 2

Unit II

4. (a) Derive the thermodynamic derivation of law of chemical equilibrium. 8

(b) Derive the Gibbs-Duhem equation. 4

(c) Explain the chemical potential. 4

5. (a) Derive the Clausius-Clapeyron equation. 8

(b) Water boils at 373 K at 1 atm pressure. At what temperature will it boil when atmospheric pressure becomes 528 mm of Hg. 4

(c) What are different types of equilibrium constants, define them ? Also, give their units. 4

Unit III

6. (a) Write short notes on the following : 8

(i) Ionic product of water

(ii) Degree of hydrolysis.

(b) Calculate degree of ionization of 0.01 M HCN solution. The dissociation constant of HCN is 4.8×10^{-10}. Also calculate the hydronium ion concentration of solution. 4

(c) What is dissociation constant of an acid ? How is it related to the strength of acid ? 4

7. (a) Calculate the degree of ionization of 0.05 M CH_3COOH if its pKa is 4.74. What would be its degree of ionization if the solution also contains 0.01 M HCl. 6

(b) Explain the following terms : 6

(i) Dissociation constant of acids

(ii) pH.

(c) Briefly describe the Bronsted-Lowry concept of acid and bases. 4

Unit IV

8. (a) Calculate the pH of 10^{-8} M HCl. 4

(b) Define the term hydrolysis constant and degree of hydrolysis of a salt. Derive an expression for degree of hydrolysis of : 8

(i) Weak acid and strong base

(ii) Weak base and strong acid.

(c) How many grams of potassium bromide (KBr) to be added to 1 litre of 0.05 M solution of $AgNO_3$ just to start the precipitation of AgBr ? 4

9. (a) What are buffer solutions ? Describe buffer action of acidic and basic buffer. What is buffer capacity ? 8

(b) Solubility of SrF_2 in water is 1.2×10^{-2} g/L. Calculate the solubility product of the salt at room temperature. (MW of $SrF_2 = 125.6$) 4

(c) Write the solubility product expression for the following salts : 4

(i) $Ca_3(PO_4)_2$

(ii) $Fe(OH)_3$

(iii) $PbSO_4$

(iv) Ag_2CrO_4