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B.Sc. (LS) IV SEMESTER

Chemistry IV Physical Chemistry for the Biosciences (BLS–403)

Time : 3 Hours]

[Maximum Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any **four** questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART–A

1. (a) Calculate the ionic product of water at 298 K. (1.5)

   (b) Define differential enthalpies of solution and dilution. (1.5)

   (c) Calculate pH of 0.4 M H_2SO_4 solution. (1.5)

   (d) Derive the relation between Kp and Kc for ideal gases. (1.5)

   (e) Explain Faraday's second law of electrolysis. (1.5)

   (f) Write the differences between photochemical and thermal reactions. (1.5)

(g) Calculate the residual entropy of CO at 0°C. (1.5)

(h) Explain the common ion effect with an example. (1.5)

(i) Explain quantum yields for photochemical reactions. (1.5)

(j) Explain buffer action and buffer range. (1.5)

PART–B

2. (a) Discuss the significance of Gibbs free energy. State and explain the effect of changes in concentration, pressure, temperature and addition of an ideal at equilibrium according to Le Chatelier's principle with suitable examples. (10)

(b) Discuss the variation of the enthalpy of a reaction with temperature. (5)

3. (a) Define solubility and ionic product of a sparingly soluble salt. Derive the relation between solubility and solubility product (Ksp) for AB_3 and AB_4 type salt. (5)

(b) What do you mean by elementary reaction? Derive the integrated rate equations for zero-order and first-order reactions and write their general characteristics. (10)

4. (a) Discuss and derive the Michaelis-Menten theory of enzyme catalysis. (10)

(b) Calculate the enthalpy change for the reaction:

$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$. Given that bond energies (KJ/mol) : C–H = 413, Cl–Cl = 243, C–Cl = 338, H–Cl = 431. (5)

5. (a) Derive expressions for degree of hydrolysis, hydrolysis constant, and pH for salts of weak acid & strong base. (5)

(b) State Grotthuss-Draper law. Discuss the radiative and non-radiative transitions using Jablonski diagram. (10)

6. (a) Discuss the variations of conductivity with concentration. Calculate the degree of ionization for a weak electrolyte having molar conductivity 60 Scm^2/mol and limiting molar conductivity 500 Scm^2/mol. (5)

(b) Derive the Nernst equation for an electrochemical cell. Discuss its applications in calculating pH, the equilibrium constant (K), and the solubility product (Ksp). (10)

7. Explain the following :

(i) Stark-Einstein law of photochemistry.

(ii) Arrhenius equation.

(iii) Standard enthalpies of formation and resonance energy.

(iv) Kohlrausch's Law.

(v) Primary and secondary processes in photochemical reactions. (15)
