2021

BIOCHEMISTRY — HONOURS

First Paper

(Module - I)

Full Marks : 50

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer **question no. 1** and **three** other questions, taking **one** from each unit.

1. Answer **any ten** questions from the following :   2×10

   (a) Differentiate between bonding and antibonding molecular orbitals.

   (b) How many radial and angular nodes are there for s orbital of the nth principal level?

   (c) Dipole moment of NH_3 is greater than that of NF_3, though dipole moment of N–H bond is less than that of N–F bond. — Explain.

   (d) NH_4Cl in aqueous solution is acidic— explain.

   (e) A solution of $K_2Cr_2O_7$ is used as a primary standard but that of $KMnO_4$ is not— explain.

   (f) Water shows rise in a capillary tube, but liquid Hg shows opposite behaviour when capillary tube is dipped in the respective solution— explain.

   (g) A mixture of CH_3COOH and CH_3COONa acts as a buffer— explain.

   (h) $\overset{\circ}{\Lambda}_{NH_4OH} > \overset{\circ}{\Lambda}_{NH_4Cl}$, though NH_4OH is a weak electrolyte (symbols have usual meanings).

   (i) Water is a covalent compound, yet it dissolves in a large number of ionic solids— explain.

   (j) Draw the plot of [Concentration] against time (t) and also 'Rate' against time (t) for a zero order reaction.

   (k) Calculate $[H_3O^+]$ and $[OH^-]$ concentration of human blood having pH 7·4.

   (l) Using molecular orbital (MO) theory, explain why He_2 molecule does not exist.

   (m) Equivalent conductance at infinite dilution for HCl, NaCl and CH_3COONa are 462·2, 126·5 and 91·0 Scm^2geqv^{-1}, respectively at 25ºC. Find out the equivalent conductance at infinite dilution for CH_3COOH.

   (n) What do you mean by 'steady state approximation'? Why it is useful, and what is its condition?

Please Turn Over

Unit - I

2. (a) State Hund's rule of maximum multiplicity, hence explain why configuration with half-filled and completely filled orbitals have greater stability.

    (b) How does lattice energy of an ionic solid depend on charge of the constituent ions and their size?

    (c) Calculate Bohr radius of 2nd orbit of H atom, given that 1st orbit is 0.53 Å. Also write down expression of angular momentum of electron moving in the 2nd orbit by Bohr Model.   4+3+3

3. (a) Draw the qualitative molecular orbital energy level diagram with proper labelling for O_2 molecule. Comment on its bond order and magnetic property.

    (b) What is ambidentate ligand? Explain with an example.

    (c) (i) When $[Co(NH_3)_6]Cl_3$ is dissolved in water, what ions are formed?

       (ii) Give IUPAC names of the following compounds :

          $Pt\,Cl_2(NH_3)_2$, $K_2[NiCl_4]$.   4+2+(2+2)

Unit - II

4. (a) How does viscosity of a liquid vary with temperature?

    (b) Graphically represent the variation of surface tension (γ) of a liquid with temperature (T). Explain significance of the point on the graph at critical temperature.

    (c) In measurement of viscosity by Ostwald's viscometer, water takes 580s to flow through a given volume, while an organic liquid takes 395s to flow through the same volume. Calculate viscosity co-efficient of the organic liquid from given data : $d_{H_2O} = 0.9984\,\mathrm{gcm^{-3}}$ $d_{org.liq} = 0.7867\,\mathrm{gcm^{-3}}$, $\eta_{H_2O} = 1.01$ centipoise.

    (d) Discuss the term 'solubility product' of a sparingly soluble salt. If 0.1 M KCl is added to AgCl solution, find out the solubility of AgCl in the solution at 300 K.

      [Given $S_{AgCl} = 10^{-5}$M at 300 K.]   2+2+3+3

5. (a) If a solution of pH = 2 is mixed with an equal volume pH = 5, what will be the pH of the resulting solution?

    (b) Find out the relation between K_p and K_c for the following reaction :

$$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g).$$

    (c) In the above reaction, if the equilibrium partial pressures of the gases are

      $p(CO) = 0.4$ atm, $p(CO_2) = 0.6$ atm, $p(O_2) = 0.2$ atm at 3000 K, calculate K_p of the reaction.

    (d) When CH_3COOH is added to water, write down the equilibrium that exists. Why is it called ionic equilibrium?   2+2+4+2

Unit - III

6. (a) Define equivalent conductance (Λ). Λ decreases with increasing concentration (C) but decreases differently for different electrolytes. Explain and give suitable diagrams to support your answer.

   (b) Give the construction of glass electrode. Give expression for the electrode potential of the glass electrode.

   (c) Draw the conductometric titration curves of CH_3COOH with NaOH with explanation of the regions.

   4+3+3

7. (a) In a multistep reaction, what would be rate limiting step of the reaction? Explain with example.

   (b) The rate constant of a reaction is $3 \cdot 46 \times 10^{-2} S^{-1}$ at 298 K. What is the rate constant at 350 K if the activation energy for the reaction is $50 \cdot 2$ kJ/mol? Can you identify what is the order of the reaction?

   (c) Do enzymes affect the biochemical reaction equilibrium? Justify your answer with mentioning its role in biochemical reaction.

   (d) State Langmuir adsorption isotherm explaining the terms involved therein.   2+4+2+2