B.Sc. 4th Semester New Scheme Examination, May–2016

BIOTECHNOLOGY

Paper–BT–405

Physical Chemistry

Time allowed : 3 hours]   [Maximum marks : 40

Note : *Attempt five questions in all, selecting **one** question from each section. **Question No. 1 is compulsory.***

1.   (i)   Explain residual entropy.

    (ii)   How can the efficiency of Carnot engine be increased ?

    (iii)   Give the units of entropy. *Joules per kelvin (JK^{-1})*

    (iv)   Define standard electrode potential.

    (v)   Why KCl is not used in the salt bridge in case of Cu-Ag cell ?

    (vi)   Define Activity coefficient.

    (vii)   Give the cell reaction occuring in weston standard cell.

    (viii)   Give the physical significance of work. 1×8

Section–I

2.   (a)   What are the limitations of first law of thermodynamics ? How have these been overcome by the second law of Thermodynamics ?   4

    (b)   Show that the efficiency of reversible Carnot cycle is $\dfrac{T_2 - T_1}{T_2}$, where T_2 and T_1 are the temperature of source and sink.   4

3. (a) Derive that for an ideal gas

$$\Delta S = C_x \, \ell n \, \frac{T_2}{T_1} + R \, \ell n \, \frac{P_1}{P_2}$$ 4

(b) One mole of helium gas is heated from a temperature of 300 K to 600 K. Calculate the entropy change if

(i) Volume is kept constant

(ii) Pressure is kept constant 4

Section–II

4. (a) Explain the terms 'free energy' and 'Maximum work function'. Derive the relationship between the two. Under what conditions ΔG becomes equal to ΔA? 5

(b) State and explain 'Nernst Heat Theorem'. 3

5. (a) Show that $\Delta G \leq 0$ is a criterion of spontaneity and equilibrium. 4

(b) State 'third law of thermodynamics'. How does third law help in the determination of absolute entropies of Chemical Compounds at any desired temperature. 4

Section–III

6. (a) Give the main points of difference between electrochemical and electrolytic cell. 3

(b) Define electrochemical cell. Taking a typical electrochemical cell, explain its working. 5

7. (a) Derive Nernst equation for measuring EMF of a cell. 3

(b) Describe construction and working of Hydrogen electrode. 3

(c) Can a solution of 1M $ZnSO_4$ solution be stored in a vessel made of Copper ? Given that

$$E^o_{Zn, Zn^{2+}} = 0.76V, \ E^o_{Cu^{2+}, Cu} = 0.34 \ V \qquad 2$$

Section–IV

8. (a) What are concentration cells ? How are they classified into different types ? 4

(b) Derive an expression for the EMF of a concentration cell consisting of Zinc electrodes immersed in solution containing Zn^{2+}, ions having activities a_1 and a_2. 4

9. (a) What is meant by 'Liquid Junction Potential' ? How can the liquid Junction potential be minimised ? 4

(b) Describe the construction and working of quinhydrone electrode. How is the electrode useful in determining the pH of a solution. 4