

92276

B. Sc. 4th Semester (New Scheme) Examination,
May-2017

BIOTECHNOLOGY

Paper-BT-405

Physical Chemistry

6196560

Time allowed : 3 hours]

[Maximum marks : 40

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

1. (a) Is it possible to construct a reversible heat engine of unit efficiency? Give reason for your answer. 1×8
- (b) Under what conditions electrical energy produced in a cell reaction is equal to the heat evolved in the cell reaction?
- (c) Define residual entropy.
- (d) What is overvoltage?
- (e) What is the cell reaction occurring in the Weston Standard cell?
- (f) What are the advantages of using glass electrode?
- (g) What is the relationship between entropy and disorder for a system?
- (h) Define an electrochemical cell.

92276-P-4-Q-9-(17)

P.T.O.

Section-A

2. (a) What is the purpose of Carnot theorem? Prove the theorem. How can the efficiency of Carnot engine be increased? 4
- (b) State the second law of thermodynamics. Under what conditions may heat be converted to work? 2
- (c) Show that ΔS total and ΔG criteria for a spontaneous process are equivalent to each other. 2
3. (a) Derive an expression for the calculation of the entropy change of an ideal gas when the temperature changes from T_1 to T_2 and pressure changes from P_1 to P_2 ? 4
- (b) Explain the term free energy and work function. Show that Gibbs free energy change, at constant temperature and pressure, is the measure of maximum useful work obtained from a system. 4

Section-B

4. (a) Define 'Third Law of Thermodynamics'. How does this law help in the determination of absolute entropies of chemical compounds at any desired temperature? 4
- (b) Derive thermodynamically the relationships 4

$$\Delta G = RT \ln \frac{P_2}{P_1} = RT \ln \frac{V_1}{V_2}$$

5. (a) State and explain Nernst heat theorem. How the results of Nernst heat theorem led to the enunciation of third law of thermodynamics? 4
- (b) During an isothermal reversible expansion of one mole of an ideal gas, its volume changes from 5 liters to 50 liters. The process was carried out at 57°C. Calculate the change in entropy and change in free energy of the gas. 4

Section-C

6. (a) Derive an equation to determine the pH of a solution using a quinhydrone electrode. What are the limitations of this electrode and in what pH range is it useful? 5
- (b) What is the source of energy in a galvanic cell? Give the relation between electrical energy and chemical energy. 3
7. (a) Derive Nernst equation for measuring EMF of a cell. 4
- (b) Derive expressions for ΔG , ΔH and ΔS in terms of EMF of a cell and the temperature coefficient of EMF. 4

Section-D

8. (a) Describe the potentiometric method to determine the solubility of a sparingly soluble salt. 3
- (b) What do you mean by liquid junction potential? How can the liquid junction potential be minimized? How does salt bridge eliminate junction potential? 5
9. (a) Discuss the principle underlying potentiometric titrations. Discuss the following titrations using potentiometric methods: 5
- (i) Acid base titrations;
 - (ii) Precipitation titrations.
- (b) Explain the terms-activity and activity-coefficient. How are these determined using EMF measurement? 3

$w_2 = nRT \ln \frac{V_2}{V_1}$ isothermal (1)
 (adi) $w_2 = nRT_2$ Adiabatic
 $w_3 = nRT \ln \frac{V_4}{V_3}$ isothermal
 $w_4 = nRT_3$ Adiabatic
 from
 92276 last
 $\frac{T_2}{T_1} = \frac{w_2}{w_1} = \frac{T_2}{T_1}$