Exam. Code : 107403
Subject Code : 2201

B.Sc. (Biotechnology) 3rd Semester

PHYSICAL CHEMISTRY—A

Paper—BT-1

Time Allowed—3 Hours] [Maximum Marks—40

Note :— Attempt ***all*** questions of Section-A, ***five*** questions from Section-B and ***two*** questions from Section-C. Log tables may be provided.

SECTION—A

1. Differentiate between reversible and irreversible processes.
2. Define bond dissociation energy and standard enthalpy of formation.
3. Differentiate between K_p and K_c. Give the relation between the two.
4. State and explain second law of thermodynamics.
5. What are ideal and non-ideal solutions ? Give one example for each.
6. What are isotonic solutions ?
7. Explain why the fusion curve of water has a negative slope.
8. Explain metastable equilibrium with the help of one example. 8×1=8

SECTION—B

9. Derive an expression for ΔH for the adiabatic reversible expansion of a real gas.

10. The bond enthalpies of $H_2(g)$ and $N_2(g)$ are 435.5 $kJmol^{-1}$ and 941.8 $kJmol^{-1}$ respectively. Calculate the average bond enthalpy of an N-H bond in ammonia. Standard enthalpy of formation of ammonia is equal to – 46.0 $kJmol^{-1}$.

11. State third law of thermodynamics. Discuss its application for the calculation of absolute entropies of the substances.

12. Show that for an irreversible process : $\Delta S_{system} + \Delta S_{surr.} > 0$.

13. Give a brief account of the factors affecting the solubility of a gas in liquids.

14. Write a short note on abnormal molecular weights.

15. What is Gibb's phase rule ? Give its thermodynamic derivation.

16. Explain the differences between the phase diagrams of KI – H_2O and Pb – Ag systems. 5×4=20

SECTION—C

17. (a) Explain why the work done in a reversible isothermal expansion is greater than the work done in the reversible adiabatic expansion of an ideal gas.

(b) The enthalpies of sublimation and combustion of graphite are 717 kJ $mole^{-1}$ and –394 kJ $mole^{-1}$ respectively. Calculate the dissociation enthalpy for the C=O bond. Bond enthalpy of O=O may be taken as 498 kJ mol^{-1}.

18. (a) Derive Gibb's-Helmholtz equation.

(b) One mole of an ideal gas at 27°C expands reversibly and isothermally from a volume of 2.0×10^{-2} m^3 to 4.0×10^{-2} m^3. Calculate the entropy change for the gas.

19. (a) Derive the relation $\Delta T_b = K_b m$ from thermodynamic considerations where the symbols have their usual meaning.

(b) An amount of 0.020 kg of urea is dissolved in 0.025 kg of water. Calculate the freezing point and boiling point of the solution. (K_f = 1.86; K_b = 0.52).

20. (a) Sketch and explain the phase diagram of water system.

(b) Water boils at 100°C at a pressure of one atmosphere. Calculate the vapour pressure of water at 80°C. The heat of vaporization of water is 41.6 kJ $mole^{-1}$. 2×6=12