TDC (CBCS) Even Semester Exam., 2025

CHEMISTRY

(2nd Semester)

Course No. : CHMHCC–202

(Physical Chemistry)

Full Marks : 50

Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* of the following questions :

$$2×2=4$$

(a) State and explain zeroth law of thermodynamics.

(b) Prove that $\Delta H = \Delta U + P \Delta V$.

(c) What is adiabatic flame temperature?

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2. Answer any *one* of the following questions : 6

(a) (i) Derive the mathematical statement of first law of thermodynamics. 2

(ii) Two litres of an ideal gas at a pressure of 10 atm expands isothermally at 25 °C into a vacuum until its total volume is 10 litres. How much heat is absorbed and how much work is done in the expansion? 2

(iii) State and explain Hess's law of constant heat summation. 2

(b) (i) Derive a relationship between temperature and pressure in adiabatic expansion of an ideal gas. 4

(ii) Two moles of H_2 are compressed adiabatically from STP conditions to occupy a volume of 4·48 litres. Calculate the final temperature. (γ for $H_2 = 1·41$) 2

UNIT—II

3. Answer any *two* of the following questions :

$$2 \times 2 = 4$$

(a) "Entropy of the universe is increasing." Justify the statement.

(b) What is residual entropy?

(c) Differentiate between Gibbs free energy and Helmholtz free energy.

4. Answer any *one* of the following questions :   6

(a) Derive the expression for entropy change of an ideal gas under different conditions.

(b)   (i) Establish the criteria for feasibility or spontaneity of a process in terms of G and S.   4

     (ii) Derive the Maxwell relation

$$-\left[\frac{\partial S}{\partial P}\right]_T = \left[\frac{\partial V}{\partial T}\right]_P$$

     2

UNIT—III

5. Answer any *two* of the following questions :

     2×2=4

(a) What is chemical potential?

(b) What do you mean by partial molar quantities?

(c) Write the expression for the variation of chemical potential with pressure.

6. Answer any *one* of the following questions : 6

   (a) Derive Gibbs-Duhem equation.

   (b) For a system of ideal gas, prove the relation $\mu_i = \mu_i^0 + RT \ln P_i$.

UNIT—IV

7. Answer any *two* of the following questions :

   $2 \times 2 = 4$

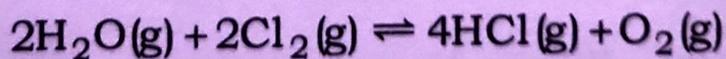   (a) What do you mean by degree of advancement of reaction?

   (b) How does equilibrium constant change with temperature?

   (c) State Le Chatelier's principle.

8. Answer any *one* of the following questions : 6

   (a) (i) Derive a relation between k_P and k_C. 4

   (ii) The value of k_P for the equilibrium

   $$2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$$

   is 0·035 atm at 400 °C when the partial pressure are expressed in atm. Calculate the value of k_C for the same reaction. 2

(Continued)

(b)   (i) Derive thermodynamically the law of chemical equilibrium.   4

(ii) What is the physical significance of fugacity?   2

UNIT—V

9. Answer any *two* of the following questions :

2×2=4

(a)   State and explain Henry's law.

(b)   What is abnormal molecular mass?

(c)   What do you mean by lowering of vapour pressure?

10. Answer any *one* of the following questions :   6

(a)   Derive thermodynamically the relation between the boiling point elevation of a solution and the mole fraction of the dissolved solute.

(b)   (i) Explain how the degree of dissociation of an electrolyte may be determined from the measurement of colligative properties.   4

(ii) Calculate the molal freezing point depression constant of water. The molar heat of fusion of ice at 0 °C is 6024·6 J.   2

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