

This question paper contains 4 printed pages]

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S. No. of Question Paper : **6012**

Unique Paper Code : **217305**

**D**

Name of the Paper : **Physical Chemistry-II (CHHT-307)**

Name of the Course : **B.Sc. (H) Chemistry**

Semester : **III**

Duration : **3 Hours**

Maximum Marks : **75**

*(Write your Roll No. on the top immediately on receipt of this question paper.)*

Answer *six* questions in all, question no. **1** is compulsory.

Draw the graphs (wherever required) on your answer sheets. Graph paper is not required.

Use of scientific calculator is permitted.

$$R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}; N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

1. Explain giving reasons (any *five*) :

- (a) Crystallization is a negative entropy process yet it occurs spontaneously.
- (b) Joule-Thomson experiment is isoenthalpic.
- (c) The magnitude of the boiling point elevation is less than that of the freezing point depression.
- (d) For mixing of two solvents to form an ideal solution,  $\Delta V_{\text{mix}} = 0$ .
- (e) Work done by the system in a reversible isothermal expansion of an ideal gas is greater than that of irreversible expansion.

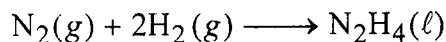
P.T.O.

- (f)  $\Delta G_{\text{System}}$  accounts automatically for entropy changes of system and surrounding ( $\Delta S_{\text{Univ}}$ ).
- (g)  $C_p$  is always greater than  $C_v$ . 5×3
2. Derive the following relations (any *three*) :
- (a)  $C_p - C_v = [(\partial E / \partial V)_T + P] (\partial V / \partial T)_P$
- (b)  $(\partial T / \partial V)_S = -(\partial P / \partial S)_V$
- (c)  $(\partial V / \partial T)_P \cdot (\partial T / \partial P)_V \cdot (\partial P / \partial V)_T + 1 = 0$
- (d)  $TV^{\gamma-1} = \text{Constant}$ . 4×3
3. (a) Deduce a relation between relative lowering of vapour pressure and depression in freezing point for a solution containing a non-volatile solute.
- (b) A solution containing 1.05 g of a substance per 100 ml was found to be isotonic with 3% Glucose solution. Calculate molecular weight of the substance.
- (c) Show mathematically that the differential heats of solution and dilution are partial molar enthalpies of solvent and solute in a solution. 4×3
4. (a) State and explain the Zeroth law of thermodynamics. Also discuss its applications.
- (b) 100 g of CO at 298 K is held by a piston under  $3 \times 10^4 \text{ Nm}^{-2}$  pressure. The pressure is suddenly released to  $1 \times 10^4 \text{ Nm}^{-2}$  and gas adiabatically expands. If CO is assumed to be ideal and  $C_v = 20.80 \text{ JK}^{-1} \text{ mol}^{-1}$ , find final temperature,  $q$ ,  $w$ ,  $\Delta E$  and  $\Delta H$  for the process.
- (c) Distinguish between bond energy and bond dissociation energy using suitable examples. How is the bond energy helpful in determining the resonance energy ? 4×3

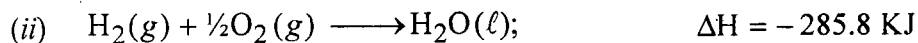
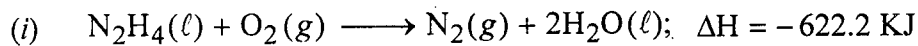
5. (a) How does statistical entropy  $S = k \ln W$  explain residual entropy ?
- (b) An ideal solution is made from mixing 5.0 mol of Benzene and 3.25 mol of Toluene. Calculate  $\Delta G_{\text{mixing}}$  and  $\Delta S_{\text{mixing}}$  at 25°C and 1 atm. pressure. Is mixing a spontaneous process ? Justify your answer.
- (c) Deduce the entropy changes of an ideal gas in reversible adiabatic and irreversible isothermal processes. Also comment on the result. 4×3

6. (a) State and explain Hess's law of constant heat summation.

Hydrazine,  $\text{N}_2\text{H}_4$ , is a colourless liquid used as a rocket fuel. What is the enthalpy change for the process in which hydrazine is formed from its elements ?



Use the following reactions and enthalpy changes :



- (b) Show that the work done in isothermal expansion of an ideal gas is more than in adiabatic expansion to same volume.
- (c) What are exact and inexact differentials ? Show that 'dw' is an inexact differential. 4×3

7. (a) Derive the relation between equilibrium constant and temperature. Comment on the result.
- (b) A mixture of 0.482 mol  $N_2$  and 0.933 mol  $O_2$  is placed in a reaction vessel of 10.0 litres and allowed to form  $N_2O$  at a temperature for which  $K_C = 2.0 \times 10^{-37}$ , what will be the composition of the equilibrium mixture ?
- (c) Show that :

$$-(\Delta H/T) dT + V dP + G'' d\xi_e = 0. \quad 4 \times 3$$

8. Write short notes on the following (any three) :

- (a) Adiabatic Flame Temperature
- (b) Coupled Reactions
- (c) Henry's law
- (d) Gibbs-Duhem equation.

4 × 3