

(d) Show that —
(i) $PV^\gamma = \text{constant}$ for an adiabatic process;

(ii) $\Delta S = C_V \ln \frac{T_2}{T_1} + nR \ln \frac{V_2}{V_1}$ for an ideal gas;

(iii) $\Delta S_{\text{mixing}} = -nR \sum x_i \ln x_i$

3+2+5=10

(e) (i) For an irreversible process show that $\Delta S_{\text{univ}} \geq 0$ 5

(ii) What is residual entropy? Explain with an example. 1+4=5

(f) (i) Show that

$$K_p = K_x(P)^{\Delta ng} = K_c(RT)^{\Delta ng}$$

(ii) What are colligative properties? Explain two practical applications of colligative properties.

Total number of printed pages-4
3 (Sem-2/CBCS) CHE HC 2
2024

CHEMISTRY (Honours Core)

Paper : CHE-HC-2026

(Physical Chemistry-II)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

- Answer the following questions: 1×7=7
 - What do you mean by thermodynamics state function?
 - Why is the first law of thermodynamics necessary?
 - What is meant by $\Delta U = -P\Delta V$?
 - Define molar heat capacity at constant volume.
 - What do you mean by available energy?
 - Write the S.I. unit of chemical potential.
 - Write the statement of second law of thermodynamics given by Kelvin-Planck.

2. Answer the following questions : $2 \times 4 = 8$
- Define thermodynamic equilibrium.
 - Show that ΔG is a measure of total non-mechanical work.
 - How does chemical potential of an ideal solution change with temperature?
 - Define state function with an example.
3. Answer **any three** from following questions : $5 \times 3 = 15$
- Derive the expression of work done in an isothermal reversible expansion of an ideal gas. 88g CO_2 gas is expanded isothermally and reversibly from 100L to 120L at 27°C . Calculate the amount of work done by the system. $3 + 2 = 5$
 - Derive Gibbs-Duhem equation for a two-component system.
 - For a cyclic process show that $\oint dS = 0$.
 - Predict the spontaneity of the following reactions : $1 \times 5 = 5$
 - $2\text{N}_2\text{O}_5(g) \rightarrow 4\text{NO}_2(g) + \text{O}_2(g)$
 - $\text{N}_2(g) + 3\text{H}_2(g) \rightarrow 2\text{NH}_3$
 - $2\text{SO}_2(g) + \text{O}_2(g) \rightarrow 2\text{SO}_3$
 - $2\text{H}_2(g) + \text{O}_2(g) \rightarrow 2\text{H}_2\text{O}(g)$
 - $2\text{HI}(g) \rightarrow \text{H}_2(g) + \text{I}_2(g)$

- What is extensive property? For 1 mole of an ideal gas show that $\bar{C}_P - \bar{C}_V = R$. $1 + 4 = 5$
4. Answer **any three** questions from the following : $10 \times 3 = 30$
- What is Joule-Thomson effect? Show that Joule-Thomson experiment is an isoenthalpic process. Define Joule-Thomson co-efficient. How can you determine Joule-Thomson co-efficient experimentally? Show that $\left(\frac{\partial H}{\partial P}\right)_T = -\mu_J C_P$. $1 + 4 + 2 + 1 + 2 = 10$
 - Derive the expression of efficiency of Carnot engine. Give the characteristics of η . Give the signs of w , ΔS and q in each step of the Carnot cycle. $5 + 2 + 3 = 10$
 - Derive Kirchhoff's equation.
 - Calculate the standard enthalpy change formation of C_2H_6 from the following data of heat of combustion : $6 + 4 = 10$

