INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI

Mid-Term 2 2022-2023

CHM202: ENERGETICS AND DYNAMICS OF CHEMICAL REACTIONS

FULL MARKS 20 **DURATION 1 HR**

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1. One mole of a gas system is changed from A ≡ (P_1, V_1) to B ≡ (P_2, V_2) by first changing pressure at constant volume and then volume at constant pressure. Show that,
   (a) $S_2 - S_1 = C_P . ln\frac{T_2}{T_1} - R . ln\frac{P_2}{P_1}$
   (b) Write the expression for the entropy-change if the process goes other way, first change in V at constant P followed by a pressure-change at constant V, and via an intermediate of I≡ (P_0, V_0).
   (c) Show from the above equation in (a), the entropy-change in adiabatic process leads to no-entropy change.

   3 + 1 + 2 = 6

2. Using Maxwell's relations, derive the Clapeyron equation. **2**

3. Depict the change in entropy and free-energy as a liquid is heated and transformed to gas in S vs T and G vs T diagrams, respectively.

   2 + 2 = 4

4. What is the absolute entropy of 1 mole of water at 346 K? [Given: $C_P^{ice} = 0.5\ cal/g.K$ and $C_P^{w} = 1.0\ cal/g.K$, L_f (at 273 K) = 80 cal/g]

   4

5. (a) Show that free-energy of mixing decreases in mixing ideal gases.
   (b) The decrease in the free-energy of mixing is largest when equimolar quantities of two components are mixed. Show in a diagram. **2+2 = 4**