Tutorial 3
CY11001

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1. Show that: $\left(\frac{\partial H}{\partial p}\right)_T = V - T\left(\frac{\partial V}{\partial T}\right)_p$
2. Show that: $\left(\frac{\partial \alpha}{\partial p}\right)_T + \left(\frac{\partial \kappa}{\partial T}\right)_p = 0$

3. The temperature dependence of the vapour pressure of solid sulphur dioxide can be approximately represented by the relation log (*p*/Torr) = 10.5916 - 1871.2/(T/K) and that of liquid sulphur dioxide by log (*p*/Torr) = 8.3186-1425.7/(T/K). Estimate the temperature and pressure of the triple point of sulphur dioxide.

4. The enthalpy of vaporization of a certain liquid is found to be 14.4 kJ/mol at 180K, its normal boiling point. The molar volumes of the liquid and the vapour at the boiling point are 115 cm^3 mol^{-1} and 14.5 dm^3 mol^{-1}, respectively. (a) Estimate *dP/dT* from the Clapeyron equation and (b) the percentage error in its value if Clausius-Clapeyron equation is used instead.

5. The enthalpy of fusion of mercury is 2.292 kJ mol^{-1} and its normal freezing point is 234.3 K with a change in molar volume of +0.517 cm^3 mol^{-1} on melting. At what temperature will the bottom of a column of mercury (density 13.6g cm^{-3}) of height 10.0 m be expected to freeze?

6. 50.0 dm^3 of dry air was slowly bubbled through a thermally insulated beaker containing 250 g of water initially at 25^0C. Calculate the final temperature. Vapour pressure of water is approximately constant at 3.17 kPa throughout, and its heat capacity is 75.5 J K^{-1} mol^{-1}. Assume that the air is not heated or cooled and that water vapour is a perfect gas.

7. What proportion of hexane and heptane should be mixed by mole fraction to achieve the greatest entropy of mixing?

8. For the equilibrium, $N_2O_4(g) \Leftrightarrow 2\ NO_2(g)$, the degree of dissociation, α at 298.15 K is 0.201 at 1.00 bar total pressure. Calculate *K*.