

CHEM F211
Problem Sheet for Assignment-3

1. The standard enthalpy of combustion at 25°C of liquid acetone $(\text{CH}_3)_2\text{CO}$ to $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$ is -1790 kJ/mol. Find $\Delta_f H^\circ_{298}$ and $\Delta_f U^\circ_{298}$ of $(\text{CH}_3)_2\text{CO}(\text{l})$.

2. For the reaction $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ in the range 298 to 900 K,

$$K_p^\circ = a(T/\text{K})^b e^{-c/(T/\text{K})}$$

where $a = 1.09 \times 10^{13}$, $b = -1.304$, and $c = 7307$. (a) Find expressions for ΔG° , ΔH° , ΔS° , and ΔC_p° as functions of T for this reaction. (b) Calculate ΔH° at 300 K and at 600 K.

3. Problem 6.32 of Levine Physical Chemistry, 6th Edition:

6.32 For the ideal-gas reaction $\text{A} + \text{B} \rightleftharpoons \text{C}$, a mixture with $n_{\text{A}} = 1.000$ mol, $n_{\text{B}} = 3.000$ mol, and $n_{\text{C}} = 2.000$ mol is at equilibrium at 300 K and 1.000 bar. Suppose the pressure is isothermally increased to 2.000 bar; find the new equilibrium amounts.

4. Problem 7.14 of Levine Physical Chemistry, 6th Edition:

7.14 Ar has normal melting and boiling points of 83.8 and 87.3 K; its triple point is at 83.8 K and 0.7 atm, and its critical temperature and pressure are 151 K and 48 atm. State whether Ar is a solid, liquid, or gas under each of the following conditions: (a) 0.9 atm and 90 K; (b) 0.7 atm and 80 K; (c) 0.8 atm and 88 K; (d) 0.8 atm and 84 K; (e) 1.2 atm and 83.5 K; (f) 1.2 atm and 86 K; (g) 0.5 atm and 84 K.

5. Problem 7.24 of Levine Physical Chemistry, 6th Edition:

7.24 The heat of fusion of Hg at its normal melting point, -38.9°C , is 2.82 cal/g. The densities of Hg(s) and Hg(l) at -38.9°C and 1 atm are 14.193 and 13.690 g/cm³, respectively. Find the melting point of Hg at (a) 100 atm; (b) 500 atm.

6. Problem 9.13 of Levine Physical Chemistry, 6th Edition:

9.13 At 25°C and 1 atm, a solution of 72.061 g of H₂O and 192.252 g of CH₃OH has a volume of 307.09 cm³. In this solution, $\bar{V}_{\text{H}_2\text{O}} = 16.488 \text{ cm}^3/\text{mol}$. Find $\bar{V}_{\text{CH}_3\text{OH}}$ in this solution.

7. Problem 9.38 of Levine Physical Chemistry, 6th Edition:

9.38 At 100°C the vapor pressures of hexane and octane are 1836 and 354 torr, respectively. A certain liquid mixture of these two compounds has a vapor pressure of 666 torr at 100°C. Find the mole fractions in the liquid mixture and in the vapor phase. Assume an ideal solution.

8. Problem 10.39 of Levine Physical Chemistry, 6th Edition:

10.39 Calculate γ_{\pm} in a 0.0200 mol/kg HCl solution in CH₃OH at 25°C and 1 atm. For CH₃OH at 25°C and 1 atm, the dielectric constant is 32.6 and the density is 0.787 g/cm³. Assume $a = 3 \text{ \AA}$.