

Worksheet #9 (Total number of points you can get is 3 pts)

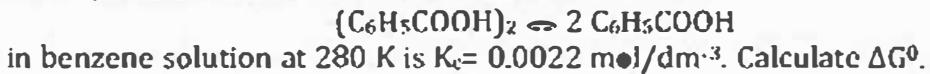
1. For a certain chemical reaction one finds an enthalpy difference $\Delta H = -150 \text{ kJ/mol}$ and an entropy difference $\Delta S = -300 \text{ J/(K mol)}$. Assume that these two values do not depend on temperature. At what temperature will be the Gibbs energy difference $\Delta G = 0$?

$$\Delta G = \Delta H - T\Delta S = 0$$

$$\Rightarrow T\Delta S = \Delta H$$

$$\Rightarrow T = \frac{\Delta H}{\Delta S} = \frac{-150 \cdot 10^3 \text{ J/mol}}{-300 \text{ J/K} \cdot \text{mol}} = 500 \text{ K}$$

2. The equilibrium constant for the reaction



$$\Delta G^\circ = -RT \ln K_c^\circ$$

$$= -83145 \cdot 280 \cdot \ln(2.2 \cdot 10^{-3}) \text{ J/mol}$$

$$= -83145 \cdot 280 \cdot (-6.193) \text{ J/mol}$$

$$= 14.25 \text{ kJ/mol}$$

The Gibbs energies of formation of A(g) and B(g) are 50 kJ/mol and

25.5 kJ/mol, respectively. The standard state is 1 bar and 300 K. Assume ideal behavior and a reaction A \rightleftharpoons 2B. Calculate the pressure where 50% of A is dissociated.

$$\Delta G^\circ = 54 \text{ kJ} - 50 \text{ kJ} = 4 \text{ kJ}$$

$$= -RT \ln K_p^\circ \Rightarrow \ln K_p^\circ = \frac{-\Delta G^\circ}{RT} = \frac{-1000 \text{ J/mol}}{8.3145 \text{ J/K} \cdot 300 \text{ K}} = 0.4009$$

$$\Rightarrow K_p^\circ = 0.67$$



$$P_A = \frac{1-\alpha}{1+\alpha} P, \quad P_B = \frac{2\alpha}{1+\alpha} P$$

$$K_p^\circ = \frac{[2\alpha/(1+\alpha)]^2}{[1-\alpha/(1+\alpha)]} = \frac{4\alpha^2}{1-\alpha^2}$$

$$\left. \begin{aligned} & P = \frac{1-\alpha}{4\alpha^2} K_p^\circ \text{ bar} \\ & \alpha = 0.5 \\ & \Rightarrow P = \frac{0.75}{1} \cdot 0.67 \text{ bar} \\ & = 0.5025 \text{ bar} \end{aligned} \right\}$$