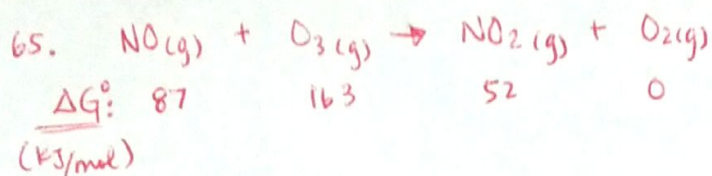


Ch. 17 # 65, 67, 69 (page 826)



$$\Delta G^\circ_{\text{rxn}} = 52 - 87 - 163 = -198 \text{ kJ/mol}$$

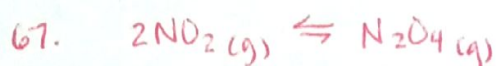
$$Q = \frac{P_{\text{NO}_2} P_{\text{O}_2}}{P_{\text{NO}} P_{\text{O}_3}} = \frac{(1.00 \times 10^{-7})(1.00 \times 10^{-3})}{(1.00 \times 10^{-6})(2.00 \times 10^{-6})} = 50$$

$$G = G^\circ + RT \ln Q$$

$$= -198 \text{ kJ/mol} + \left(8.314 \frac{\text{J}}{\text{mol K}} \right) (298 \text{ K}) (\ln 50)$$

$$= -198 \frac{\text{kJ}}{\text{mol}} + 9.69 \frac{\text{kJ}}{\text{mol}}$$

$$= -188.3 \frac{\text{kJ}}{\text{mol}} = \boxed{-188 \text{ kJ}}$$



$$\Delta G^\circ: \quad 52 \frac{\text{kJ}}{\text{mol}} \quad \quad 98 \frac{\text{kJ}}{\text{mol}}$$

$$Q = \frac{P_{\text{N}_2\text{O}_4}}{(P_{\text{NO}_2})^2}$$

$$\Delta G^\circ_{\text{rxn}} = 98 \frac{\text{kJ}}{\text{mol}} - 2\left(52 \frac{\text{kJ}}{\text{mol}}\right) = -6 \frac{\text{kJ}}{\text{mol}} = -6000 \frac{\text{J}}{\text{mol}}$$

$$\Delta G = \Delta G^\circ + RT \ln Q$$

$$\text{a) } \Delta G = -6000 \frac{\text{J}}{\text{mol}} + \left(8.314 \frac{\text{J}}{\text{mol K}} \right) (298 \text{ K}) \left(\ln \frac{1.0}{1.0^2} \right) = -6000 \frac{\text{J}}{\text{mol}}$$

$$\uparrow$$

$$Q = 1$$

$(\Delta G = \Delta G^\circ) < 0$
 forward rxn is spontaneous.

$$\text{b) } \Delta G = -6000 \frac{\text{J}}{\text{mol}} + \left(8.314 \frac{\text{J}}{\text{mol K}} \right) (298 \text{ K}) \left(\ln \frac{.50}{(.21)^2} \right) = -15.9 \frac{\text{kJ}}{\text{mol}} \approx 0 \frac{\text{kJ}}{\text{mol}}$$

$6015.9 = 6000 \text{ (s.f.)}$

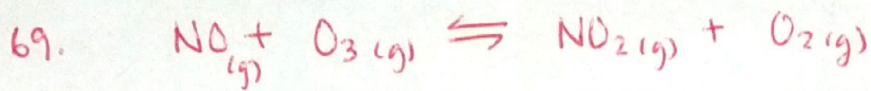
ΔG is 0

reaction is at equilibrium
 (no shift)

$$\text{c) } \Delta G = -6000 \frac{\text{J}}{\text{mol}} + \left(8.314 \frac{\text{J}}{\text{mol K}} \right) (298 \text{ K}) \ln \left(\frac{1.6}{.29^2} \right) = 1300 \frac{\text{J}}{\text{mol}}$$

ΔG is (+)

reaction shifts left to
 reach equilibrium



ΔG° : $87 \frac{\text{kJ}}{\text{mol}}$ $163 \frac{\text{kJ}}{\text{mol}}$ $52 \frac{\text{kJ}}{\text{mol}}$ 0

$$\Delta G^\circ = 52 - 87 - 163 = -198 \text{ kJ}$$

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

$$\ln K = \frac{-\Delta G^\circ}{RT} = \frac{-(-198 \text{ kJ} \times 1000 \text{ J/kJ}) \text{ mol}^{-1}}{(8.314 \frac{\text{J}}{\text{mol K}})(298 \text{ K})}$$

$\ln K = 79.912$

inverse $\ln K \rightarrow K = \boxed{5.07 \times 10^{34}}$