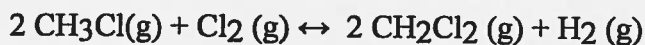


Useful Information: $\Delta G = -RT \ln K$

1. Provide the equilibrium constant expression for K_p for the following reaction. (5 pts)



$$K_p = \frac{[\text{P}_{\text{CH}_2\text{Cl}_2}]^2 (\text{P}_{\text{H}_2})}{(\text{P}_{\text{CH}_3\text{Cl}})^2 (\text{P}_{\text{Cl}_2})}$$

2. Provide the equilibrium constant expression for K for the following reaction. (5 pts)



$$K = [\text{O}_2]$$

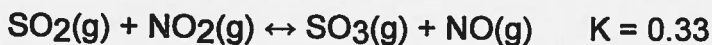
3. Determine the value of K for the following reaction if the equilibrium concentrations are as follows: $[\text{N}_2]_{\text{eq}} = 3.6 \text{ M}$, $[\text{O}_2]_{\text{eq}} = 4.1 \text{ M}$, $[\text{N}_2\text{O}]_{\text{eq}} = 3.3 \times 10^{-18} \text{ M}$. Show your work for partial credit. (10 pts)



$$K = \frac{[\text{N}_2\text{O}]^2}{[\text{N}_2]^2 [\text{O}_2]} = \frac{(3.3 \times 10^{-18})^2}{(3.6)^2 (4.1)} = 2.0 \times 10^{-37}$$

Answer: _____

4. Consider the following reaction and its equilibrium constant:



A reaction mixture contains 0.39 M SO_2 , 0.14 M NO_2 , 0.11 M SO_3 and 0.14 M NO . Which of the following statements is TRUE concerning this system? Show your method. No credit if your work isn't shown, (10 pts)

- a) The reaction will proceed in the direction of reactants.
- b) The equilibrium constant will decrease.
- c) The reaction will proceed in the direction of products.
- d) The reaction quotient will decrease.
- e) The system is at equilibrium.

$$Q = \frac{[\text{NO}]_{\text{in}} [\text{SO}_3]_{\text{in}}}{[\text{SO}_2]_{\text{in}} [\text{NO}_2]_{\text{in}}} = \frac{(0.11)(0.14)}{(0.39)(0.14)}$$

$$= 0.28$$

Reaction goes to the right

5. a) Which of the following reactions will have the largest equilibrium constant (K) at 298 K? (3 pts)

- a) $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g}) \quad \Delta G^\circ = +131.1 \text{ kJ}$
- b) $2 \text{Hg}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2 \text{HgO}(\text{s}) \quad \Delta G^\circ = -180.8 \text{ kJ}$
- c) $3 \text{O}_2(\text{g}) \rightarrow 2 \text{O}_3(\text{g}) \quad \Delta G^\circ = +326 \text{ kJ}$
- d) $\text{Fe}_2\text{O}_3(\text{s}) + 3 \text{CO}(\text{g}) \rightarrow 2 \text{Fe}(\text{s}) + 3 \text{CO}_2(\text{g}) \quad \Delta G^\circ = -28.0 \text{ kJ}$
- e) It is not possible to determine without more information.

b) Calculate the value of the equilibrium constant for the reaction you chose in part 5(a). Show your work. (7 pts)

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

$$-180.8 \text{ kJ} = -8.314 \times 10^{-3} \text{ kJ/K} (298 \text{ K}) \ln K$$
$$\ln K = 72.97$$
$$K = 4.9 \times 10^{31}$$

Answer: _____