Name_____

Equilibrium Worksheet

1. The decomposition of $CaCO_3$ is an endothermic process (you are smart enough to determine which side of the equations get the words "+ Heat" using this):

$$CaCO_3(s) \leftrightarrows CaO(s) + CO_2(g)$$

a) Use Lechâtlier's Principle to explain how an increase in temperature would affect the equilibrium (answer either shift left or shift right).

b) If more CO_2 is added to a flask in which this equilibrium exists, how is the equilibrium affected?

c) If pressure within a flask in which this equilibrium exists is increased, how is the equilibrium affected (consider the effect on the concentration of all gases present)?

2. Calculate Q and determine the direction the reaction will shift
$H_2 + F_2 \rightleftharpoons 2\ HF \quad K = 1.15 \times 10^2$

$[H_2] = .0010 \qquad [F_2] = 5.0 \times 10^{-3} \qquad [HF] = .50\ M$

$[H_2] = .020 \qquad [F_2] = 2.0 \times 10^{-3} \qquad [HF] = 5.0 \times 10^{-4}\ M$

3. The reaction below has an equilibrium constant, K, of 171 at 25°C. Using the reaction conditions given, determine the concentration of the other compound at equilibrium.

$$2\ NO_2(g) \leftrightarrows N_2O_4(g)$$

a) 2.0×10^{-2} M NO_2

b) 2.1 M N_2O_4

c) 2.0×10^{-3} mol NO_2 in a 5.0 mL flask

4. An equilibrium mixture contains 3.00 moles of carbon monoxide, 2.00 moles of chlorine gas, and 9.00 moles of $COCl_2$ gas in a 50.0 L reaction vessel at 800 K. Calculate K at this temperature. The reaction occurring is:

$$CO(g) + Cl_2(g) \leftrightarrows COCl_2(g)$$

5. At 20°C the equilibrium constant K is 1.4×10^{30}, for the reaction:

$$2NO(g) \leftrightarrows N_2(g) + O_2(g)$$

In the atmosphere at room temperature the concentration of nitrogen gas is 0.33 mol/L and the concentration of oxygen gas is 27% that value. Calculate the equilibrium concentration of nitrogen monoxide in the atmosphere.

6. Calculate the solubility and maximum concentrations of solutes in a saturated solutions for the following:

$$Ag_2CrO_4\,(s) \leftrightarrows 2\,Ag^+(aq) + CrO_4^{2-}(aq) \qquad K_{sp} = 2.0 \times 10^{-12}$$

$PbF_2(s) \leftrightarrows Pb^{2+}(aq) + 2\ F^{-}(aq)$ $\quad K_{sp} = 3.7 \times 10^{-8}$

$Zn(OH)_2(s) \leftrightarrows Zn^{2+}(aq) + 2\ OH^{-}(aq)$ $\quad K_{sp} = 5 \times 10^{-17}$