Equilibrium II

Name: _____

1. Consider the following equilibrium for which $\Delta H < 0$:

   $2SO_2(g) + O_2(g) \leftrightarrow 2SO_3(g)$

   How will each of the following changes affect an equilibrium mixture of the three gases?
   (a) $O_2(g)$ is added to the system
   (b) the reaction mixture is heated;
   (c) the volume of the reaction vessel is doubled;
   (d) a catalyst is added to the mixture;
   (e) the total pressure of the system is increased by adding a noble gas;
   (f) $SO_3(g)$ is removed from the system

2. Consider the following reaction:

$4NH_3(g) + 5O_2(g) \leftrightarrow 4NO(g) + 6H_2O(g)$ $\Delta H_{rxn} = -990$ kJ/mol

How does each of the following changes affect the yield of NO at equilibrium? Answer increase, decrease, or no change:
(a) increase $[NH_3]$; (b) increase $[H_2O]$; (c) decrease $[O_2]$
(d) decrease the volume of the container in which the reaction occurs
(e) add a catalyst (f) increase temperature

3. Methanol can be made by the reaction of carbon monoxide and hydrogen:

$CO(g) + 2H_2(g) \leftrightarrow CH_3OH(g)$

Reaction is **exothermic**

(a) Write the equilibrium expression for this equilibrium
(b) To maximize the equilibrium yield of methanol, would you use a high or low temperature? Explain.
(c) To maximize the equilibrium yield of methanol, would you use a high or low pressure? Explain.

4. For the equilibrium process:

   $2IBr(g) \leftrightarrow I_2(g) + Br_2(g)$ $K_p = 8.5 \times 10^{-3}$ at 150°C

   If 0.025atm of IBr is placed in a 2.0L container, what is the partial pressure of this substance (IBr) after equilibrium is reached?

5. At 700K the equilibrium constant for the reaction:
   $CCl_4(g) \leftrightarrow C(g) + 2Cl_2(g)$
   is $K_p = 0.76$. A flask is charged with 2.00 atm of CCl_4 which then reaches equilibrium at 700K.
   (a) What percent of the original CCl_4 is reacted when the system reaches equilibrium?
   (b) What are the partial pressures of CCl_4 and Cl_2 at equilibrium?

6. Silver chloride, AgCl(s) is an insoluble strong electrolyte (doesn't dissolve in water, and a strong electrolyte is something that completely breaks apart forming its two ions)

   (a) Write the equation for the dissolution of solid silver chloride in liquid water.
   (b) Write the expression for K_c for the reaction in part (a).
   (c) Explain how an **insoluble** solid (ionic) in water could be considered an equilibrium process