1. Write the expression for $K_c$ for each of the following equilibrium:
a) $2NO_2(g) \leftrightharpoons 2NO(g) + O_2(g)$
b) $SrCO_3(s) \leftrightharpoons SrO(s) + CO_2(g)$
c) $2HBr(g) \leftrightharpoons H_2(g) + Br_2(l)$
d) $P_4(g) + 3O_2(g) \leftrightharpoons P_4O_6(s)$
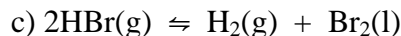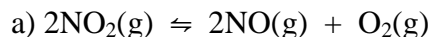
2. Given the equilibrium constants for the following reactions at a particular temperature:
$$3H_2(g) + N_2(g) \leftrightharpoons 2NH_3(g) \qquad K_c = 1.7 \times 10^{-4}$$
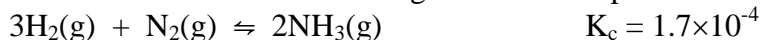
calculate the value for the equilibrium constant, $K_c$, for the following reaction
$$3/2H_2(g) + 1/2N_2(g) \leftrightharpoons NH_3(g) \qquad K_c = ?$$
at the same temperature.
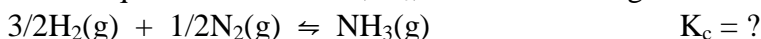
3. Initially, 0.84 moles of $PCl_5(g)$ and 0.18 moles of $PCl_3(g)$ are mixed in a 1.0 L container. It is later found that only 0.72 moles of $PCl_5$ are pressent when the system has reached equilibrium. Calculate the value of $K_c$ for the reaction
$$PCl_5(g) \leftrightharpoons PCl_3(g) + Cl_2$$

4. When 4.0 moles of $HI(g)$ are placed in a 2.0 L container at 25°C and allowed to dissociate according to the equation
$$2HI(g) \leftrightharpoons H_2(g) + I_2(g)$$
it is found that 20.% of the HI has dissociated at equilibrium. Calculate $K_c$ and $K_p$.

5. Nitrosyl bromide, $NOBr(g)$, decomposes according to the equation
$$NOBr(g) \leftrightharpoons NO(g) + 1/2Br_2(g) \qquad K_p = 0.15 \text{ at } 350°C.$$
If 1.0 atm of NOBr, 0.8 atm of NO, and 0.4 atm of $Br_2$ are mixed at 350°C, will any net reaction occur? If a net reaction is observed, will NO be formed or consumed?

6. Consider the following reaction
$$ZnS(s) \leftrightharpoons Zn^{2+}(aq) + S^{2-}(aq) \qquad K_c = 1.1 \times 10^{-21}$$
If a small amount of $ZnS(s)$ is placed in water what is the equilibrium concentrations of $Zn^{2+}$.

7. At 633°C, 3.60 moles of ammonia are placed in a 2.00 L vessel and allowed to decompose to the elements.
$$2NH_3(g) \leftrightharpoons N_2(g) + 3H_2(g) \qquad K_c = 6.56 \times 10^{-3} \text{ at } 633°C$$
Calculate the equilibrium concentration of each reagent

8. Consider the following equilibrium
$$2NOBr(g) \leftrightharpoons 2NO(g) + Br_2(g) \qquad \Delta H = -344 \text{ kJ}$$

Using LeChatelier's Principle predict the effect of the following changes on the position of the equilibrium. a) Addition of more $Br_2$. b) Removal of some NOBr. c) Increse in container volume. d) Decrease in temperature. e) Addition of a catalyst.
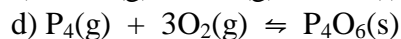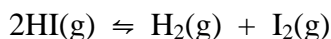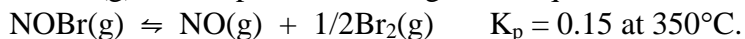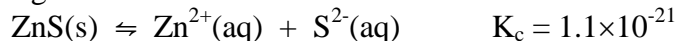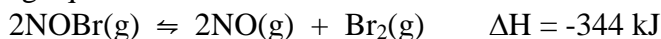
**Answer Set for Chem 1105-2015 Summer Problem Set #5**

1.

a) $K_c = \dfrac{[NO(g)]^2[O_2(g)]}{[NO_2(g)]^2}$

b) $K_c = [CO_2(g)]$

c) $K_c = \dfrac{[H_2(g)]}{[HBr(g)]^2}$

d) $K_c = \dfrac{1}{[P_4(g)][O_2(g)]^3}$

2. $K_c = 1.3 \times 10^{-2}$

3. $K_c = 0.050$

4. $K_p = K_c = 0.0156$

5. $Q = 0.5 > K_p$. Therefore, NO and and $Br_2$ are consumed and produce more NOBr.

6. $[Zn^{2+}] = 3.3 \times 10^{-11}$ M

7. $[NH_3(g)] = 1.49$ M, $[H_2(g)] = 0.459$ M, $[N_2(g)] = 0.153$ M

8.a) Equilibrium will shift to the left. b) Equilibrium will shift to the left. c) Equilibrium will shift to the right. d) Equilibrium will shift to the right. e) No affect on the position of the equilibrium. System will obtain equilibrium faster.