CHM 152 Group Work 2 Crib

1. Answer the following for the reaction of NO gas with chlorine gas to produce NOCl gas.
   a. Write out the balanced reaction, and the K_c and K_p expressions.

$2\ NO(g) + Cl_2(g) \leftrightarrows 2\ NOCl(g)$ $\quad K_c = \dfrac{[NOCl]^2}{[NO]^2\,[Cl_2]}$ $\quad K_p = \dfrac{P_{NOCl}^{\ 2}}{P_{NO}^{\ 2} P_{Cl_2}}$

   b. Calculate K_p and K_c at 25.0°C given the pressure of NO gas is 1.56 atm, chlorine gas is 0.887 atm, and NOCl gas is 3.45 atm.

$K_p = \dfrac{(3.45)^2}{\{0.887\}(1.56)^2} = 5.51398 =$ **5.51** $\quad K_c = \dfrac{5.51398}{[(.08206)(298)]^{-1}} =$ **135**

2. Phosphorus pentachloride decomposes into phosphorus trichloride and chlorine gas. What is the initial concentration of phosphorus pentachloride if at equilibrium the concentration of chlorine gas is 0.500M? Given: $K_c = 10.00$ *(Hint: ICE table)*

	PCl_5	⇆	**PCl_3**	+	**Cl_2**
I	**x**		**0**		**0**
C	**-0.500**		**+0.500**		**+0.500**
E	**(x-0.500)**		**(0.500)**		**(0.500)**

$10.00 = (0.500)^2 \ / \ (x-0.500)$
$10.00\ x - 5 = 0.25$
$x = 0.525\ M = [PCl_5]$

3. Once a system has reached equilibrium, are the following true or false?
   a. The reaction is finished, no more products are forming. __**false**__
   b. The concentrations of the reactants and the products are equal. **false**__
   c. The concentrations are no longer changing. __**true**__
   d. The reaction is not over, but will continue forever if isolated. _**true**_
   e. The speed at which products are made equals the speed at which reactants form. **true**

4. Consider this endothermic reaction: $3\ O_2(g) \leftrightarrows 2\ O_3(g)$. To shift this reaction to the reactants:
   a. You could ___ decrease ___ the pressure. (increase or decrease)
   b. You could ____ increase ___ the volume. (increase or decrease)
   c. You could ____ remove ____ oxygen gas. (add or remove)
   d. You could ___ decrease __ the temperature. (increase or decrease)

5. Calculate the equilibrium constant K_c for this unbalanced reaction: $2\ SO_3\ (g) \leftrightarrows 2\ SO_2\ (g) + O_2\ (g)$ Given: $[SO_3] = 0.0255M$, $[SO_2] = 1.08M$, and $[O_2] = 1.45M$ at equilibrium.

$K_c = \dfrac{[SO_2]^2[O_2]}{[SO_3]^2} = \dfrac{(1.08)^2(1.45)}{(.0255)^2} =$ **2.60×10^3**

6. Write the equilibrium expression K_c for the reaction between potassium phosphate and calcium nitrate in water. Show the balanced reaction.

$2\ K_3PO_4(aq) + 3\ Ca(NO_3)_2(aq) \leftrightarrows 6\ KNO_3(aq) + Ca_3(PO_4)_2(s)$

$$K_c = \frac{[KNO_3]^6}{[K_3PO_4]^2[Ca(NO_3)_2]^3} \qquad K_p = NA$$

7. A 1.000 L flask is initially filled with 1.000 mole of hydrogen gas and 2.000 moles of iodine gas at 448°C. At this temperature K_c is 50.5. Calculate the equilibrium concentrations for all the chemical species in the reaction, which is hydrogen gas and iodine gas produce HI gas.

	$H_2(g)$	+ $I_2(g)$	$\leftrightarrows$	$2\ HI(g)$
I	**1.000M**	**2.000M**		**0**
C	**-x**	**-x**		**+2x**
E	**(1.000-x)**	**(2.000-x)**		**(2x)**

$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(2x)^2}{(1.000-x)(2.000-x)} = 50.5$

$50.0(1.000-x)(2.000-x) = 50.5(2.000-3.000+x^2) = (2x)^2$

$101-151.5x + 50.5x^2 = 4x^2$

$46.5x^2 – 151.5x + 101.0 = 0$

Plug into quadratic $x = \{+151.5 +/- \sqrt{(-151.5)^2 - 4(46.5)(101.0)}\ \} / 2(46.5)$

X = 2.3231 or 0.93498 (the first gives negative concentrations so is wrong)

$[H_2] = 1.000-x = 0.065M$

$[I_2] = 2.000-x = 1.065M$

$[HI] = 2x = 1.870M$