

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.



- 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.

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

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	\rightleftharpoons	PCl_3	+	Cl_2
I	x		0		0
C	-0.500		+0.500		+0.500
E	(x-0.500)		(0.500)		(0.500)

$$10.00 = \frac{(0.500)^2}{(x-0.500)}$$

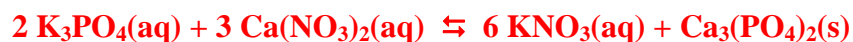
$$10.00x - 5 = 0.25$$

$$x = \mathbf{0.525 \text{ M} = [\text{PCl}_5]}$$

3. Once a system has reached equilibrium, are the following true or false?
- The reaction is finished, no more products are forming. false
 - The concentrations of the reactants and the products are equal. false
 - The concentrations are no longer changing. true
 - The reaction is not over, but will continue forever if isolated. true
 - The speed at which products are made equals the speed at which reactants form. true
4. Consider this endothermic reaction: $3 \text{O}_2\text{(g)} \rightleftharpoons 2 \text{O}_3\text{(g)}$. To shift this reaction to the reactants:
- You could decrease the pressure. (increase or decrease)
 - You could increase the volume. (increase or decrease)
 - You could remove oxygen gas. (add or remove)
 - You could decrease the temperature. (increase or decrease)
5. Calculate the equilibrium constant K_c for this unbalanced reaction: $2 \text{SO}_3\text{(g)} \rightleftharpoons 2 \text{SO}_2\text{(g)} + \text{O}_2\text{(g)}$ Given: $[\text{SO}_3] = 0.0255\text{M}$, $[\text{SO}_2] = 1.08\text{M}$, and $[\text{O}_2] = 1.45\text{M}$ at equilibrium.

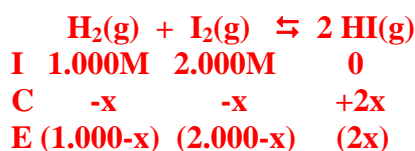
$$K_c = \frac{[\text{SO}_2]^2 [\text{O}_2]}{[\text{SO}_3]^2} = \frac{(1.08)^2 (1.45)}{(0.0255)^2} = \mathbf{2.60 \times 10^3}$$

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



$$K_c = \frac{[\text{KNO}_3]^6}{[\text{K}_3\text{PO}_4]^2[\text{Ca}(\text{NO}_3)_2]^3} \quad K_p = \text{NA}$$

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.



$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]} = \frac{(2x)^2}{(1.000 - x)(2.000 - x)} = 50.5$$

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

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

$$46.5x^2 - 151.5x + 101.0 = 0$$

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

$$X = 2.3231 \text{ or } 0.93498 \quad (\text{the first gives negative concentrations so is wrong})$$

$$[\text{H}_2] = 1.000 - x = 0.065\text{M}$$

$$[\text{I}_2] = 2.000 - x = 1.065\text{M}$$

$$[\text{HI}] = 2x = 1.870\text{M}$$