Chemical Equilibrium Review Sheet

I. Part 1 – Multiple Choice

1. This section will account for 20 points on the test and will be OPEN NOTES.
2. Have the following notes and quizzes organized, highlighted, and reviewed.
   - ***Chemical Equilibrium***
   - ***Factors Affecting Equilibrium***
   - ***Limiting Reactants & Percent Yield***

II. Part 2 – Performance Assessment

This section will account for 20 points on the test and will be CLOSED NOTES.

#1 – Equilibrium Constants

1. Write equilibrium constant expressions for these equilibria.

   a. $N_2O_4 \leftrightarrow 2NO_2$

   $$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]}$$

   b. $2H_2S \leftrightarrow 2H_2 + S_2$

   $$K_{eq} = \frac{[H_2]^2[S_2]}{[H_2S]^2}$$

   c. $CO + 3H_2 \leftrightarrow CH_4 + H_2O$

   $$K_{eq} = \frac{[CH_4][H_2O]}{[CO][H_2]^3}$$

   d. $4NH_3 + 5O_2 \leftrightarrow 4NO + 6H_2O$

   $$K_{eq} = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$$

   e. $CH_4 + 2H_2S \leftrightarrow CS_2 + 4H_2$

   $$K_{eq} = \frac{[CS_2][H_2]^4}{[CH_4][H_2S]^2}$$

2. Calculate K_{eq} for the equation, $N_2O_4 \leftrightarrow 2NO_2$, if $[N_2O_4] = 0.0185$ mol/L and $[2NO_2] = 0.0627$ mol/L.

$$K_{eq} = \frac{[NO_2]^2}{[N_2O_4]} = \frac{(0.0627)^2}{(0.0185)} = 0.213$$

3. The reaction, $COCl_2 \leftrightarrow CO + Cl_2$ reaches equilibrium at 900 K. $K_{eq} = 8.2 \times 10^{-2}$. If the equilibrium concentrations of CO and Cl_2 are 0.150 M, what is the equilibrium concentration of $COCl_2$?

(1.) $\frac{[CO][Cl_2]}{[COCl_2]} = 8.2 \times 10^{-2}$ (2.) $\frac{(0.150)(0.150)}{[COCl_2]} = 8.2 \times 10^{-2}$ (3.) $[COCl_2] = \frac{(0.150)(0.150)}{8.2 \times 10^{-2}} = 0.28\ M$

#2 - Percent Yield

1. How many grams of silver can be produced by the reaction of 5.05 grams of silver nitrate with excess copper? [$Cu + 2AgNO_3 \longrightarrow Cu(NO_3)_2 + 2Ag$]

$5.05\ g\ AgNO_3 \times \frac{1\ mol\ AgNO_3}{170\ g\ AgNO_3} \times \frac{2\ mol\ Ag}{2\ mol\ AgNO_3} \times \frac{108\ g\ Ag}{1\ mol\ Ag} = 3.21\ g\ Ag$

2. The amount of product in a given reaction turns out to be only 1.68 grams, although the theoretical amount was calculated to be 1.84 grams. What is the percentage yield?

$\frac{1.68\ g}{1.84\ g} \times 100 = 91.3\ \%$

3. In the reaction from question 1., if 0.947 grams of copper react with silver nitrate how many grams of copper II nitrate are produced?

$0.947\ g\ Cu \times \frac{1\ mol\ Cu}{63.546\ g\ Cu} \times \frac{1\ mol\ Cu(NO_3)_2}{1\ mol\ Cu} \times \frac{187.56\ g\ Cu(NO_3)_2}{1\ mol\ Cu(NO_3)_2} = 2.795\ g\ Cu(NO_3)_2$

If 1.89 grams of silver is actually produced, what is the percent yield?

$\frac{1.89\ g}{3.21\ g} \times 100 = 58.9\ \%$