There are three (3) areas of work you will complete this summer to give you a leg up on next year. They are:

1. Equilibrium
2. Acid/Base
3. Kinetics

You will:

1. Watch Videos on edpuzzle
2. Read a few pages
3. Review notes provided (these are expected to be in more detail than the assignment)
4. Complete assignment questions

In early September, we will have a test on the work above.

Equilibrium

1. There are three videos on edPuzzle:

A. Chemical Equilibria and Reaction Quotients
B. Le Chatelier's Principle
C. Practice Problem: Calculating Equilibrium Concentrations

2. Pages in textbook to read:

pp 593-626

3. Notes are in a separate document on GClass. Recall, these are more detailed notes than what you will need for the summer assignment.

4. **Questions**. Please complete all work either typed in a different colored font or handwritten with a picture INSERTED on this document.

1. What is meant when a reaction is described as "having reached equilibrium"? What does this statement mean regarding the forward and reverse reaction rates? What does this statement mean regarding the amounts or concentrations of the reactants and the products?

2. Is it correct to say that the reaction has "stopped" when it has reached equilibrium? Explain your answer and support it with a specific example.

3. If an equilibrium reaction is endothermic, what happens to the equilibrium constant if the temperature of the reaction is increased? if the temperature is decreased?

4. Industrial production of NO by the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is carried out at elevated temperatures to drive the reaction toward the formation of the product. After sufficient product has formed, the reaction mixture is quickly cooled. Why?

5. How would you differentiate between a system that has reached chemical equilibrium and one that is reacting so slowly that changes in concentration are difficult to observe?

6. What is the relationship between the equilibrium constant, the concentration of each component of the system, and the rate constants for the forward and reverse reactions?

7. Write the equilibrium constant expressions for K and K_p for each reaction:

a. $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$
b. $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$
c. $2O_3(g) \rightleftharpoons 3O_2(g)$d

8. Write the equilibrium constant expressions for K and K_p for each reaction:

a. $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$
b. $½\ H_2(g) + 12I_2 \rightleftharpoons HI(g)$

9. Why is it incorrect to state that pure liquids, pure solids, and solvents are not part of an equilibrium constant expression?

10. Write the equilibrium constant expressions for K and K_p for each reaction:

a. $2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g)$
b. $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$
c. $2ZnS(s) + 3O_2 \rightleftharpoons 2ZnO(s) + 2SO_2(g)$

Acid/Base

1. There are four videos on edPuzzle:

A. Acids and Bases, pH and pOH
B. Neutralization Reactions
C. Acid-Base Titration
D. Acid-Base Equilibria and Buffer Solutions

2. Pages in textbook to read:

pp 638-679

3. Notes are in a separate document on GClass. Recall, these are more detailed notes than what you will need for the summer assignment.

4. **Questions**. Please complete all work either typed in a different colored font or handwritten with a picture INSERTED on this document.

1. Acetic acid is the principal ingredient in vinegar; that's why it tastes sour. At equilibrium, a solution contains [CH_3CO_2H] = 0.0787 *M* and [H_3O^+] and [CH_3COO^-] = 0.00118 M. What is the value of K_a for acetic acid?

2. What is the equilibrium constant for the ionization of the HSO_4^- ion, the weak acid used in some household cleansers:

   $HSO_4^-(aq) + H_2O(l) \leftrightharpoons H_3O^+(aq) + SO_4^{2-}(aq)$

   In one mixture of $NaHSO_4$ and Na_2SO_4 at equilibrium, [H_3O^+] = 0.027 M, [HSO_4^-] = 0.29 M and [SO_4^{2-}] = 0.13 M

3. The pH of a solution of household ammonia, a 0.950-*M* solution of NH_3, is 11.612. What is K_b for NH_3?

4. Write the dissociation reaction and the corresponding K_a equilibrium expression for each of the following acids in water.

   a. HCN
   b. HOC_6H_5
   c. $C_6H_5NH_3^+$

5. For each of the following aqueous reactions, identify the acid, the base, the conjugate base, the and the conjugate acid.

a. $Al(H_2O)_6^{3+} + H_2O \leftrightharpoons H_3O^+ + Al(H_2O)_5(OH)^{2+}$
b. $H_2O + HONH_3^+ \leftrightharpoons HONH_{,2} + H_3O^+$
c. $HOCl + C_6H_5NH_2 \leftrightharpoons OCl^- + C_6H_5NH_3^+$

6. Calculate the $[H^+]$ of each of the following solutions at 25 ℃. Identify each solution as neutral, acidic or basic

a. $[OH^-] = 1.5$ M
b. $[OH^-] = 3.6 \times 10^{-15}$ M
c. $[OH^-] = 1.0 \times 10^{-7}$ M
d. $[OH^-] = 7.3 \times 10^{-4}$ M

Kinetics

1. There are two videos on edPuzzle:

A. Initial Rates and Integrated Rate Laws
B. Practice Problem: Initial Rates and Rate Laws

2. Pages in textbook to read:

pp 539-562

3. Notes are in a separate document on GClass. Recall, these are more detailed notes than what you will need for the summer assignment.

4. **Questions**. Please complete all work either typed in a different colored font or handwritten with a picture INSERTED on this document.

1. The reaction

$2I^-(aq) + S_2O_8^{2-}(aq) \rightarrow I_2(aq) + 2SO_4^{2-}(aq)$ was studied at 25 ℃. The following results were obtained where

Rate = $-\frac{\Delta[S2O8^{2-}]}{\Delta t}$

$[I^-]$ (mol/L)	$[S_2O_8^{2-}]$ (mol/L)	Initial Rate (mol/L s)
0.080	0.040	12.5×10^{-6}
0.040	0.040	6.25×10^{-6}
0.080	0.020	6.25×10^{-6}

0.032	0.040	5.00×10^{-6}
0.060	0.030	7.00×10^{-6}

a. Determine the rate law
b. Calculate a value for the rate constant for one trial above.

2. The following data were obtained for the reaction

$2ClO_2(aq) + 2OH^-(aq) \rightarrow ClO_3^-(aq) + ClO_2(aq) + H_2O(l)$

Where

Rate = $-\frac{\Delta[ClO2]}{\Delta t}$

$[ClO_2]_o$ (mol/L)	$[OH^-]$ (mol/L)	Initial Rate (mol/L s)
0.0500	0.100	5.72×10^{-2}
0.100	0.100	2.30×10^{-1}
0.100	0.0500	1.15×10^{-1}

a. Determine the rate law and the volume of the rate constant.