STRONG VERSUS WEAK ACIDS

Name:_____

Part I. Classifying Acids

Acids are often classified as strong or weak acids. What does it mean when we say that nitric acid (HNO_3) is a strong acid and that acetic acid (CH_3COOH) is a weak acid? In this investigation you will find out the answer to this question and investigate the K_a of a weak acid.

Look at the following models in the Petri dishes. Answer the questions for each acid.

Key: Blue = H^+ Other color = A^- ex: Br^-, ClO_2^-, PO_4^{3-}

Petri Dish #1 = HNO_2

a. For this acid, what does the blue bead represent?

b. What, specifically, does the colored bead represent?

c. Write the dissociation reaction for this acid.

HNO_2 ⇌ +

d. Record how many of the 10 acid molecules are whole molecules and how many acid molecules have dissociated into ions. Determine the % ionization of the acid.

whole acid: _____ # broken into ions: _____ % ionization: _____

Use the models in the remaining Petri Dishes to fill in the following tables.

	HBr	**HF**	**H_2SO_4**
Blue bead represents:			
Colored bead represents:			
# whole acid molecules			
# broken into ions			
% ionization			

Use the models in the remaining Petri Dishes to fill in the following tables.

	CH_3COOH	H_2SO_3	$HClO_4$
Blue bead represents:			
Colored bead represents:			
# whole acid molecules			
# broken into ions			
% ionization			

For each acid above, write the dissociation reaction:

a. HBr → +

b. HF ⇌ +

c. H_2SO_4‡ → +

d. CH_3COOH ⇌ +

e. H_2SO_3‡ ⇌ +

f. $HClO_4$ → +

‡ Why are there two blue beads attached to each colored bead? Do all the H^+ dissociate from the A^- ion at one time? How do you know?

Use your results to fill in the table below:

Name of acid	% ionization	Type of acid (Strong or Weak)
HNO_2		
HBr		
HF		
H_2SO_4		
CH_3COOH		
H_2SO_3		
$HClO_4$		

Part II.

Strong Acids.

Write a balanced reaction for the dissociation of nitric acid, HNO_3.

Use the equation $pH = -\log[H^+]$ to determine the $[H^+]$ of each sample. Record this value in the table below. Then complete the table.

Concentration of HNO_3	pH	$[H^+]$	$[NO_3^-]$
0.100 M	1.00		
0.0100 M	2.00		
0.00100 M	3.00		

Weak Acids.

Write a balanced reaction for the dissociation of acetic acid, CH_3COOH. Then, write the Ka expression for the dissociation of acetic acid.

Complete the table below, considering the following questions:

- How do you calculate **$[H^+]$?**
- Considering the dissociation reaction you wrote above, what is the relationship between **$[H^+]$** and **$[CH_3COO^-]$**?
- Why is the final **$[CH_3COOH]$** different than the initial concentration? How does that help you determine **$[CH_3COOH]$**?

Initial Concentration of CH_3COOH	pH	Equilibrium $[H^+]$	Equilibrium $[CH_3COO^-]$	Equilibrium $[CH_3COOH]$	K_a value
1.00 M	2.37				
0.100 M	2.87				
0.0100M	3.38				

What do you notice about the concentration of the HNO_3 and the hydrogen ion concentration? What does it mean when we say that the HNO_3 completely ionizes? What is the relationship between the hydrogen ion and nitrate ion concentration?

What do you notice about the concentration of the CH_3COOH and the hydrogen ion concentration? How do the concentrations of the hydrogen ion and acetate ion (CH_3COO^-) compare?

What Happens when Water is Added to an Acid?

Canister number _____

1. Look at the molecules/ions in the canister. Based on the ionization what type of acid is this? How do you know?

2. Place all the molecules/ions from the canister in the beaker. From the other canister, add half of the "water" beads to the beaker. By adding water, what have you done to the concentration of the acid? What type of acid is this now?

3. Add the rest of the "water" beads to the beaker. What type of acid is this now? Does this change the percent ionization of the acid?

4. Does a change in concentration affect the strength of an acid? Explain.

Part III. Wrap-Up

Answer the following questions:

1. What is the relationship between percent ionization and acid strength?

2. What is the relationship between percent ionization and acid concentration?

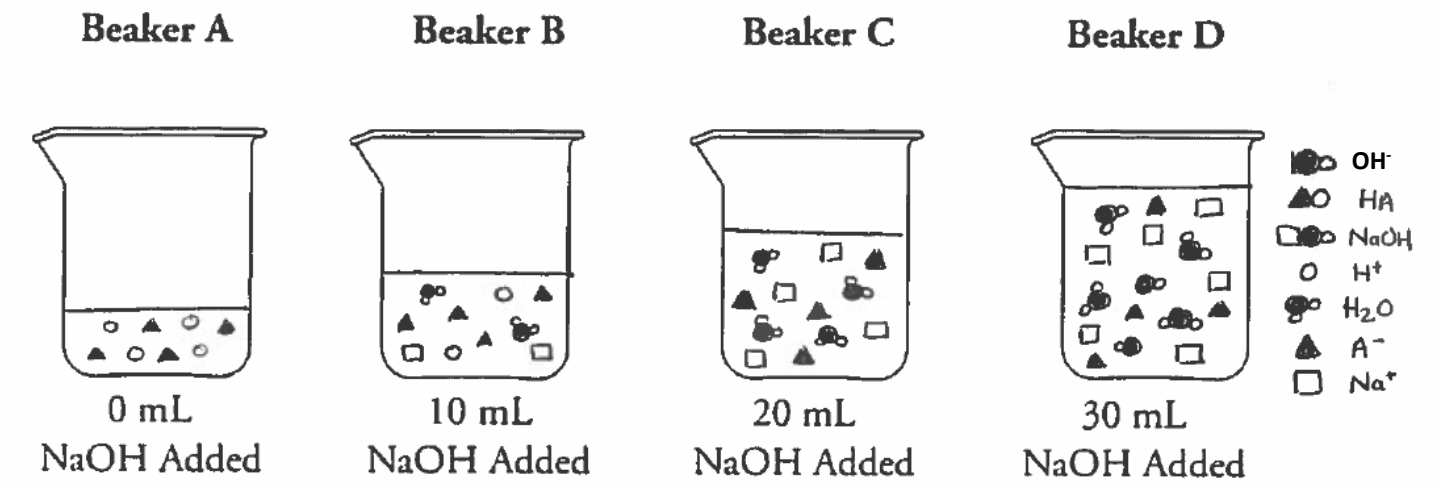
3. Why do you calculate a K_a for the acetic acid but not for the nitric acid?

4. We know that pH is a measure of acidity. If you have 0.100M solutions of a weak acid and a strong acid, which would have a lower pH? Justify your answer.

5. Will a strong acid always have a lower pH than a weak acid? Explain. (look at your data)

Part IV.

Using what you know about strong and weak acids, consider the reaction of an acid (HA) with NaOH.



Is HA a strong acid or a weak acid? What evidence do you have?

Write the chemical reaction that is occurring as NaOH is added.

For each beaker, would the solution be acidic, basic, or neutral if checked with a pH meter? Justify your answer.