Strong versus Weak Acids Name:_____

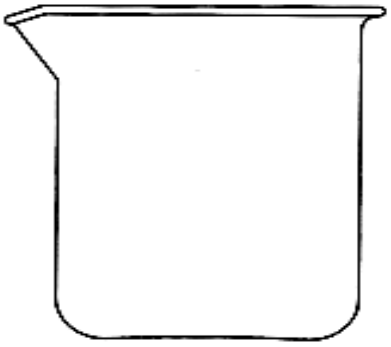
Part I. Acids are often classified as strong or weak. What does it mean when we say that nitric acid (HNO_3) is a strong acid and that acetic acid (CH_3COOH) is a weak acid? In this investigation you will find out the answer to this question.

The following website has a simulation you will use: https://phet.colorado.edu/sims/html/acid-base-solutions/latest/acid-base-solutions_en.html. Click on "My Solution".

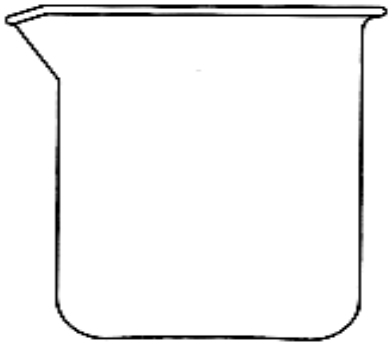
Using the simulation, look at a strong acid and a weak acid with the same concentration. In the beakers below, draw the species present in each beaker, in the approximate amounts you observe.

(Note: HA is a generic term for an acid. In this case, HA can be nitric acid or acetic acid, depending on the situation. H_3O^+ is another way to represent H^+.)

Strong Acid (HNO_3):



Weak Acid (CH_3COOH):



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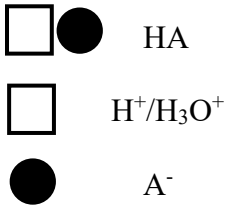


What is similar between the reaction of a strong acid with water and the weak acid with water?

What is the biggest difference between the two reactions?

Test the following properties for a 0.10 M solution of a weak acid and a strong acid. Fill in the table below.

	Weak Acid (slider left)	**Weak Acid (slider middle)**	**Strong Acid**
pH			
Conductivity			
Estimate of % ionization*			

*You can estimate % ionization by looking at the number of acid molecules that have ionized compared to the total number of acid molecules initially present in the solution using the GRAPH view.

Part II.

A. 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 acid concentration. Record the value in the table. 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		

B. 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]	$\frac{[H^+][CH_3COO^-]}{[CH_3COOH]}$
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 initial 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 do you notice about the value that you calculated in the last column of your acetic acid table? What does this ratio tell you about the dissociation of acetic acid?

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?

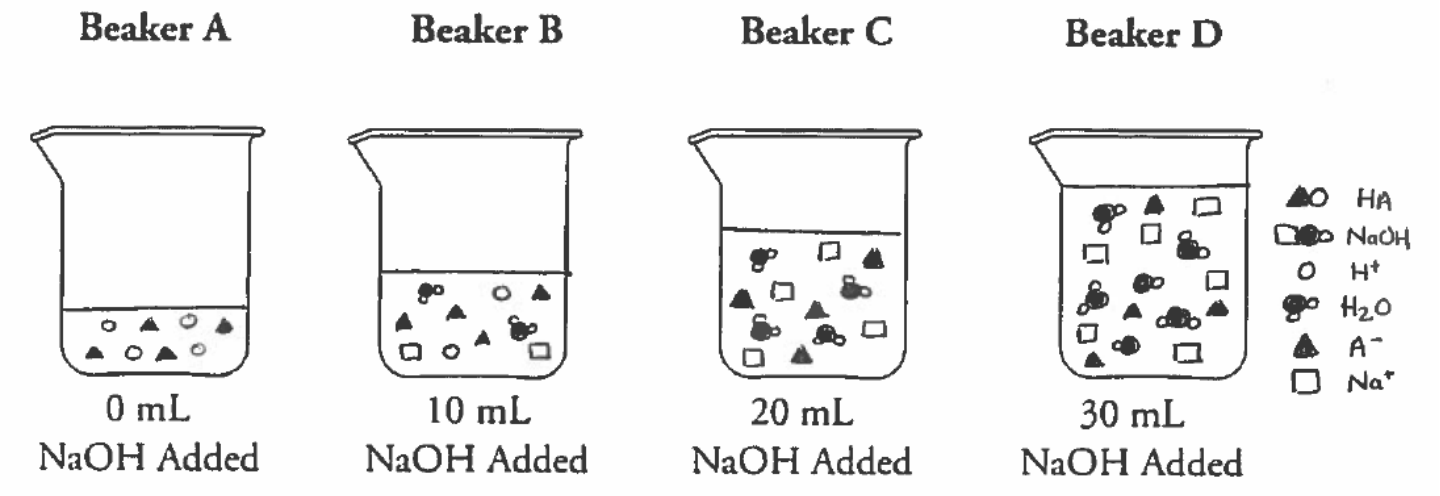
3. Does a change in concentration affect the strength of an acid? Explain.

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 III.

Using what we 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. (Hint: Write the reactants, identify the reaction type, then predict the products.)

If you checked with a pH meter, would the solution in each beaker be ACIDIC, BASIC, or NEUTRAL? Justify your answer.

BEAKER	PREDICTION	EXPLANATION
A		
B		
C		
D		