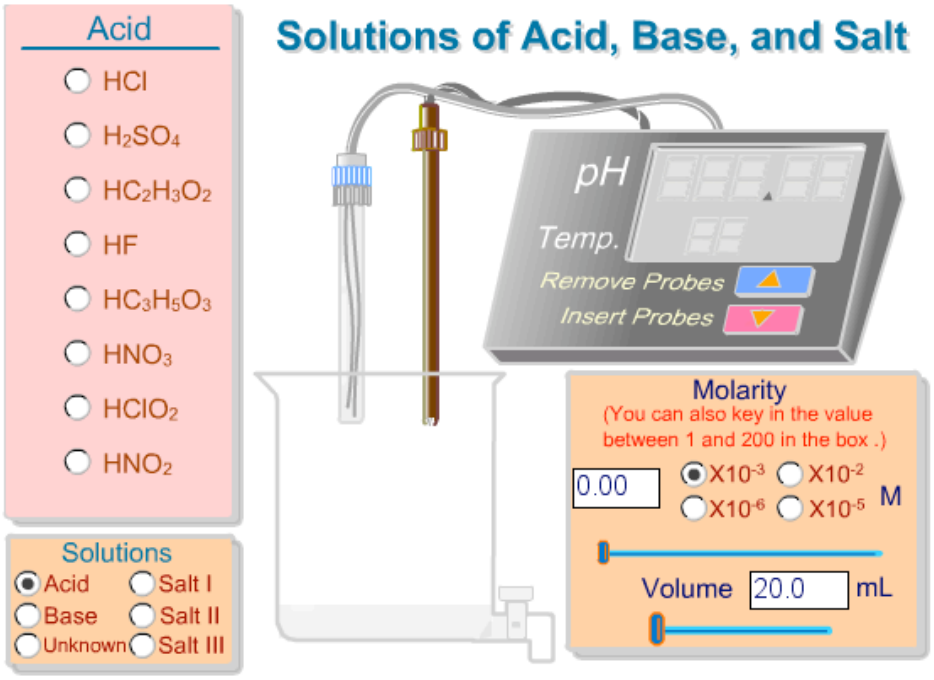
Acid/Base pH

Name_____ Lab Section_____

Problem Statement: What are the acid and base properties of solutions?

I. Data Collection:

A. Go to http://introchem.chem.okstate.edu/DCICLA/ph_meter.swf and open the Acid/Base pH Simulation. Your screen should look like the figure.



This simulation contains a pH meter. You can test the pH of strong and weak acid, base and salt solutions of different concentrations. You will set up the conditions of each measurement using the radio buttons and then insert the pH probes into the solution to obtain the pH of the solution.

B. Under the acid solutions, choose HCl. Set the concentration of the solution at 1.00 X 10^{-2} M (use the slider bar or key in 1.00 and then the radio button). Set the volume at 100 mL (use the slider bar). Click on the Insert Probes button on the pH meter. Enter your pH data in the following table.

Solution	Concentration (M)	pH	$[H^+]$
HCl (aq)	1.00 x 10^{-2}		
HCl (aq)	1.00 x 10^{-3}		
HCl (aq)	1.00 x 10^{-5}		
HCl (aq)	1.00 x 10^{-6}		

C. Remove the probes. Adjust the conditions of your measurements and measure the pH of each of the concentrations for the HCl solutions in the above table and enter the pH data you obtain.

II. Data Analysis and Interpretation

A. pH is defined by the equation: $pH = - \log [H^+]$. Calculate the $[H^+]$ for each of the conditions in the table in the previous section and record your results in the table.

B. Compare the $[H^+]$ with the original concentration of HCl. What does this tell you about the amount of HCl present in the solution? What is the percentage of HCl that has reacted when it is dissolved in water? (Acids that have this characteristic are called strong acids.)

C. Write an equation representing the reaction when HCl is dissolved in water.

III. Data Collection:

A. Under the acid solutions, choose $HC_2H_3O_2$. Set the concentration of the solution at 1.00 X 10^{-2} M (use the slider bar or key in 1.00 and then the radio button). Set the volume at 100 mL (use the slider bar). Click on the Insert Probes button on the pH meter. Enter your pH data in the following table.

Solution	Concentration (M)	pH	$[H^+]$
$HC_2H_3O_2$ (aq)	1.00 x 10^{-2}		
$HC_2H_3O_2$ (aq)	1.00 x 10^{-3}		
$HC_2H_3O_2$ (aq)	1.00 x 10^{-5}		
$HC_2H_3O_2$ (aq)	1.00 x 10^{-6}		

B. Remove the probes. Adjust the conditions of your measurements and measure the pH of each of the concentrations for the $HC_2H_3O_2$ solutions in the above table and enter the pH data you obtain.

IV. Data Analysis and Interpretation

A. Calculate the $[H^+]$ for each of the conditions in the table in the previous section and record your results in the table.

B. Compare the $[H^+]$ with the original concentration of $HC_2H_3O_2$. What does this tell you about the amount of $HC_2H_3O_2$ present in the solution? What is the percentage of $HC_2H_3O_2$ that has reacted when it is dissolved in water? (Acids that have this characteristic are called weak acids.)

C. Write an equation representing the reaction when $HC_2H_3O_2$ is dissolved in water.

V. Data Collection:

A. Under the acid solutions, choose H_2SO_4. Set the concentration of the solution at 1.00 X 10^{-2} M (use the slider bar or key in 1.00 and then the radio button). Set the volume at 100 mL (use the slider bar). Click on the Insert Probes button on the pH meter. Enter your pH data in the following table.

Solution	Concentration (M)	pH	$[H^+]$
H_2SO_4 (aq)	1.00×10^{-2}		
H_2SO_4 (aq)	1.00×10^{-3}		
H_2SO_4 (aq)	1.00×10^{-5}		
H_2SO_4 (aq)	1.00×10^{-6}		

B. Remove the probes. Adjust the conditions of your measurements and measure the pH of each of the concentrations for the H_2SO_4 solutions in the above table and enter the pH data you obtain.

VI Data Analysis and Interpretation

A. Calculate the $[H^+]$ for each of the conditions in the table in the previous section and record your results in the table.

B. Compare the $[H^+]$ with the original concentration of H_2SO_4. What does this tell you about the amount of H_2SO_4 present in the solution? What is the percentage of H_2SO_4 that has reacted when it is dissolved in water? Is H_2SO_4 a strong or weak acid?

C. Write an equation representing the reaction when H_2SO_4 is dissolved in water.

VII. Data Collection and Analysis:

A. Using the procedure of the previous sections, measure the pH of 1.00×10^{-2} M concentrations of each of the acids in the list. Record your findings in the following table.

Solution	Concentration (M)	pH	$[H^+]$	Strong/Weak
HCl (aq)	1.00×10^{-2}			
H_2SO_4 (aq)	1.00×10^{-2}			
$HC_2H_3O_2$ (aq)	1.00×10^{-2}			
HF (aq)	1.00×10^{-2}			
$HC_3H_5O_3$ (aq)	1.00×10^{-2}			
HNO_3 (aq)	1.00×10^{-2}			
$HClO_2$ (aq)	1.00×10^{-2}			
HNO_2 (aq)	1.00×10^{-2}			

B. Calculate the $[H^+]$ of each solution and classify each acid as weak or strong. Enter your findings in the previous table.

VIII. Data Collection:

A. Under the base solutions, choose NaOH. Set the concentration of the solution at 1.00 X 10^{-2} M (use the slider bar or key in 1.00 and then the radio button). Set the volume at 100 mL (use the slider bar). Click on the Insert Probes button on the pH meter. Enter your pH data in the following table.

Solution	Concentration (M)	pH	$[H^+]$	$[OH^-]$
NaOH (aq)	1.00×10^{-2}			
NaOH (aq)	1.00×10^{-3}			
NaOH (aq)	1.00×10^{-5}			
NaOH (aq)	1.00×10^{-6}			

B. Remove the probes. Adjust the conditions of your measurements and measure the pH of each of the concentrations for the NaOH solutions in the above table and enter the pH data you obtain.

IX. Data Analysis and Interpretation

A. Calculate the $[H^+]$ for each of the conditions in the table in the previous section and record your results in the table.

B. In a water solution the $[H^+]$ is related to the $[OH^-]$ by the following equation:

$$10^{-14} = [H^+]\,[OH^-]$$

Use this equation to calculate the $[OH^-]$ of the NaOH solutions. Enter your results in the previous table.

C. Compare the $[OH^-]$ with the original concentration of NaOH. What does this tell you about the amount of NaOH present in the solution? What is the percentage of NaOH that has reacted when it is dissolved in water? Is NaOH a strong or weak base?

D. Write a chemical equation to represent what happens when NaOH dissolves in water.

X. Data Collection and Analysis:

A. Using the procedure of the previous sections, measure the pH of 1.00×10^{-2} M concentrations of each of the bases in the list. Record your findings in the following table.

Solution	Concentration (M)	pH	$[H^+]$	$[OH^-]$	Strong/Weak
NaOH (aq)	1.00×10^{-2}				
KOH (aq)	1.00×10^{-2}				
NH_3 (aq)	1.00×10^{-2}				
$Ca(OH)_2$ (aq)	1.00×10^{-2}				
$(CH_3)_2NH$(aq)	1.00×10^{-2}				
$C_6H_5NH_2$ (aq)	1.00×10^{-2}				
$HONH_2$ (aq)	1.00×10^{-2}				

B. Calculate the $[H^+]$ and $[OH^-]$ of each solution and classify each base as weak or strong. Enter your findings in the previous table.