Acid/Base Classifications

Name_____ Lab Section_____

Log on to the Internet. Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/ACIDSM.htm

This will load a Particulate Simulation. Once you have the simulation running your screen will look like what is shown in Figure 1 below. If you haven't already done so, read the Particulate Simulation section of the Introduction to MoLEs Activities to learn how to use the simulation.

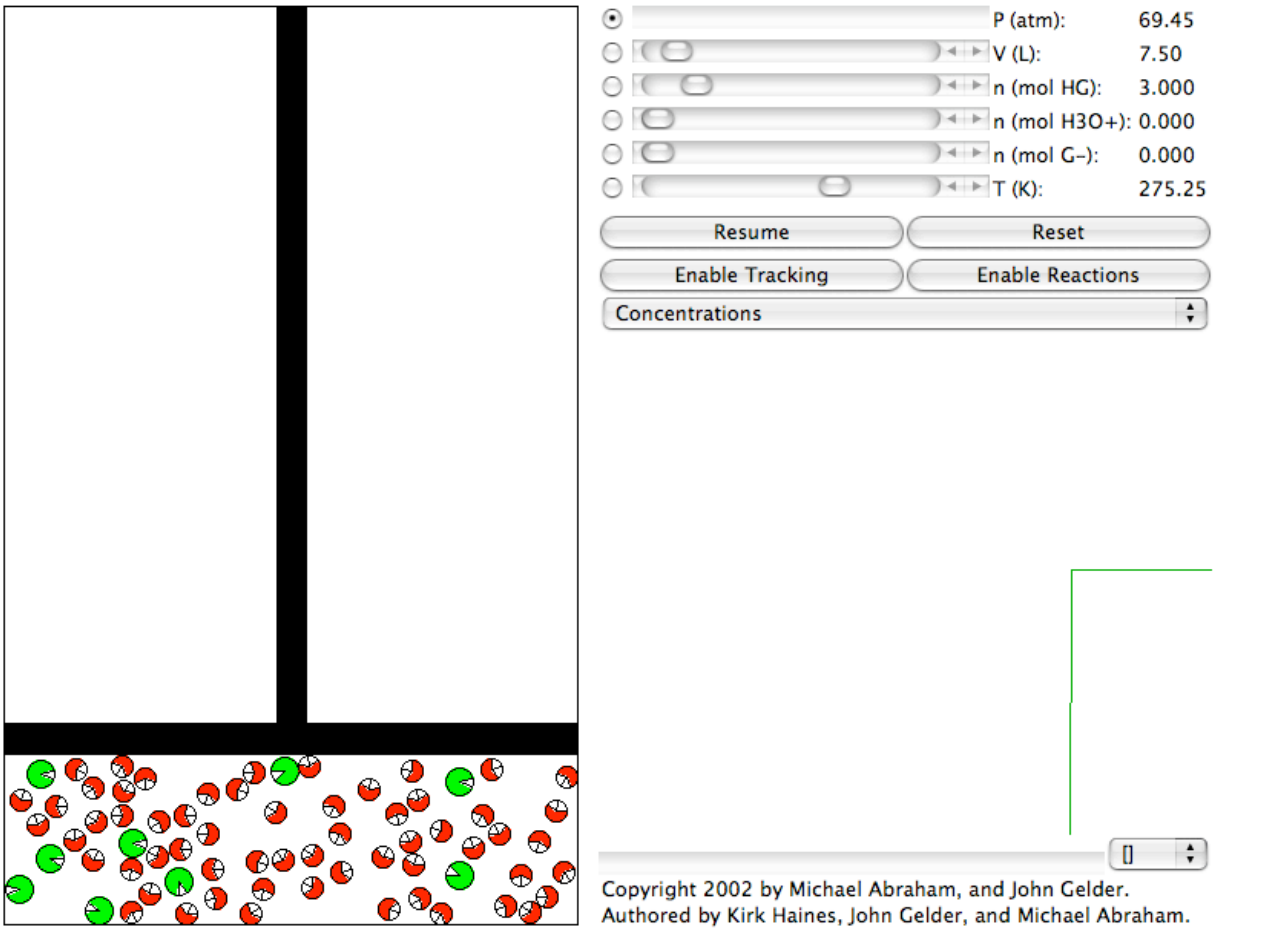

Figure 1.

Problem Statement: What are the characteristics of acid solutions?

I. Data Collection:

A. Click on the Resume button and then the Enable Reactions button and allow the simulation to run. Record your observations of what is happening. Use some or all of the following terms in your description: solution, solvent, solute, concentration, water, acid, base, reactant, and product. What is (are) the reactant(s) in this reaction? What is (are) the product(s) in this reaction?

B. Reset the simulation. Based on what you observe in the sample region and control bar region of the screen, calculate and record the concentration of each substance present in the following table before the reaction has taken place. Click on the Enable Reaction button. Allow the simulation to run until no more changes occur. Click on the Pause button and calculate and record the concentration of each substance present in the following table.

	[HG]	[H_2O]	[H_3O^+]	[G^-]
Before Reaction		--		
After Reaction		--		

II. Data Analysis and Interpretation:

A. Write a balanced chemical equation for the reaction you have observed in this simulation.

B. HG represents a class of chemical compound called an acid. Most common acids are found as water solutions. As a consequence, the reaction you wrote in section II. A. is called a hydrolysis reaction. These kinds of interaction can be characterized as transfers. What is being transferred in an acid solution? Where is it transferred? What is the result of the transfer?

C. Write a hydrolysis reaction for the acids HCl and for HNO_3.

D. What chemical species do all of these acids have in common?

E. Compare the concentration of the reactant acid with the concentration of the product compounds for the reaction in section II B. What can you say about the extent of this reaction? Such compounds are called strong acids.

III. Data Collection:

A. Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/ACIDSN.htm

This will load the Graphic Simulation for the reaction you studied in the previous sections of this activity. If you haven't already done so, read the Numeric Simulation section of the Introduction to MoLEs Activities to learn how to use the simulation.

B. Write the balanced equation for the reaction.

C. Before starting the simulation, fill in the Before Reaction row in the table below with the information requested.

	[HG]	[H_2O]	[H_3O^+]	[G^-]
Before Reaction				
After Reaction				

D. Click on the Resume and Enable Reactions buttons. Allow the simulation to run until no more changes occur. Click on the Pause button and record your observations. Fill in the After Reaction row in the previous table with the information requested.

E. Reset the simulation and increase the amount of HG to 2.00 moles. Repeat the previous experiment and fill in the following table with the information requested.

	[HG]	[H_2O]	[H_3O^+]	[G^-]
Before Reaction				
After Reaction				

IV. Data Analysis and Interpretation:

A. Compare the concentration of the strong acid HG before the reaction has occurred with the concentration of H_3O^+ after the reaction for both experiments. What was the extent of the reaction in each experiment? (What percentage of the HG was converted to H_3O^+?)

B. For the reaction in section III. C. compare the concentration of water before the reaction with the concentration of HG before the reaction? What is the ratio of H_2O to HG?

C. For the reaction in section III. C. compare the concentration of water before the reaction with the concentration of water after the reaction? Discuss this comparison.

D. How much of the water actually reacts with the HG? What percentage of the total water is this?

E. What role does the water that doesn't react with the HG play in the reaction?

F. An alternate way of writing the equation for the reaction studied is to not include water. Why might you be justified in doing this? Write this equation.

V. Data Collection:

Open the molecular simulation ACIDWM:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/ACIDWM.htm

This is a Particulate Simulation for the acid HB.

A. Click on the Resume button and then the Enable Reactions button and allow the simulation to run. Use the replay function in the Module Display Region of the simulation to study the result of individual collisions between reactant and product particles. Record your observations of what is happening. Use some or all of the following terms in your description: solution, solvent, solute, concentration, water, acid, base, reactant, product, forward reaction, and reverse reaction. What is (are) the reactant(s) in this reaction? What is (are) the product(s) in this reaction?

B. Using the procedure you used to study the chemical reaction in the previous sections, fill in the table below with the information requested for this new chemical reaction.

	[HB]	[H_2O]	[H_3O^+]	[B^-]
Before Reaction		--		
After Reaction		--		

C. Reset the simulation, and adjust the amounts of H_3O^+ and B^- to 3.0 moles each and the amount of HB to 0.0 moles. Using the procedure you used to study the chemical reaction in the previous sections, fill in the table below with the information requested.

	[H_3O^+]	[B^-]	[HB]	[H_2O]
Before Reaction				--
After Reaction				--

VI. Interpretation and Conclusions:

A. Write a single balanced chemical equation (hydrolysis) that represents your observations in both sections V. B. and C.

B. What is the nature of this reaction? Compare the concentration of the reactant acid with the concentration of the product compounds for the reaction in section V. How would you characterize the extent of this reaction? How is it different from the reaction studied in section I. of this activity? Such compounds are called weak acids.

C. What is being transferred in the reaction studied in section V. B.? What is being transferred in the reaction studied in section V. C.?

VII. Data Collection:

Type the following address into the location-input line of your browser:

http://cheminfo.chem.ou.edu/~mra/CCLI2004/ACIDWN.htm

This will load the Graphic Simulation for the reaction you studied in the previous sections of this activity.

A. Using the data from the Control Bar Region, enter the initial concentrations of each substance in the equation into the table (called an ICE table) below.

	$HB + H_2O \leftrightarrows H_3O^+ + B^-$			
Initial Concentration – I	___	___	___	___
Concentration Change – C	___	___	___	___
Ending Concentration – E	___	___	___	___

B. Click on the Resume and then the Enable Reactions buttons to begin the reaction. When the reaction appears to be complete, click Pause to stop the action. Record the values of the ending concentrations in the table in Section A. Calculate and record the change in numbers of moles of each of the substances in the reaction.

C. Reset the simulation and adjust the beginning amount of HB to 0.750 moles. Repeat the experiment in the previous sections and complete the ICE table that follows.

	$HB + H_2O \leftrightarrows H_3O^+ + B^-$			
Initial Concentration – I	___	___	___	___
Concentration Change – C	___	___	___	___
Ending Concentration – E	___	___	___	___

VIII. Interpretation and Conclusions:

A Compare the concentration of the weak acid HB before the reaction has occurred with the concentration of H_3O^+ after the reaction for both experiments. What percentage of the HB was converted to H_3O^+ in each experiment?

B. For the reaction in section VII. A. compare the concentration of water before the reaction with the concentration of HB before the reaction? What is the ratio of H_3O^+ to HB?

C. For the reaction in section VII. A. compare the concentration of water before the reaction with the concentration of water after the reaction? Discuss this comparison. What role does the water that doesn't react with the HB play in the reaction?

D. Considering the change in concentration, would you be justified in ignoring the concentration of water in determining the dissociation constant (equilibrium constant, K_a) of HB? Why or why not? Write an alternate equation for the reaction that doesn't include water.

E. Determine the dissociation constants (K_a) for HB for both experiments in section VII. Compare the values you obtain.