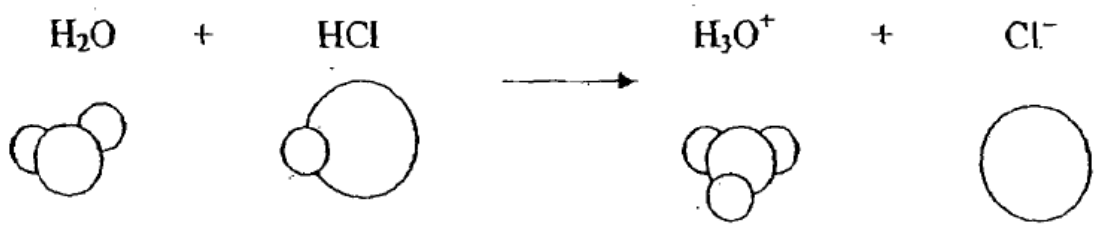
Chemistry **Name _____**
Determining the Molarity of an Acid **Date_____ Block____**

Background
In this activity you will calculate the concentration of a solution of hydrochloric acid. This acid is a combination of water as the solvent, and the gaseous compound, HCl, as the solute. The "active ingredient" of an acid solution is the hydronium ion (often referred to as just a "hydrogen ion"). In the presence of water HCl molecules *ionize* to form separate ions in the solution. The hydrogen "ions" actually combine with water molecules to form *hydronium* ions H_3O^+. The Cl^- ions remain separate as long as water is present. The ions are free to react with other particles they come in contact with.



Many books simply refer to these ions as follows,

$$HCl \rightarrow H^+ + Cl^- \text{ (}\textit{with the assumption that water is present}\text{)}$$

If the acid solution has a rich abundance of solute, and relatively few "plain" water molecules, the acid is called concentrated. If there is an abundance of water, and not many of the solute particles, the acid is called dilute

Another way to refer to the "richness" of the acid is by the term *Molarity, M*. The molarity of a solution tells the number of moles of solute *per* liter of total solution.

$$M = \frac{\text{moles of solute}}{\text{liters of solution}}$$

In past labs, we have used two different concentrations of hydrochloric acid. 1M HCl and 6M HCl. 1M HCl means that every 1 liter of the acid solution holds 1 mole of dissolved HCl. 6M HCl means that every 1 liter of solution holds 6 moles of dissolved HCl.

In this Lab…
You will calculate the number of moles of HCl dissolved in a certain volume of acid by reacting the acid with $CaCO_3$. This is essentially a double replacement reaction, with a decomposition of one of the product. Stoichiometry skills will be used to process mole information.

Procedures
1. Obtain the mass of a clean, dry 100-250 mL beaker.
2. Place 5-7 $CaCO_3$ chips in the beaker. Obtain the mass of the beakers and chips.
3. The teacher will tell your group how much acid to use. Measure this amount carefully into a graduated cylinder and add it to the $CaCO_3$. Wear your goggles and wipe up spills – the acid may be irritating.
4. Place the beaker above the Bunsen burner – heat the contently gently – DO NOT BOIL THE ACID – until all "fizzing has stopped. This is evidence that the HCl has been used up.
5. Rinse the remaining $CaCO_3$ chips a few times with fresh water, and decant the solution. Do not discard any leftover solid material.
6. Heat the $CaCO_3$ chips gently until they are dry. Let the beaker cool and mass it.

Data

The grayed boxes are not to be used.
The white boxes should contain measured and calculated values that pertain to this lab!

Collected Data		Calculated Data	
Mass of beaker and $CaCO_3$ chips	g		
Mass of beaker (clean, empty, dry)	g		
		Mass of $CaCO_3$ before reaction	g
Mass of beaker and leftover $CaCO_3$	g		
		Mass of $CaCO_3$ leftover after the reaction	g
		Mass of $CaCO_3$ used up in the reaction	g
Volume of acid used in the reaction	mL		

Analysis

1. Write the balanced equation.

2. Calculate the number of moles of $CaCO_3$ **used up** in the reaction.

3. Examine the balanced equation for this reaction and use the coefficients to determine the number of moles of HCl that were used up in your reaction.
   Important Note: ***You cannot use 1 mol = 22.4 L because that is only used for gases at STP.***

4. Convert the volume of acid used to liters.

5. Calculate the **experimental** molarity of the acid you used.

6. Explain how it is that students who used more (or less) acid than you did will still obtain the same molarity of acid.

7. A measure of the molarity of a solution is more meaningful than saying that a solution is "concentrated" or "dilute." Explain.

8. Using the actual molarity that was given by the teacher and your experimental molarity, calculate the percent error for this experiment.

9. The molarity (concentration) of your acid is also the concentration of hydrogen ion [H+] in solution because hydrochloric acid is a strong acid that dissociated completely. Using this concentration, calculate the pH of the acid solution that was used in this experiment.