LAD B.2 (pg 1 of 3) Determining the Molarity of Acid from Base

Name__________________Per___

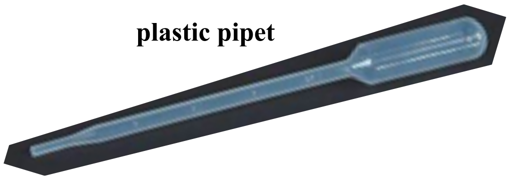
Introduction:

Acid and base react with each other to produce salt water. This is double replacement reaction, in particular, a neutralization reaction. We will use this Lab to learn about titration. A technique of quantitatively adding volumes of solutions. In this lab in particular, we will use a base of known molarity in order to determine the molarity of an acid.

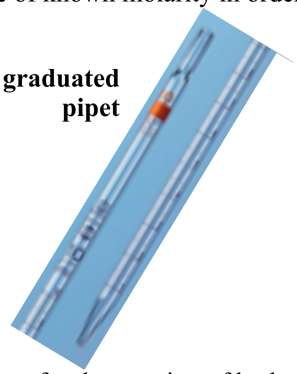
PreLAD:

A. Learn the following lab ware items:

plastic pipet



graduated pipet



Erlenmeyer flask

buret

B. Write the balanced overall and net ionic equations for the reaction of hydrochloric acid with sodium hydroxide in the space below.

C. In this Lab we will solve for the concentration of the HCl using the formula, $M_bV_b = M_aV_a$

In the space below, solve for M_a.

D. Different acid base indicators will produce different colors when in an acid environment vs a basic environment. Thus during the neutralization reaction an indicator will change color signaling the endpoint of the reaction.

1. Use the labeled plastic pipets to put a small squirt of the acid into the small 10 ml beaker.
2. Add a couple of drops of the indicator. In the table below, record the color of the indicator in the acid.
3. Add small squirts of NaOH into the acid/indicator mixture until the color changes. In the table below, record the color of the indicator in the base.
4. Test all of the indicators, even though you will not use them all during this titration.

name	**color in acid**	**color in base**	**chemical name, *yikes !***
bromphenol blue			3’,3”,5’,5” tetrabromophenolsulfone-phthalein
methyl orange			4’-dimethylaminoazobenzene-4-sulfonic acid, Na salt
methyl red			4-dimethylaminoazobenzene-2carboxylic acid
alizarin red			1,2-dihydroxyanthroquinone-3-sulfonic acid
litmus			7-hydroxyphenoxazone
bromothymol blue			3’,3”-dibromothymolsulfonephthalein
phenolphthalein			3,3-bis(4-hydroxyphenyl)isobenzofuran-1(3H)-one aka: di(*p*-dioxydiphenyl)phthalide
universal indicator			This indicator is a mixture of various indicators. Be sure and check out the color card.

LAD B.2 (pg 2 of 3) Determining the Molarity of Acid from Base

Procedure:

1. Use the *graduated pipet* to measure a known quantity of HCl (unknown molarity) to the flask.

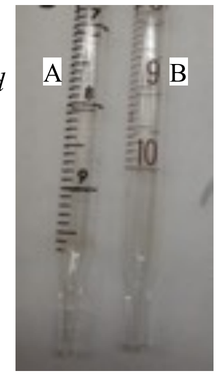
   Please note that burets and pipets read from the top down. This is because we use burets to deliver volumes of liquid and we want to know how much liquid is delivered − in other words we care about the change of volume in the buret/pipet. We do not care how much is actually in the buret/pipet. Remember that change is always calculated final − initial:

   $$\Delta V = V_{initial} - V_{initial}$$

   When reading the burets/pipets down, the final reading will be larger than the initial reading resulting in ΔV *being a positive volume (not a negative volume).*

   In addition, pay special attention to the tip of the pipet. There are two types of pipets in our lab, and you must pay close attention to which type you are using in order to deliver the correct amount of fluid into the flask.

   One type as shown in picture A, has markings right to the tip of the buret, and thus when you allow all of the liquid to drain out it measures the full 10 ml. The second type of buret shown in picture B does not measure the fluid in the tip of the buret, thus to deliver 10 ml, you would need to stop at the 10 mark. If you deliver all of the fluid out of the buret, you would be delivering more than you were measuring for.



2. Add a few drops of phenolphthalein into the acid as an indicator.
3. Use the *buret* to deliver a measured quantity of 0.124 M NaOH to the the flask until the *endpoint* is reached.
4. Use the data to calculate the molarity of the HCl using the molarity formula. $M_b V_b = M_a V_a$

	trial 1	trial 2	trial 3
volume of acid added to the flask (ml)			
initial reading of the base in the buret (ml)			
final reading of the base in the buret (ml)			
volume of base used to neutralize the acid (ml)			
known molarity of the base (M)	0.124	0.124	0.124
calculated molarity of the acid (M)			

Post LAD Questions:

Justify by explaining which measurements and resulting calculations would change (higher or lower).

1. A student noticed that their stirring bar was not stirring the acid very well, so the student added water to their flask, and proceeded with the titration. The student's lab partner yelled at him because he said it would "mess up" the titration. Would this addition of water make the final calculated molarity of the acid larger, smaller or stay the same?

LAD B.2 (pg 3 of 3) Error Analysis

2. As the instructor was walking around the room, she was heard to exclaim “Yikes! that is a very pink solution.” Would the student’s who’s trial she was referring to, result in the final calculated molarity of the acid be to large, too small or no difference?

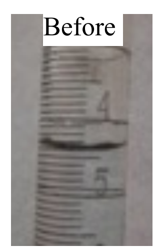
3. A student failed to notice that there were air bubbles in the tip of their buret containing the base before titrating the base into the acid. After the titration reached the endpoint, the air bubbles had been cleared. Would the student’s neglect of clearing air bubbles *before* the titration cause the final calculated molarity of the acid to be larger, smaller, or no change?

4. The student failed to notice that there were two different pipets at their lab station. Both times they measured their acid into the flask they drew up acid to the zero at the zero mark of the pipet and then plunged all the acid out of the pipet and into the flask. Having done their second trial with pipet B, would you expect their second trial to result in the final calculated molarity of the acid to be larger, smaller, or the same as the first trial?

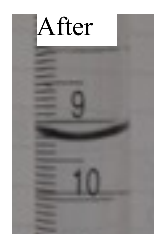
5. The student was concerned that the buret may have had acid in it from some other class, so they went to the sink to clean their buret. They finished their cleansing of the buret with a rinse of deionized water. Would the presence of drops of deionized water in the buret before filling it with the base cause the final calculated molarity of the acid to be larger, smaller or no change?

6. The student did a third trial and while pipetting acid into the beaker, the student noticed that the inside of the beaker was wet. She told her lab partner “not to worry,” was she right? Would the presence of this water cause the final calculated molarity of the acid to be larger, smaller, or stay the same?

7. Two lab partners were arguing about how to read the buret. Calvin says that the before buret shown to the right should be read as 4.41 ml and his partner, Hobbs, says it should be read as 5.59 ml. Which student is correct? If the incorrect student (Calvin or Hobbs) had read the buret with the base in it both before and after, would this make the final calculated molarity of the acid larger, smaller or no change? Be specific with the numbers from the before and after burets.



Should this be read as 4.41 or 5.59?



Should this be read as 9.25 or 10.75?