Chemistry — Acid Base Titration Lab **Name**_____

Period_____

Background:

In this lab you will do a titration of an acid with a base. A titration is a laboratory method that is used to determine the moles of a substance by precisely measuring the amount of another substance that exactly reacts with it. Neither substance can be in excess at the end of the titration. Both substances must be in the aqueous state. A buret is used to both deliver and measure one of the substances.

One requirement of a titration is the ability to know exactly when one substance is used up. This is because you don't want anything left over (no excess reactant). In acid-base titrations, an pH indicator is often used. This is a substance that changes color very abruptly when the pH changes. You will be using an indicator called phenolphthalein. In acidic solution, phenolphthalein has no color at all. Once the solution is basic, however, it turns bright fuschia pink. Usually this takes one drop or less of base.

In this lab you will prepare 100.0 mL of a standard solution of sodium hydroxide. A standard solution means that you know what its concentration is. You will fill your buret with this solution and use it to react with a hydrochloric acid solution. Your goal is to determine the concentration of the hydrochloric acid.

Materials:

ringstand with buret in clamp
100 mL graduated cylinder
beaker
stirring rod
pH paper
HCl (unknown molarity)
250 mL Erlenmeyer flask
10 mL graduated cylinder
distilled water
balance
litmus paper

Techniques:

Safety concerns: YOU MUST WEAR GOGGLES. You will be working with sodium hydroxide and with hydrochloric acid. Sodium hydroxide is caustic and causes the fat in your skin to dissolve. It is extremely important not to get it in your eyes. Hydrochloric acid will burn your skin. If you spill either NaOH or HCL on yourself, immediately rinse the affected area in the sink with water. Hydrochloric acid will also "eat holes" in your clothes, although it may not do so immediately. (You'll know the next time you wash your clothes.) Rinse any spills on clothing with water right away. If you spill either substance—regardless of whether it is on yourself, a classmate or on the lab bench or floor—let your teacher know right away.

Procedure:

*WORK IN GROUPS OF THREE—**EACH PERSON MUST DO ONE TITRATION PERSONALLY**.*

Part 1: Prepare the NaOH

1. Weigh the beaker. Add about 0.9–1.1 g of NaOH to the beaker and mass again.

2. Add about 40 mL of distilled water to the beaker and stir to dissolve the NaOH.

3. When the NaOH is completely dissolved, pour the solution into the 100 mL graduated cylinder. Then rinse the beaker with distilled water a couple of times and add the rinsings to the graduated cylinder. Do not fill the graduated cylinder above the 100 mL line. Then add distilled water until it is exactly up to the 100.0 mL on the graduated cylinder. Stir it with the stirring rod and pour the solution back into the beaker. Make sure it is will mixed.

4. Test this solution by dipping the stirring rod into it and touching it to a piece of pH paper and also to a piece of litmus paper. Record your observations.

Part 2: Prepare your buret

1. Remove your buret from its clamp. Pour about 5 mL of your NaOH solution into your buret. Take it to the sink and tip it sideways (horizontal) and rotate it so the NaOH coats the inside. Then hold it upright again, open the stopcock and let the NaOH drain out into the sink. The purpose of this is to make sure there is nothing in the buret that will dilute or change the NaOH solution. You only need to do this step before the first titration.

Part 3: Titration *Each person must do one.*

1. Fill your buret with the NaOH solution that you just made. Make sure that the level is not above the 0.00 mark. Let some drain out into the beaker to make sure you have no air bubbles in the stopcock assembly. Refill the buret. Record the starting buret level. Read the buret to the nearest 0.05 mL (halfway between the smallest lines).

2. Carefully measure 5.0 mL of the unknown molarity HCl using your graduated cylinder. Pour it into the Erlenmeyer flask. Add 20 mL of distilled water to the flask. Add 2 drops of phenolphthalein to the flask.

3. Rinse the stirring rod with water (tap is OK) and use it to test acid solution in the flask with the pH paper and the litmus paper. Record your results.

4. Put a white piece of paper under the buret. Put the Erlenmeyer flask of acid on the paper below the buret and open the stopcock. The NaOH solution will drain out into the flask. You can let it flow quickly until you are within 2 mL of the volume you calculated in prelab question 3. At this point, slow the flow of NaOH.

5. One way to slowly add NaOH is to add it drop-by-drop. Constantly mix the flask by swirling it. (This takes attention, proper “wrist action”, and some patience.) You should begin to see a pink color when the NaOH is added. The color will quickly fade as the flask is swirled. Your goal is to achieve FAINT PERSISTENT PINK. If you end up with bright fuschia or purple you have added too much NaOH which is known as “blowing past the endpoint.”

6. Once the solution is FAINT PERSISTENT PINK, record the buret level. You can pour the contents of the flask down the sink. Rinse the flask a couple of times with tap water.

7. Refill the buret with NaOH. Don’t forget to record the new starting level. Prepare another trial with HCl (in other words, repeat Step 2 of the titration). A different person in your lab group should do this titration.

8. Repeat one more time for the last person in your lab group.

Part 4: Clean up

1. Pour the contents of your buret, beaker and flask down the sink.

2. Rinse each one well with tap water. They must be rinsed AT LEAST 3 TIMES. Leave the buret empty and clamp it to the ring stand for the next class.

3. Make sure all of your equipment is ready for the next group. Check the materials list on the other side of this sheet.

4. Make sure the phenolphthalein is tightly capped.

5. Have your space checked to get your clean up points.

Chemistry — Acid Base Titration Lab **Name**_____

Report Sheet **Period**_____

Pre-lab:

1. Write a balanced chemical equation for the reaction of aqueous HCl with aqueous NaOH. Include state symbols.

2. If you dissolved 1.04 g of NaOH in exactly 100.0 mL of water, what is the molarity of the NaOH? Show your work.

3. Suppose the unknown molarity HCl in this lab was 1.00 M. How many mL of 0.25 M NaOH would be required to react with 5.0 mL of the HCl? Show your work.

4. If exactly 23.45 mL of 0.218 M NaOH was required to titrate an HCl solution, how many moles of HCl were present? Show your work.

5. If the titration in question 4 used 5.00 mL of HCl, what was the molarity of the HCl?

6. Why is it important to not have any air bubbles trapped in the buret before you start the titration? _____

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Data and Analysis:

1. Record your data in the table below. Don't forget units.

Mass of NaOH:
pH of NaOH using pH paper:
litmus paper test of NaOH:
pH of HCl using pH paper:
litmus paper test of HCl:

Titration #	Student Doing Titration	Initial Buret Reading	Final Buret Reading	Notes (if any)
1				
2				
3				

2. What color does litmus paper turn in basic solution? _____ in acidic solution?_____

3. Calculate the concentration of your NaOH solution in molarity. Show your work.

4. Each individual: calculate the mL of NaOH used in your titration. _____

5. Each individual: calculate the moles of HCl that you titrated. Show work.

6. Each individual: calculate the molarity of the HCl based on your titration. Show work.

7. Record the values of molarity calculated by each person in your group. Calculate the average

Molarity by _____	Molarity by _____	Molarity by _____	AVERAGE

8. What *in the experiment* could have caused differences between the results of lab members? You need to think about experimental issues. Making mistakes in calculations is not an experimental error and you are expected to check each other's calculations in this lab! _____

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