Chemistry **Name**
Period _____

Acids and Bases Titration Lab

The process of titration is a controlled neutralization of an acid with a known base or a base with a known acid. In this experiment the end point of the titration will be signaled by a change in color of an indicator, phenolphthalein. This indicator causes basic solutions to turn in pink and is colorless in acids. Phenolphthalein was widely used as a primary ingredient in laxatives such as Ex-Lax until the early 90's when a correlation between its use and various forms of cancer surfaced.

Purpose:

Materials:

1.0 M NaOH	buret	250 mL flask
Unknown HCl Acid	250 mLWaste Beaker	50 mL graduated cylinder
Phenolphthalein	funnel	Ring stand, buret clamp
White Paper		

Procedure:

Part 1: Concentration of a mystery acid

1. Using the funnel, fill buret with **water** to just over the 0 mL mark.
2. With the 250 mL waste beaker under the buret release valve, practice measuring 5 mL of water. Practice creating a slow a flow as possible (i.e. one drop at a time)
3. Once you are comfortable with the operation of the release valve, empty all of the water from the buret into the waste beaker.
4. Obtain 1.0 M NaOH solution. ***USE EXTREME CAUTION!!! Wear goggles, no food and wash your hands!***
5. Use a funnel to fill the buret with NaOH solution to just over the 0 mL mark. Clean any spilled NaOH, return the 1.0M NaOH to supply cart.
6. Place the waste beaker under the buret's release valve and gradually release NaOH to the 0 mL level.
7. Obtain the unknown mystery acid solution.
8. Rinse the 50 mL graduated cylinder. Use it to measure approx. 20 mL of your unknown. Record volume.
9. Transfer into a clean 250 mL Erlenmeyer Flask. Add 2 drops phenolphthalein solution. Place under the buret release valve. Place a white piece of paper under the flask to clearly show color change.
10. Record the level initial level of NaOH in the buret.
11. Begin a gradual titration, swirling the flask consistently. As you get close to the titration point, reduce the flow of NaOH. Carefully observe, drop by drop, until the color **barely** changes from clear to pink (and stays pink). Record the buret reading once the color permanently changes to pink. Do not add more NaOH.

12. Dispose the acid/base solution in the sink. Rinse flask with DI water. Repeat steps 12-14 for two more trials.

13. Dispose of all extra base in the waste containers in the fume hood, rinse burets with water when done.

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Data Table 1-1: Titration of an acid

	Trial #1	Trial #2	Trial #3
1. Volume of mystery acid (Step 8)			
2. Initial NaOH reading (Step 10)			
3. Final NaOH reading (Step 11)			
4. Volume of NaOH used (#3-#2)			
5. Moles of NaOH used (Use M=mol/L)			
6. Moles of mystery acid (Use mole ratio)			
7. Molarity of mystery acid (M=mol/L)			
8. Average Molarity of acid			
9. Actual Molarity of acid			

Equations: Write a balanced chemical equation for the neutralization reactions in Parts 1 & 2.

Calculations: Show calculations for only 1 trial. Place your final answers in the Data Tables above. **BE SURE TO SHOW ALL WORK, EQUATIONS AND UNITS.**

1. Calculate the pH, pOH, and $[H^+]$ of the 1M NaOH before the reaction

2. Calculate the Moles of NaOH to titrate (Line 5)

3. Moles of HCl in the unknown solution. (line 6)

4. Molarity of HCl in the unknown solution in the flask. (line 7)

5. Calculate your average molarity of unknown HCl.

6. Calculate percent error. %Error = (Experimental-Actual)/Actual x 100%

7. What is the pH, pOH, and $[OH^-]$ of the unknown HCl solution before the reaction?

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Conclusion:

Write a paragraph including the following: (attach on a separate sheet of paper)

1. Discuss your precent error.
2. Was your lab successful or not? Be sure to state your purpose.
3. What are three errors that occurred to explain your percent error?

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Follow Up Questions:

1. Classify each of the following compounds as an acid or a base:

   NaOH NH_3 HCl H_2SO_4 KOH H_3PO_4

2. Complete and balance each neutralization equation. Don't forget the symbols!

   $NaOH(aq) + H_2SO_4(aq) \rightarrow$

   $HCl(aq) + Al(OH)_3(aq) \rightarrow$

   $H_3PO_4(aq) + NH_3(aq) \rightarrow$

3. 50 mL of a household cleaner containing hydrochloric acid (HCl) requires 16.5 mL of 3.0 M sodium hydroxide (NaOH) solution to neutralize. What is the molarity of the HCl in the cleaner? Write out the balanced equation for this reaction.