CHEMISTRY LAB: INTRODUCTION TO TITRATION

What to turn in:	Hypothesis	Data Table 1	Data Table 2	Data Table 3
	Calculations 1-6	Error Analysis	Conclusion	Questions 1-5

Background info.

Titration is the process used to determine the volume of one solution that will react with a carefully measured volume of another solution. It is a quantitative technique based on mole relationships in a reaction and a type of volumetric analysis.

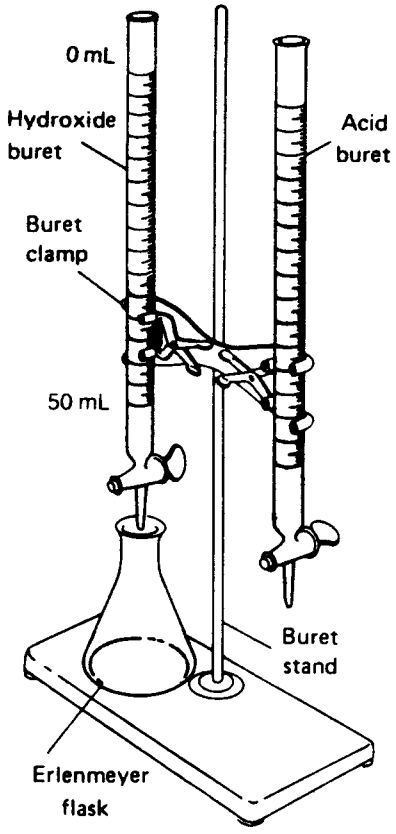
The titration in this experiment involves sodium hydroxide and hydrochloric acid. By determining the volume of one solution needed to neutralize a measured quantity of the other, the unknown molarity can be calculated.

The indicator used in this lab is phenolphthalein. PHTH is clear in acidic solution and dark pink/purple in basic solution. The equivalence point is a faint pink color. At the equivalence point (neutralization), moles acid = moles base, if the coefficients of the balanced equation are in a 1:1 ratio.

Materials per station

ring stand	1.00 M NaOH
double buret clamp	unknown M HCl
plastic wash bottle	distilled water
two burets with stopcocks	PHTH in dropper bottle
Erlenmeyer flask	white paper

two beakers, labeled A (acid) and B (base)
two funnels, labeled A (acid) and B (base)



Procedure

CHECK WITH INSTRUCTOR: YOU MAY BE ABLE TO BEGIN AT STEP 5 or 6.

1) Obtain at least 50 mL of acid in a clean beaker. Obtain at least 50 mL of base in a clean beaker.
2) Set up ring stand and double buret clamp. Close the stopcocks (the faucet parts) of the two burets.
3) Designate one buret as the acid buret; pour in 5 mL acid. Open stopcock, rinse, repeat. Discard liquid.
4) Designate one buret as the base buret; pour in 5 mL base. Open stopcock, rinse, repeat. Discard liquid.
5) With both stopcocks closed, fill the acid buret with hydrochloric acid and the base buret with sodium hydroxide. Record both initial volumes to the nearest 0.01 mL (two decimal places).
6) Obtain a clean Erlenmeyer flask. Use a piece of white paper under the flask to see any color changes. From the acid buret, add about 10 mL of the acid, and add a generous squirt of distilled water to increase the volume. Add two drops of phenolphthalein ("PHTH") indicator to the flask. The solution should be clear.

MORE →

7) From the buret, begin to add base to the flask. Swirl constantly and wash the sides with distilled water from the squeeze bottle. When the color of the solution begins to turn dark pink/purple near the added drops, begin to add the base more slowly, dropwise, until the last drop after swirling turns the solution a very light pink color. This is the equivalence point.

8) Add successive quantities of both acid and base, going over the equivalence point a few times, until it is well established (does not go away). Record the final volumes of both burets.

9) Rinse the flask thoroughly with distilled water and repeat the titration procedure, steps 6-8. Be sure there is enough acid and base in the burets. Complete three trials.

Calculations (* = show numbers in lab)

* 1) YOU MAY SHOW ONE EXAMPLE OF THIS.
Calculate the volumes of acid and base used in each trial:
| *(Final volume in mL) – (initial volume in mL)* | OR
| *(Initial volume in mL) – (final volume in mL)* |
Enter numbers in Data Table 3.

* 2) Calculate the moles of base used in each trial. Remember to change mL to L.
Enter numbers in Data Table 3.

molarity = moles / L. *In this lab, the molarity of the NaOH = 1.00 mol/L or 1.00* $\frac{mol}{L}$

moles = (molarity) x (volume in)L: $\left(1.00 \frac{mol\ base}{\cancel{L\ soln}}\right)$ *x (____* ~~*L base*~~*) = ____ mol base*

* 3) Calculate the moles of acid used in each trial. This is stoichiometry: use the mole ratio from the balanced equation. Enter numbers in Data Table 3.

* 4) Calculate the molarities of the acid solution for each trial. Enter numbers in Data Table 3.
Molarity (M) = $\frac{moles\ acid\ from\ calculation\ 3}{L\ acid\ used,\ from\ data\ table\ 3}$

* 5) Calculate the average molarity of the acid. Enter in Data Table 3.

* 6) Percent error: $\left| \frac{ACTUAL - THEORETICAL}{THEORETICAL} \right| \times 100$

DATA TABLES AND QUESTIONS ON NEXT PAGE →

DATA TABLE 1: REACTION

balanced chemical equation:

_____

	NAME	FORMULA
acid reactant	_____	_____
base reactant	_____	_____
salt product (in solution)	_____	_____
liquid product	_____	_____

DATA TABLE 2: VOLUMES

	Buret readings (mL)			
	BASE		ACID	
TRIAL	initial	final	initial	final
1				
2				
3				

DATA TABLE 3: VOLUME, MOLES, AND MOLARITY

	BASE			ACID		
TRIAL	Volume (mL)	Moles	Molarity (M)	Volume (mL)	Moles	Molarity (M)
1			1.00			
2			1.00			
3			1.00			

Calculated average molarity (M) of ACID _____ M

Theoretical molarity (M) of ACID, from teacher _____ M

Percent error _____ %

Questions

1) In your own words, describe a titration.
2) Why can you add distilled water to the titration solution without worrying about changing the results?
3) a) What color is an acidic solution with PHTH indicator?
   b) What color is a basic solution with PHTH indicator?
4) What is the "equivalence point"?
5) Why is it better to do three trials instead of only one?