*Name*_____ *Date*_____

Acid-Base Titration

PRE-LAB DISCUSSION

In the chemistry laboratory, it is sometimes necessary to experimentally determine the concentration of an acid solution or a base solution. A procedure for making this kind of determination is called an **acid-base titration.** In this procedure, a solution of known concentration, called the *standard solution,* is used to neutralize a precisely measured volume of the solution of unknown concentration to which one or two drops of an appropriate acid-base indicator have been added. If the solution of unknown concentration is acidic, a standard base solution is added to the acid solution until it is neutralized. If the solution of unknown concentration is basic, a standard acid solution is added to the base solution until it is neutralized.

When carrying out an acid-base titration, you must be able to recognize when to stop adding the standard solution, that is, when neutralization is reached. This is the purpose of the acid-base indicator mentioned above. A sudden change in color of the indicator signals that neutralization has occurred. At this point, the number of hydronium ions from the acid is equal to the number of hydroxide ions from the base. The point at which this occurs is called the *endpoint* of the titration. When the endpoint is reached, the volume of the standard solution used is carefully determined. Then, the measured volumes of the two solutions and the known concentration of the standard solution can be used to calculate the concentration of the other solution.

Up to this point in your laboratory work, most of your quantitative experiments have required you to calculate mass relationships. This is known as *gravimetric analysis.* Titration requires you to use volume relationships, a technique known as *volumetric analysis.*

This experiment should lead to a better understanding of the properties of acids and bases, neutralization reactions, and titration techniques.

PURPOSE

Determine the molarity of a NaOH solution by titrating it with a standard HCl solution.

EQUIPMENT

burets, 50-mL (2)
buret stand
double buret clamp
graduated cylinder, 10-mL
Erlenmeyer flask, 250-mL
beakers, 250-mL (2)
dropper pipet
safety glasses

MATERIALS

0.100 *M* HCl (standard solution)
NaOH (concentration unknown)
phenolphthalein
distilled water
detergent solution

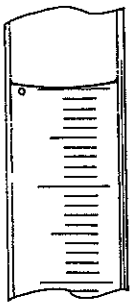
PROCEDURE

1. Wash two burets with detergent solution. Rinse them thoroughly, first with tap water, then with distilled water.
2. Obtain about 100 mL of standard acid solution in a clean, dry 250-mL beaker. Obtain about the same amount of the base of unknown concentration in a second 250-mL beaker. **CAUTION:** *Handle these solutions with care. They can cause painful burns if they contact the skin.*
3. Pour about 10 mL of acid into one buret and rinse the inside surface of the buret thoroughly. Allow the acid to run out the buret tip. Fill the buret to slightly above the 0.0-mL mark with acid. Then allow the acid to flow out the buret tip until the bottom of the meniscus is at the 0.0-mL mark (see Figure 42-1). Be sure there are no bubbles in the tip. If bubbles are present, add a little more acid to the buret and allow it to drain through the tip until it is free of bubbles and the meniscus is at 0.0 mL.
4. Repeat step 3 using the base solution in the second buret.

Starting with step 5 of the procedure, one lab partner should carry out the instructions while the second partner records the data.

5. Place a 125-mL Erlenmeyer flask under the acid buret as in Figure 42-2. Holding a sheet of white paper behind the buret to make the scale easier to read, allow exactly 10.0 mL of acid to flow into the flask.
6. Add exactly 10.0 mL of distilled water to the flask. Then, using a clean dropper pipet, add 3 drops of phenolphthalein indicator. Swirl the flask to mix all the ingredients.
7. Place the flask on a sheet of white paper under the buret containing the base solution. To avoid splashing, be sure the tip of the buret is in the flask as illustrated.
8. Swirling the flask gently, begin the titration by adding NaOH to the flask drop by drop. Continue until a faint pink color remains for about 30 seconds. If over-titration occurs (the pink color is too deep), follow your teacher's instructions for correcting this condition.
9. Note and record the exact final volume reading on the scale of the base buret. Discard the solution in the flask as per instructions. Wash and rinse the flask.
10. Repeat the titration (steps 5 through 9). It is not necessary to refill the burets. Simply read and record the initial volumes of the solutions in the burets carefully.

Figure 42-1



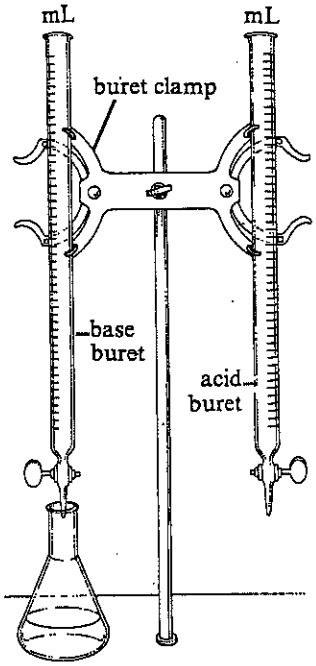


Figure 42-2

OBSERVATIONS AND DATA

DATA TABLE

	Trial 1		Trial 2		Trial 3		Trial 4	
	HCl	NaOH	HCl	NaOH	HCl	NaOH	HCl	NaOH
Initial reading								
Final reading								
Volume used								