

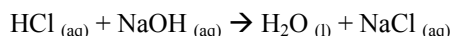


# Creation of a Titration Curve with a CBL Lab #32

This lab will give you the opportunity to measure the changing pH of a titrated solution. You will start with an acidic solution with a characteristically low pH. You will then slowly add base, which will cause the pH to increase as the solution becomes more basic and less acidic. The shape of the graph generated will give you a visual representation of the pH of the solution at various points during the titration.

Because the pH changes most dramatically at the equivalence point, the point at which the moles of acid and moles of base are equal, the equivalence can be determined by finding the central point of this region of dramatic change. This will allow you to determine the molarity of the acidic solution given the concentration of the base.

During this lab you will be titrating hydrochloric acid with sodium hydroxide, according to the reaction below:



## Materials:

CBL System	magnetic stirrer (if available)
TI Graphing Calculator	stirring bar
Vernier pH Amplifier and pH Electrode	50-mL buret
Vernier adapter cable	ring stand
TI-Graph Link	2 utility clamps
HCl solution, unknown concentration	250-mL beaker
~0.1 M NaOH solution	distilled water

## Procedure:

Obtain and wear goggles.

Measure about 10 mL of the HCl solution into a 250 mL beaker. Add approximately 100 mL of deionized water to the beaker. Place a magnetic stir bar into the beaker and place the beaker on top of a magnetic stirrer.

Set up a calculator and CBL and connect a pH probe. Suspend the pH probe in the beaker so that the tip of the electrode is fully immersed but will not be struck by the magnetic stir bar.

Obtain a sample of ~0.1M NaOH. Rinse a burette with water several times and then with a small sample of the sodium hydroxide solution several times. Fill the burette to the 0 line with sodium hydroxide. Clamp the burette over the beaker.

Turn on the calculator and CBL. Run the program CHEMBIO. Set up the pH probe using the stored calibration. Follow the instructions on the screen for allowing warm-up time.

When ready, use the TRIGGER/PROMPT data collection choice. Press **TRIGGER** to take the first reading. The calculator will prompt you for a number. Read the volume of sodium hydroxide in your burette to the nearest 0.01 mL and type that value into your calculator. Press **ENTER** to store the volume. Choose MORE DATA.

Add enough sodium hydroxide to the solution to raise the pH by about 0.2. When the pH reading stabilizes, press **TRIGGER** to record the pH and then enter the volume from your burette into your calculator, pressing **ENTER** to store that value. Choose MORE DATA. Continue adding enough sodium hydroxide to increase the pH by 0.2 and taking readings until the pH reaches approximately 4.5.

Once the pH reaches approximately 4.5 add the NaOH in single drops (or single quick turns of the burette stopcock as demonstrated by your instructor). Take a reading of the pH and volume after each drop. Continue this until the pH reaches at least 10.5.

Once the pH has reached at least 10.5 add larger amounts of NaOH again to make the pH increase by 0.2 units, taking a reading after each 0.2 increase. Continue adding NaOH in this fashion until the pH reaches 11.5 or until you have added at least 20 mL of the base.

**Calculations:**

Use the graph to determine the equivalence point for the titration and use this data to determine the concentration of the acid used.