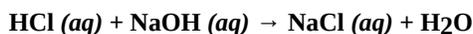


## 8.7: Titrations - Neutralization and Stoichiometry

One of the standard laboratory exercises in General Chemistry is an **acid-base titration**. In order to perform an acid-base titration, you must have a solution of acid or base with a known concentration. You then slowly add a known volume of this solution, using a volumetric **burette**, to an acid or base solution with an *unknown* concentration until neutrality has been achieved. At that point, you know the volume and concentration of the reactant you have added, which means that you can calculate the number of *moles* that you added. Based on the stoichiometry of your neutralization reaction, you then know how many moles of acid or base were in the unknown sample. How do you know when you have reached neutrality? Generally an indicator or a pH meter is used (as described in Section 8.5). For example, if we had a solution of NaOH that was exactly 0.100 M and we had a beaker containing an *unknown* concentration of HCl. To perform the titration we would add a few drops of a stock phenolphthalein solution to our HCl, and then slowly add a measured amount of the NaOH solution until all of the acid had been consumed and the indicator changed from colorless to pink.



Working with the above example, if the volume of base that we added (as measured on the buret) was 12.6 mL, we could calculate the number of moles present in the unknown acid solution. This is equal to the known concentration of our NaOH (0.100 M) multiplied by the volume required for neutrality (0.0126 L), or:

$$(0.100 \text{ moles/L})(0.0126 \text{ L}) = 1.26 \times 10^{-3} \text{ moles}$$

If we had used exactly 100.0 mL of our unknown acid in our titration, the concentration of our acid would be:

$$\frac{(1.26 \times 10^{-3} \text{ moles})}{(0.1000 \text{ L})} = 1.26 \times 10^{-2} \text{ M}$$

### ? Exercise 8.7.1

1. You are given a solution containing an unknown concentration of HCl. You carefully measure 50.0 mL of this solution into a flask and then add a few drops of phenolphthalein solution. You prepare a buret containing 0.055 M NaOH and note that the initial level of the solution in the buret is 12.6 mL. You slowly add the NaOH solution to the acid until the color change *just* occurs (as evidence of the color change becomes visible, you carefully stir the solution after each drop has been added). When the acid solution turns (and remains) pink, you note that the volume in the buret is now 28.9 mL. What is the concentration of the unknown acid solution?
2. If 25.00 mL of HCl solution with a concentration of 0.1234 M is neutralized by 23.45 mL of NaOH, what is the concentration of the base?

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