Concentration

- There are several ways to measure concentrations of solutions.
- The one that we will use is "Molarity" whose symbol is 'M'.
- Molarity is defined as the number of moles of the solute (the substance being dissolved) per liter of solution.
- The substance that dissolves the other substance is called the solvent.
- The unit for molarity is moles/liter (n/l).
- Calculating the number of moles of a substance in a certain volume of a solution whose concentration is known is simply multiplying the volume of solution by the concentration (molarity).

Acid Base Titration

- Acids and bases combine in solution to neutralize each other forming a salt (not necessarily table salt) and water. Each proton supplied by the acid is combined with a hydroxide from the base forming water and the other ions will remain in the solution as a dissolved salt unless the salt is insoluble in water in which case it will form a precipitate.
- Titration involves the careful measurement of the volume of a known concentration of an acid (or a base) and detection of the point where the solution becomes neutral as it is added to a known volume of the solution with an unknown concentration.
- Again –– a balanced equation is needed to determine the mole ratios of acid and base required for neutralization.
- Once the titration is complete, three values are known and one is left unknown.
- Known values: volume of known concentration, volume of unknown concentration and the known concentration itself.
- Multiplying the known concentration of the substance used to neutralize the solution by the volume used in titration will give the number of moles of that substance that were needed to neutralize the other.
- Next, calculate the number of moles of the unknown substance from the mole ratios.
- Finally, calculate the concentration of that substance by dividing the number of moles of it in the titration by the original volume of the solution before titration.

Example: 25 ml of 0.05 M HCl to neutralize 345 ml of $NaOH$ solution. What is the concentration of the $NaOH$ solution?

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

- Moles of HCl: 0.025 l × 0.05 n/l = 0.00125 moles.
- Mole ratio from balanced equation shows that the number of moles of $NaOH$ is the same as the number of moles of HCl. Therefore, there were 0.00125 moles of sodium hydroxide.
- Dividing 0.00125 moles of sodium hydroxide by 0.345 l of solution yields 0.003623 n/l (moles per liter).