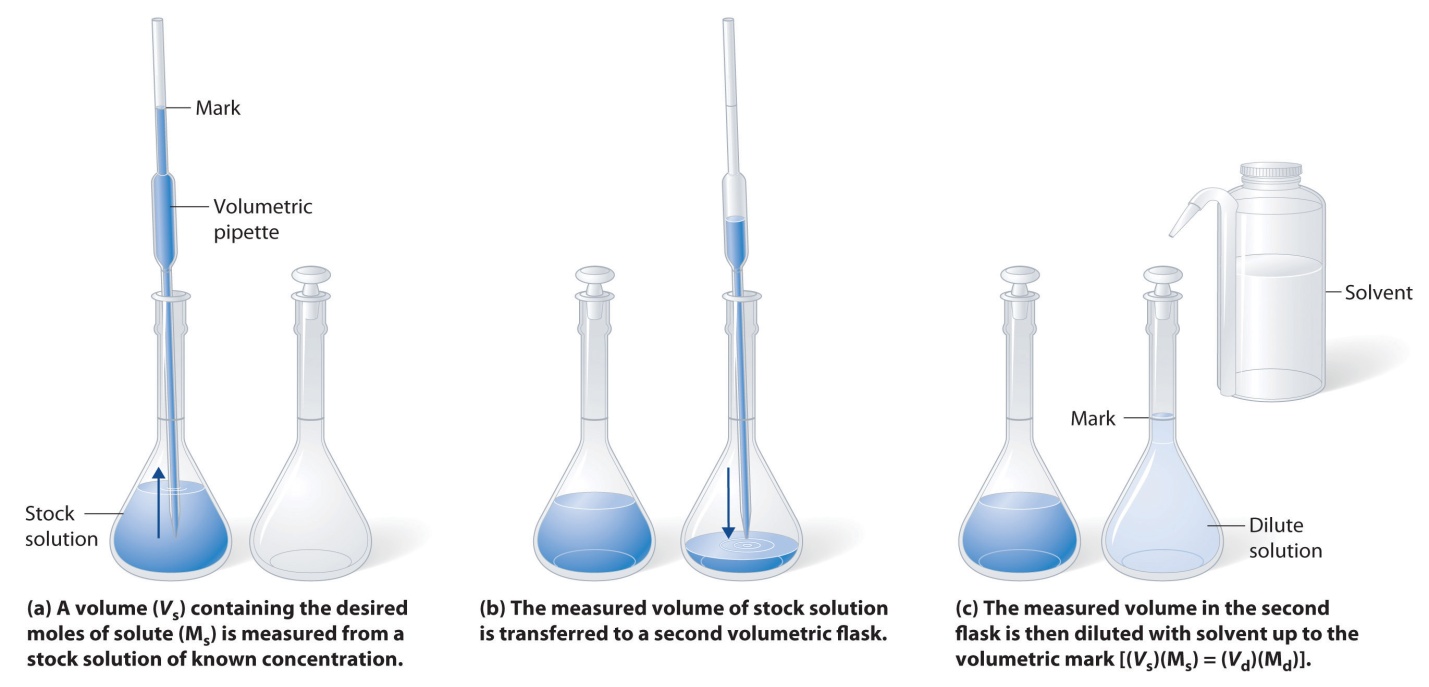
Beer’s Law expresses the relationship between absorbance and concentration. The equation for Beer’s Law is

A =€lc

In this equation, € and l are both constants, so the equation is essentially saying that absorbance is directly proportional to concentration. Therefore, as the concentration increases, so should the absorbance.

This equation is the basis of spectrometry, a method of determining the concentration of a solution by measuring its absorbance.

In order to find the concentration of an unknown, however, you must know the absorbance of a series of known concentrations. This will produce a graph to which you can compare your unknown. In order to create the solutions of known concentration, a process called dilution is often used.



Example: Given a solution of 0.4 M concentration, create a solution of 0.02 M concentration using a 250 mL volumetric flask and a pipet or buret.

Equation to use: M1V1 = M2V2

The initial molarity is 0.4 M and the final molarity should be 0.02 M. The initial volume is currently unknown, and the final volume will fill the volumetric flask (250 mL).

0.4 M \* V = 0.02 M \* 250 mL

0.4 M \* V = 5 M\*mL

V = 20 mL

In order to prepare the solution, one should add 20 mL of the 0.4 M solution to the flask and then fill the flask with water to the 250 mL mark.

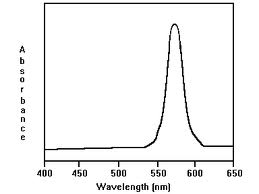
Notice that in this example, we started with a solution (in water). Solutions are measured using molarity and volume, not grams like solids.

Once a series of solutions is created, the absorption of each is measured in a colorimeter or spectrometer.

These instruments pass light of a specified wavelength through the solution and then measure the amount of light that is absorbed and the amount that is transmitted (passed through).

The wavelength of light that is used is based upon previous experimentation which shows the optimal wavelength for a solution of that color.

Example:

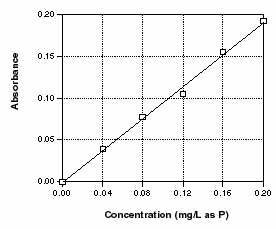
For the solution shown the right, the optimal wavelength would be approximately 570 nm.

The wavelength depends upon the color of the solution.

Solutions such as salt water and sugar water that have no color would not show absorbance at any wavelength, and therefore could not be tested using this method.

The colorimeter is set at the specified wavelength and the absorbance of the various solutions is measured. A graph of absorbance (y) vs. concentration (x) is then created.

Example:

From this graph, the concentration of an unknown solution can be found by first measuring its absorbance. From absorbance, the graph is used to determine the concentration.

As you can see from the graph, as the absorbance increases, so does the apparent concentration.

Therefore, if there is anything in the path of the light to alter the absorbance, the concentration will be altered as well. For example, if there were bubbles in the solution, the absorbance would decrease (air does not absorb as much light as a colored solution). This would cause the concentration to “appear” less than it actually is. However, if there were fingerprints on the cuvette, the reverse would be true. The fingerprints would absorb light, causing the concentration to “appear” higher than it actually is.