Preparing Solutions

Learning Goals

By the end of this lesson students will be able to:

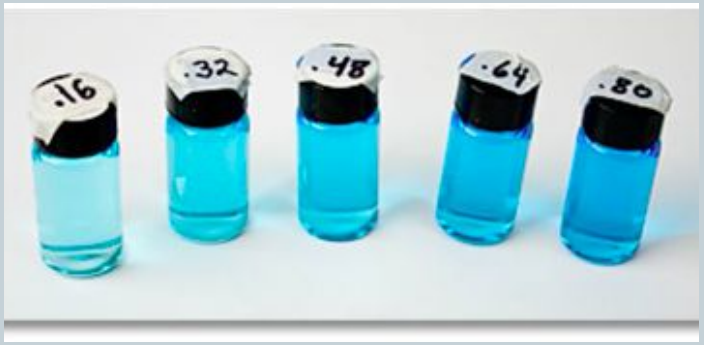
- Use appropriate terminology related to aqueous solutions and solubility
- Prepare solutions of a given by diluting a concentrated solution
- Prepare solutions of a given concentration by dissolving a solid solute in a solvent concentration

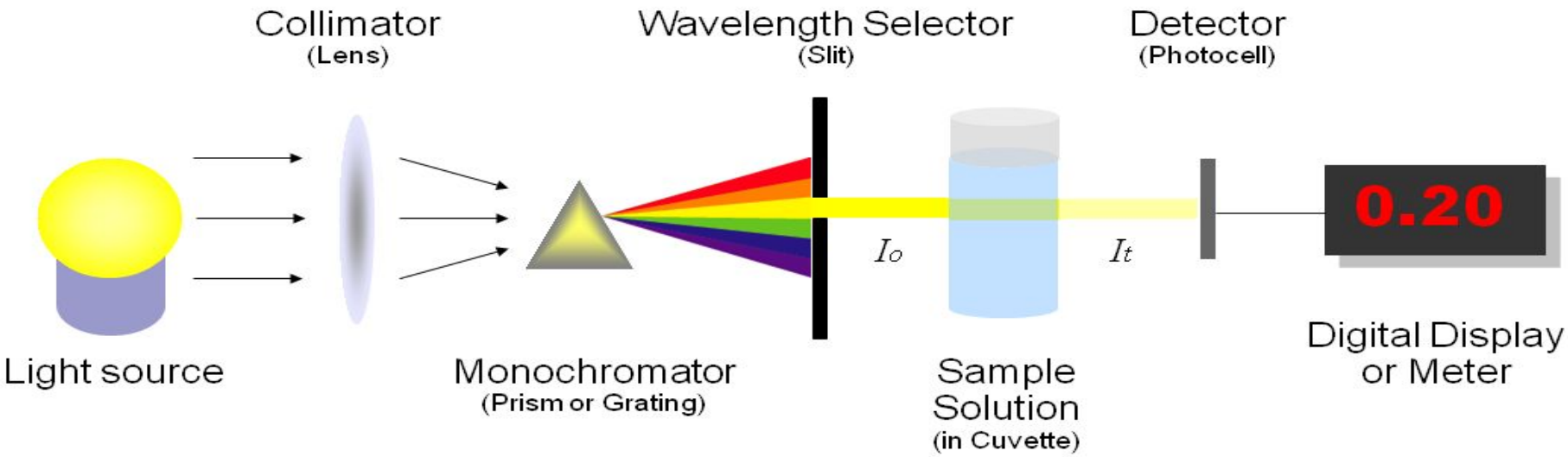
Dilute → Concentrated

Spectrophotometry

- **Spectrophotometry-** instrument that measures the amount of light absorbed by a sample.

- **Application:** used to measure the concentration of solutes in solution.





- Each molecule absorbs light in a unique spectrum pattern
- Determines the absorbance of wavelengths (light energy) by the chemical species in solution

- **Beer-Lambert law:** the amount of light absorbed at these wavelengths is directly proportional to the concentration of the chemical species

Preparing Solutions

What do the effectiveness of medicine, the safety of chemical reaction, and the cost of an industrial process all have in common?

They all depend on solutions that are made carefully with known concentrations!

Concentrations we know:

m/m, m/v, v/v, ppm, ppb, mol/L

Standard Solution

Standard Solution- a solution with a known concentration

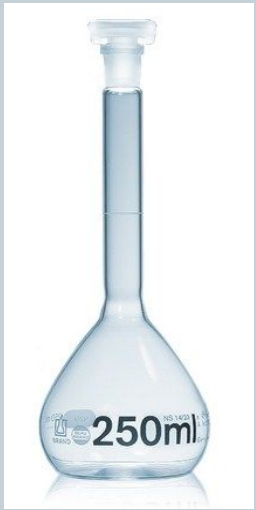
Stock Solution- is a concentrated solution that will be diluted to some lower concentration for actual use.

Two way to prepare an aqueous solution:

1. Dissolving a measured mass of solute in a certain volume of solution
2. Dilute a solution of known concentration

Dissolving Solute

- For dilutions we use volumetric flasks
  - Used for precise dilutions and preparation of standard solutions
  - Calibrated to contain a precise volume at a particular temperature



- Measure fixed volumes of solutions to +/- 0.1ml
- Calibrated usually to 20°C

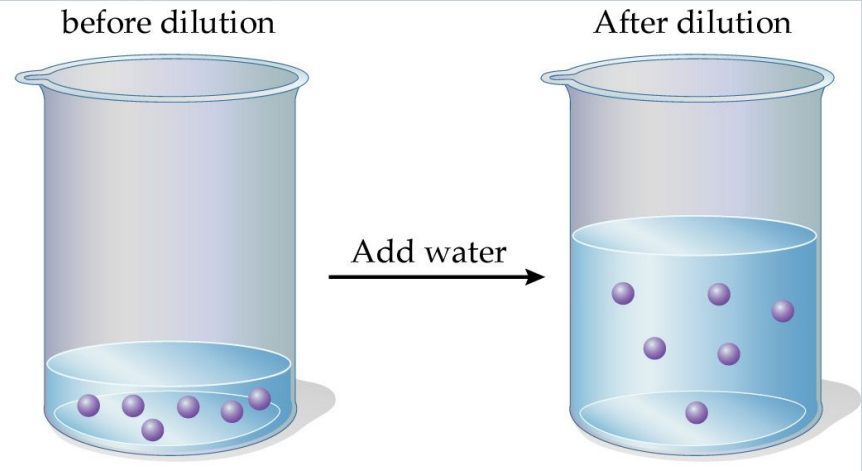
Dissolving Solute

Steps:

1. Transfer a known mass of solute into flask
2. Add solvent (water) until the flask is about half full
3. Swirl the mixture to completely dissolve solute
4. Rinse the beaker that contained the solute with solvent and add the rinsing to flask
5. Add the remaining water slowly, when the flask is almost full add water by a dropper until the bottom of the meniscus rests at the etched line

Diluting a Solution

- You can make less a concentrated solution from a known solution by adding additional solvent to the standard solution



1. When a solution is diluted the volume increases, however the amount of solute stays the same
2. The # of moles of solute present remains the same before and after dilution

Diluting a Solution

Steps:

1. Calculate amount needed
2. Add solvent to standard solution

$$C_1V_1 = C_2V_2$$

C1 = Initial concentration of the solution, before dilution

C2 = Final concentration of the solution, after dilution.

V1 = Volume about to be diluted

V2 = Final volume after dilution

Example 1

For a class experiment your teacher must make 2.0L of 0.10M sulfuric acid. This acid is usually sold as an 18M concentrated solution. How much of the concentrated solution should be used to make the new solution with the correct concentration?

Required:

Initial Volume of concentrated solution to be diluted = ?

Given:

C1 = Initial concentration of the solution= 18M

C2 = Final concentration of the solution = 0.10M

V2 = Final volume after dilution = 2.0 L

Solution

$$C_1V_1 = C_2V_2$$

Know:

$V_1 = ?$ $C_2 = 0.10M$

$C_1 = 18M$ $V_2 = 2.0\ L$

$C_1V_1 = C_2V_2$

$(18M) \times (V_1) = (0.10M) \times (2.0L)$

$V_1 = (0.10M) \times (2.0L) / (18M)$

$= 0.011L$

Example 2

Joe has 20L of a 2 g/L solution. He dilutes it and creates 3 L of a 1 g/L solution. How much of the original solution did he dilute?

Know:

V1 = ?L V2 = 3 L

C1 = 2 g/L C2 = 1 g/L

$C_1V_1 = C_2V_2$

$(2\ g/L)\ V_1 = (1\ g/L)(3L)$

$V_1 = 1.5\ L$

- We're only going to use part of the 20 L. Remember we have to end up with 3 L after dilution, so not only do we have to start with less than 20 L but also less than 3 L.

Example 3

Jill has 20 L of a 0.5M solution. To this solution she adds 30 L. What is the final concentration of the solution?

Know:

$V_1 = 20\ L$ $\quad\quad$ $C_2 = ?$

$C_1 = 0.5M$ $\quad\quad$ $V_2 = 30L + 20L = 50L$

$C_1V_1 = C_2V_2$

$(0.5M)(20L) = C_2\ (20L + 30L)$

$10\ mol = C_2(50L)$

$C_2 = 10\ mol/50L$

$= 0.80\ g/L$

Homework

- Dilution Practice Problems