Concentration

Molarity(M): number of moles of solute per liter of solution

$$M = \frac{\#\ \text{moles of solute}}{\text{volume (liter)}} = \frac{n}{V}$$

M.wt. NaOH = 23 + 16 + 1 =40g/mol

To prepare 1M solution of NaOH
Take 40 grams of NaOH and add water to make exactly 1 liter of solution.

Notice that the definition is based on the total volume of the solution.

Example

How many grams of NaOH should be used to prepare 250mL of 0.300 M NaOH?

$$M = 0.300 = \frac{n}{0.250} \Rightarrow n = 0.250 \times 0.300 = 0.0750 mol$$

0.0750mol × 40.0g/mol = 3.00g

Example

How many moles of $AgNO_3$ are there in 25.0 mL solution of 0.600M $AgNO_3$?

$$M = \frac{n}{V}$$

$$0.600 = \frac{n}{0.025} \Rightarrow n = 0.025 \times 0.600 = 0.0150 mol$$

dilution of solutions

$$M_1 \times V_1 = M_2 \times V_2$$

Example:

What volume of 2.0M KOH should be used to prepare 4.0L of 1.5M KOH?

$M_1 = 2.0$ $\qquad$ $M_2 = 1.5$

$V_1 = ?$ $\qquad$ $V_2 = 4.0L$

$$2.0 \times V_1 = 1.5 \times 4.0$$

$$V_1 = \frac{1.5 \times 4.0}{2.0} = 3.0L$$

Example

What volume (mL) of 0.750M NaOH is needed to react with 50.0mL of 0.150M H_2SO_4?

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Moles of H_2SO_4 in 50.0mL:

0.050L×0.150M=0.0075mol

form the equation: 2mol NaOH = 1mol H_2SO_4

from the problem: x mol NaOH = 0.0075mol

x = 0.0150mol NaOH

$$M = \frac{n}{V} \Rightarrow 0.750 = \frac{0.0150 mol}{V} \Rightarrow$$

$$V = \frac{0.0150}{0.750} = 0.020 L = 20.0 mL$$