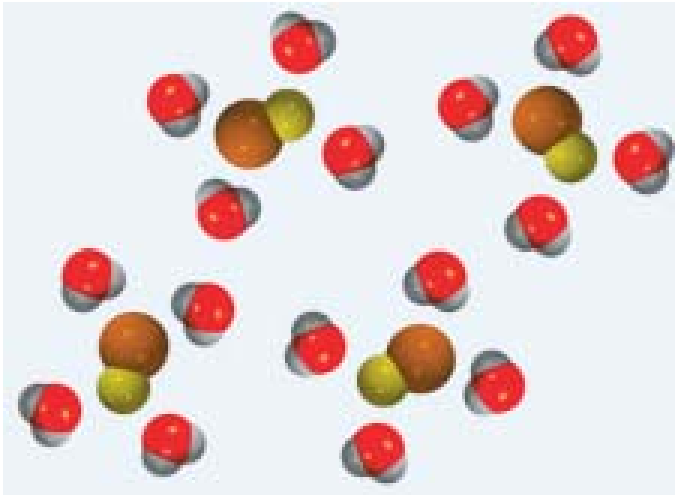
Aqueous Solutions and Acid-Base reactions

Terms

Solution

Homogenous mixture of 2 or more substances



Solvent:

Component with largest amount
Water is the universal solvent

Solute:

Remaining components: smaller amounts

Solvation/dissolving:

Water molecules surround & support solute molecules or ions
Water is NOT a part of the chemical reaction

Concentration of Solutions

Molarity

Molarity (*M*)= moles solute/L solution

Units of mol/L

Conversion factor between moles solute & volume of solution.

Prepare 2 liters of a 1.0M solution of NaCl?

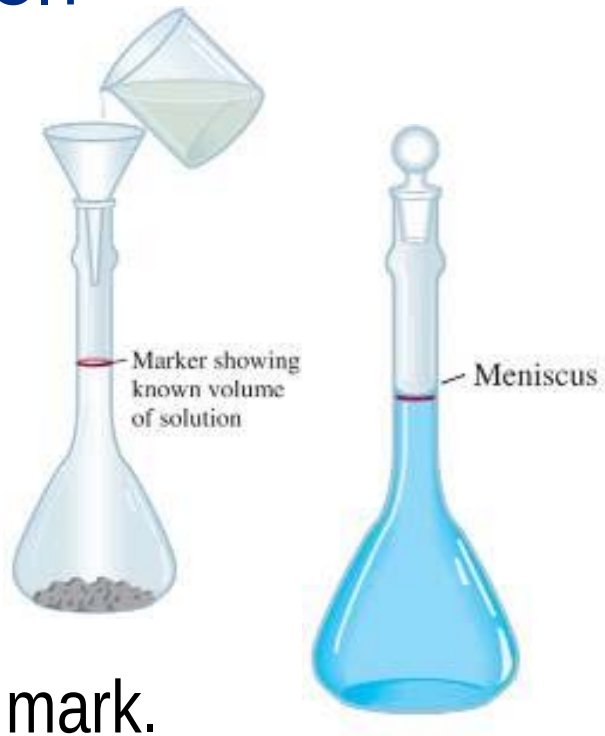
1. Calculate mass of Na Cl needed.

$$\frac{1mol_{NaCl}}{1L_{NaCl}} x \frac{58.5g_{NaCl}}{1mol_{NaCl}} x \frac{2L_{NaCl}}{1} = 117g_{NaCl}$$

2. Weigh out mass of NaCl.

3. Pour NaCl into volumetric flask.

4. Add water until the water reaches the 2L mark.



Dilution Of Solutions

Water is added to a small amount of stock solution to make a less concentrated solution.

Addition of solvent does not change the mass of solute in a solution but does change the solution concentration.

$M_1V_1=M_2V_2$

mol/L x L=mol/L x L

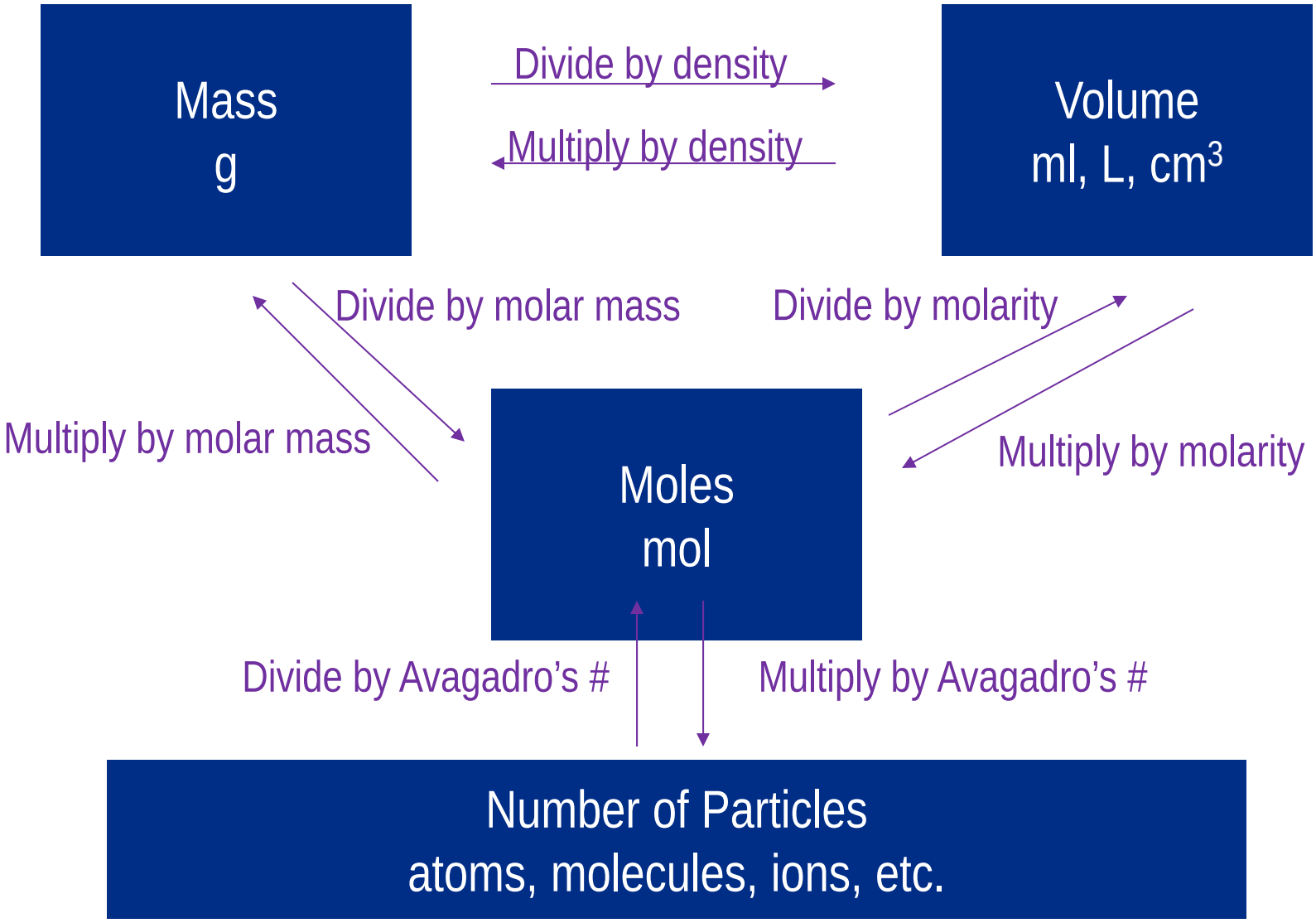
Calculate the volume of 1.0M stock solution needed to make 2.0L of a 0.12M solution of HCl.

M_1= 0.12M M_2=1.0M

V_1= 2.0L V_2=?

$$V_2 = \frac{M_1V_1}{M_2} = \frac{0.12Mx2.0L}{1.0M} = 0.24L = 240mL$$

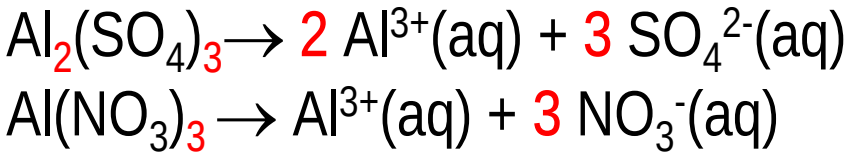
Conversion Relationships



Calculating Ion Concentrations in Solution

What are the concentrations of aluminum ion, sulfate ion & nitrate ion in a solution that is1.20 M aluminum sulfate and 1.0M aluminum nitrate?

1. Write down how the salts break up in water.



2. Add up all the concentrations and multiply by the number of ions in the solution.

$2\ Al^{3+} + 3\ SO_4^{2-}$	1.2M x 2 = 2.4M for Al^{3+}	1.2M x 3 = 3.6M SO_4^{2-}
$Al^{3+} + 3\ NO_3^{-}$	1.0M x 1 = 1.0M for Al^{3+}	1.0M x 3 = 3.0M NO_3^{-}

3. Add up ions if there is more than 1 source.

$2.4M\ Al^{3+} + 1.0M\ Al^{3+} = 3.4M\ Al^{3+}$

Titration

Titration reactions are used to determine acid/base concentration

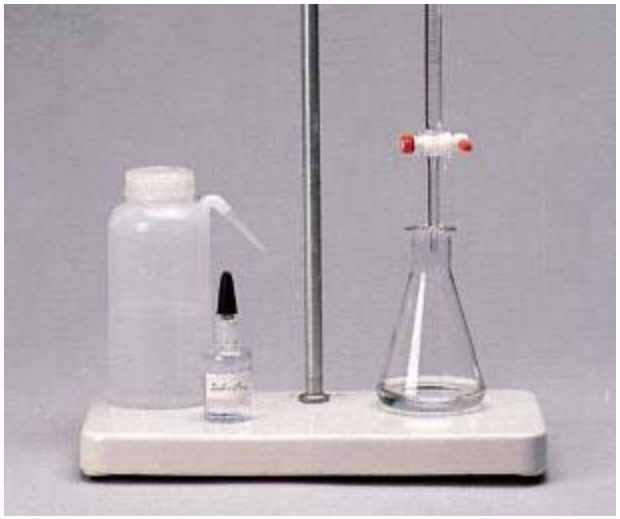
1. React solution of known concentration with measured volume of unknown solution

2. Reach endpoint of reaction
   Ratio of reactants equals that in chemical reaction.
   For acid/base: moles H^+ = moles OH^-

   Use an indicator to determine endpoint
   chemical that changes color at endpoint

3. Record volume of second solution

4. Calculate molarity of unknown solution based on molarity and volume of 1 solution and volume recorded in titration.



Acid/BaseTitration

25.00-mL of 0.200 M (H_2SO_4) is titrated with 12.32 ml of a NaOH solution. What is the molarity of the NaOH solution?

1) Find the concentration of H^+ and OH^- in the chemicals

$H_2SO_4(aq) + 2\ NaOH\ (aq) \rightarrow Na_2SO_4(aq) + 2\ H_2O$

$2H^+(aq) + 2\ OH^-(aq) \rightarrow 2\ H_2O$

2 moles of H^+ per mole of $H_2SO_4(aq)$ = 0.400M H^+

2) Solve for molarity OH-

moles of OH^- = moles of H_3O^+ at endpoint

$$M_{OH^-} = \frac{M_{H^+} x V_{H^+}}{V_{OH^-}} = \frac{0.400\,M_{H^+} x 25.00\,mL_{H^+}}{12.32\,mL_{OH^-}} = 0.812\,M_{OH^-}$$

2) Molarity of OH- = Molarity of NaOH

M_{NaOH} = 0.812M