Solutions → specic solute dissolving
it into solvent

Chemistry 11
Molarity

↗ water

The following are important definitions to know:

CONCENTRATION: the amount of solute present in a given volume of solvent

• CONCENTRATED:
↳ large amount of solute is present

• DILUTE:
↳ small amount of solute is present

MOLAR CONCENTRATION: "mole" of solute in [volume]
of solvent ← water   ↗ $\frac{1}{L}$

MOLARITY FORMULA:

$M = \frac{mol}{L}$

$M = mol \div L$
$mol = M \cdot L$
$L = mol \div M$

Example 1. If 5.0 L of solution contains 2.0 moles of Sodium Chloride, what is the molarity of the NaCl?

$M = \frac{2.0 \, moles}{5.0 \, L} = \boxed{0.40 \, (M) \, NaCl}$

Please note: the unitary symbols for molarity are mol/L but they can be expressed as:

M, [ ], or writen as "molar"

$Na = 23.0$
$Cl = 35.5$
$\overline{58.5}$

$[NaCl] = 0.40$ 0.40 molar NaCl

Example 2. What is the [NaCl] in a solution that contains 5.12 g of NaCl in 250.0 mL of solution?   → $\frac{mol}{L}$

$^{(3)}$
$\frac{5.12 \, (g) \, NaCl}{250.0 \, mL}$ × $\frac{1.0 \, mol \, NaCl}{58.5 \, g \, NaCl}$ × $\frac{1 \, mL}{1 \cdot 10^{-3} \, L}$ =
$_{(4)}$ $_{(3)}$

$\boxed{0.350 \, M \, NaCl}$

$Na = 23.0$
$O = 16.0$

MASS

7 mol
"x" g

$\frac{mol}{M \quad L}$ 40.0 g   M   mol   L

Volume of solution

Molarity of a solution

Example 3. What mass of NaOH is contained in 3.50 L of 0.200 M NaOH?

$$\frac{(3)}{3.50 \cancel{L}} \cdot \frac{0.200 \, mol \, NaOH}{(3)} \cdot$$

$$\frac{0.200 \, mol \, NaOH}{(3) \quad 1 \, L} \cdot$$

$$\frac{40.0 \, g \, NaOH}{1 \, mol} = \boxed{28.0 \, g \, NaOH}$$

$$2H = 2.0 \quad 1 \cancel{L}$$
$$1S = 32.1$$
$$4(16) \leftarrow 40 = 64.0 \longrightarrow 98.1$$

Example 4. What is the molarity of pure sulphuric acid, H_2SO_4, having a density of 1.839 g/mL?

$\frac{g}{mL} \to \frac{mol}{L}$

$$\frac{(4)}{1.839 \, g \, H_2SO_4} \cdot \frac{1 \, mol}{98.1 \, g \, H_2SO_4} \cdot \frac{1 \, mL}{1.10^{-3} \, L}$$

$$(3)$$

$$= \boxed{18.7 \, M \, H_2SO_4}$$

Example 5. What is the molarity of Calcium chloride in a solution made by dissolving 15.00 g of $CaCl_2 \cdot 6H_2O$ in 500.0 mL of water?

$$\frac{(4)}{15.00 \, g} \cdot \frac{1 \, mol}{219.1 \, g} \cdot \frac{1 \, mL}{1.10^{-3} \, L} = \boxed{0.1369 \, M \, CaCl_2}$$

$$\frac{}{500.0 \, mL} \quad \frac{}{(4)}$$

$$1 \, Ca = 40.0$$
$$2 \, Cl = 71.0$$
$$35.5$$

$$12 \, H = 12.0$$
$$6 \, O = 96.0$$

Example 6. If the density of pure perchloric acid ($HClO_4$) is 1.77 x 10^3 g/L, what is the molarity of the pure $HClO_4$?

$$\frac{(3)}{1.77 \cdot 10^3 \, g} \cdot \frac{1 \, mol \, HClO_4}{100.5 \, g} = \boxed{17.6 \, M \, HClO_4}$$

$$\frac{}{1 \, L} \quad \frac{}{(4)}$$

$$H = 1.0$$
$$Cl = 35.5$$
$$4 \, O = 64.0$$

$$100.5 \, g \, HClO_4$$

$$\boxed{H.W = 1-13}$$