Name: Key
Blk: ____ Date: ____

CHEMISTRY 11
MOLARITY

The following are important definitions to know:

CONCENTRATION: the amount of solute which exists in a given volume of solution.

CONCENTRATED: the solution has a relatively high [ ].

DILUTE: the solution has a relatively low [ ].

MOLAR CONCENTRATION: OR "MOLARITY" - the number of moles of the substance contained in 1 L of solution.

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

$$M = \frac{2.0 \text{ mol NaCl}}{5.0 \text{ L solution}} \Rightarrow \boxed{0.40 \text{ M NaCl}}$$

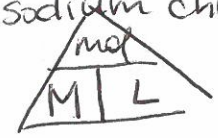
!MPT : 1. The unit symbol for "**mol/L**" is "**M**"
2. When expressed in words, the unit symbol **M** is written "**molar**"
3. The short-hand symbol for "**molar concentration of…**" is **[….]**

Example 2. If a 2.0 L solution contains 2.5 mol of NaCl, the molar concentration can be expressed in the following different ways:

$$M = \frac{2.5 \text{ mol NaCl}}{2.0 \text{ L}} \Rightarrow 1.3 \frac{\text{mol}}{\text{L}} \text{ NaCl}, 1.3 \text{ M NaCl}$$

or The molarity of sodium chloride is 1.3 molar.

THE MOLARITY EQUATION: $\boxed{M = \frac{\text{mol}}{\text{L}}}$



$\therefore$ $\text{mol} = M \cdot L$ $\left(\frac{\text{mol}}{\text{L}} \times \text{L}\right)$

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

Example 3. What is the [NaCl] in a solution containing 5.12 g of NaCl in 250.0 mL of solution?

(1.) Calculate the # of moles.

$$5.12 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.5 \text{ g NaCl}} = 0.0875 \text{ mol}$$

(2) Plug moles + Volume into M

$$M = \frac{0.0875 \text{ mol}}{0.2500 \text{ L}} = \boxed{0.350 \text{ M NaCl}}$$

Example 4. What mass of NaOH is contained in 3.50 L of 0.200 M NaOH?

mol / M | L

① Solve for the # of moles.

$0.200 \frac{mol}{L} \times 3.50 L = 0.700 \text{ mol NaOH}$

② use moles to solve for mass

$0.700 \text{ moles} \times \frac{40.0 \text{ g NaOH}}{1 \text{ mol NaOH}} = \boxed{28.0 \text{ g NaOH}}$

Example 5. What is the molarity of pure sulphuric acid, H_2SO_4, having a density of 1.839 g/mL? 1.839 g / 1 mL

① Solve the # of moles.

$1.839 \text{ g } H_2SO_4 \times \frac{1 \text{ mol } H_2SO_4}{98.1 \text{ g}} = 1.87 \times 10^{-2} \text{ mol}$

② Convert mL to L

$1 \text{ mL} \times \frac{1 \times 10^{-3} L}{1 \text{ mL}} = 1. \times 10^{-3} L$

③ M = mol / L

$\therefore \frac{1.87 \times 10^{-2} \text{ mol}}{1 \times 10^{-3} L} = \boxed{18.7 \text{ M } H_2SO_4}$

Example 6. What is the molarity of the $CaCl_2$ in a solution made by dissolving and diluting 15.00 g of $CaCl_2 \cdot 6H_2O$ to 500.0 mL?

① Solve the # of moles.

$15.00 \text{ g} \times \frac{1 \text{ mol } CaCl_2 \cdot 6H_2O}{219.1 \text{ g}} = 6.85 \times 10^{-2} \text{ mol}$

② convert mL to L $\longrightarrow$ 0.5000 L

③ Solve for M $= \frac{6.85 \times 10^{-2} \text{ mol}}{0.5000 L} = \boxed{0.1369 \text{ M } CaCl_2}$

Sample Problem: The density of pure $HClO_4$ is 1.77×10^3 g/L. What is the molarity of pure $HClO_4$?

1H = 1.0
1Cl = 35.5
4O = 64.0
100.5

① Solve # moles.

$1.77 \times 10^{+3} \text{ g } HClO_4 \times \frac{1 \text{ mol } HClO_4}{100.5 \text{ g } HClO_4} = 17.6 \text{ mol}$

② plug into (M)

$\frac{17.6 \text{ mol}}{1 L} = \boxed{17.6 \text{ M } HClO_4}$