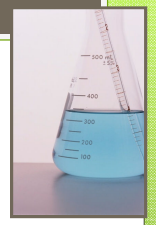
Molarity Notes

More about the Mole!

Chemistry 11

Molar Concentration:



- **CONCENTRATION:**
  - The amount of a substance which exists in a given volume of the solution
- **CONCENTRATED:**
  - A solution with a relatively HIGH concentration
  - (large amount of substance dissolved in the solution).
- **DILUTE:**
  - A solution with a relatively LOW concentration
  - (very little substance dissolved in the solution).

Molar Concentration (aka **Molarity**)

- is the number of moles of substance contained in 1L of solution. (mol/L)
  - **NOTE:** The above definition states 1 L of **SOLUTION** not 1L of SOLVENT.
- Things to remember:
  - the unit symbol for "mol/L" = "M".
  - the unit symbol "M" is said as "molar".
  - The short hand symbol for "molar concentration of..." is a set of brackets: "[...]".

Example:

- If 2.0 L of solution contains 5.0 mol of NaCl, what is the molarity of NaCl(aq)?

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

$$\therefore [\text{NaCl}] = \frac{5.0\text{mol}}{2.0\text{L}} = 2.5\ \frac{\text{mol}}{\text{L}} = 2.5\text{M}$$

More Examples:

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

Answer: [NaCl] = 0.350M

- What mass of NaOH is contained in 3.50 L of 0.200M NaOH?

Answer: 28.0g NaOH

More Examples:

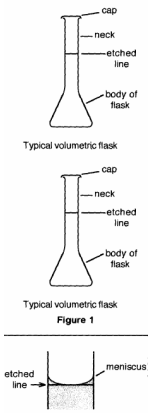
- What is the molarity of pure Sulfuric acid, $H_2SO_{4(aq)}$, having a density of 1.839 g/mL?

Answer: $[H_2SO_4]$ = 18.7M

- 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?

Answer: $[CaCl_2]$ = 0.1369M

Making Solutions:



- Using a balance, obtain the required mass of solute in a beaker.
- Dissolve the solid in distilled water.
- Transfer the solution and rinse all equipment into a clean volumetric flask.
- Add distilled water up to the calibration line on the flask. An eye dropper may be used.
- Stopper the volumetric flask and mix the contents thoroughly. (invert 20 times)

Dilution Calculations:

Simple dilution of a chemical in solution

$$m_1 \cdot v_1 = m_2 \cdot v_2$$

- Where:
  - m_1 = initial concentration of solution
  - v_1 = initial volume of solution
  - m_2 = diluted concentration
  - v_2 = diluted volume

In a diluted solution…

…the amount of chemical in the solution HAS NOT CHANGED, only the concentration.

- Therefore:

  MOLES OF CONCENTRATED CHEMICAL
  = MOLES OF DILUTED CHEMICAL

  (this is why our equation works!)

Simple Dilution Example:

- If 200.0 mL of 0.500 M NaCl is added to 300.0 mL of water, what is the resulting [NaCl] in the mixture?

$m_1 = 0.500M$

$v_1 = 200.0mL$

$m_2 = ?$

$v_2 = 500.0mL$

$m_1v_1 = m_2v_2$

$$m_2 = \frac{m_1v_1}{v_2} = \frac{0.500M \text{ x } 200.0mL}{500.0mL}$$

$m_2 = 0.200M$

Mixing Solutions of Different Chemicals Together:

- The solutions dilute each other, so two dilution equations would be needed – one for each chemical present
- Example:

  What are the final [NaCl] and [KOH], if 0.280L of 0.100M NaCl are added to 575.0mL of 0.850M KOH?

Answer: [NaCl] = 0.0327M
[KOH] = 0.572M

Mixing Solutions of the Same Chemical Together:

- Treat mixtures as two separate dilutions then add the results of the individual single dilutions to get the overall concentration
- **NOTE: the final concentration should be BETWEEN the two initial concentrations!**
- Example:

  If 300.0 mL of 0.250M NaCl is added to 500.0 mL of 0.100 M NaCl, what is the resulting [NaCl] of the mixture?

Answer: [NaCl]=0.1563M