REACTIONS IN SOLUTION

Section 5.5

Terminology

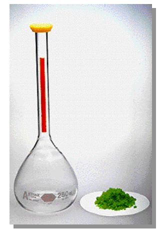
In solution we need to define the -

- **SOLVENT**

the component whose physical state is preserved when solution forms

- **SOLUTE**

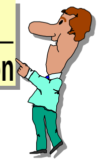
the other solution component



Concentration of Solute

The amount of solute in a solution is given by its **concentration**.

$$\text{Molarity(M)} = \frac{\text{moles solute}}{\text{liters of solution}}$$



PROBLEM: Dissolve 5.00 g of $NiCl_2 \cdot 6\,H_2O$ in enough water to make 250 mL of solution. Calculate molarity.

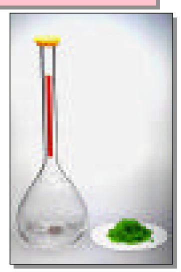
Step 1: Calculate moles of $NiCl_2 \cdot 6H_2O$

$$5.00\text{ g} \cdot \frac{1\text{ mol}}{237.7\text{ g}} = 0.0210\text{ mol}$$

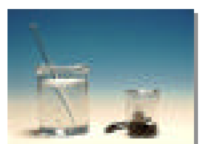
Step 2: Calculate molarity

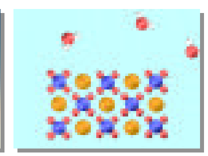
$$\frac{0.0210\text{ mol}}{0.250\text{ L}} = 0.0841\text{ M}$$

$[NiCl_2 \cdot 6\,H_2O] = 0.0841$ M



The Nature of the $KMnO_4$ Solution





$KMnO_4(aq) \rightarrow K^+(aq) + MnO_4^-(aq)$

If $[KMnO_4] = 0.30$ M, then

$[K^+] = [MnO_4^-] = 0.30$ M

The Nature of a Na_2CO_3 Solution

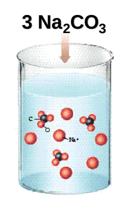
This water-soluble compound is ionic

$Na_2CO_3(aq) \rightarrow 2\,Na^+(aq) + CO_3^{2-}(aq)$

If $[Na_2CO_3] = 0.100$ M, then

$[Na^+] = 0.200$ M

$[CO_3^{2-}] = 0.100$ M



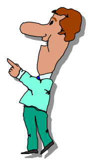
USING MOLARITY

What mass of oxalic acid, $H_2C_2O_4$, is required to make 250. mL of a 0.0500 M solution?

Because
Conc (M) = moles/volume = mol/V

this means that

moles = M • V



USING MOLARITY

What mass of oxalic acid, $H_2C_2O_4$, is required to make 250. mL of a 0.0500 M solution?

moles = M • V

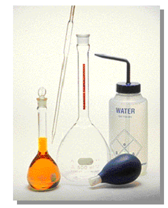
Step 1: Calculate moles of acid required.

(0.0500 mol/L)(0.250 L) = 0.0125 mol

Step 2: Calculate mass of acid required.

(0.0125 mol)(90.00 g/mol) = **1.13 g**

Preparing Solutions



- Weigh out a solid solute and dissolve in a given quantity of solvent.
- Dilute a concentrated solution to give one that is less concentrated.

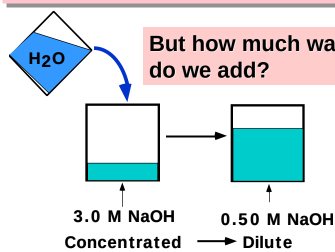
PROBLEM: You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What do you do?

Add water to the 3.0 M solution to lower its concentration to 0.50 M

Dilute the solution!

PROBLEM: You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What do you do?

But how much water do we add?



PROBLEM: You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What do you do?

How much water is added?

The important point is that --->

moles of NaOH in ORIGINAL solution = moles of NaOH in FINAL solution

PROBLEM: You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What do you do?

Moles of NaOH in original solution =

$M \cdot V$ =

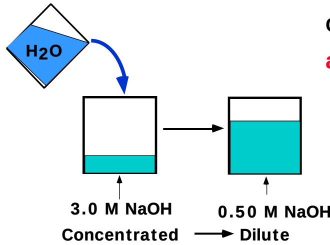
(3.0 mol/L)(0.050 L) = 0.15 mol NaOH

Therefore, moles of NaOH in final solution must also = 0.15 mol NaOH

(0.15 mol NaOH)(1 L/0.50 mol) = 0.30 L

or 300 mL = volume of final solution

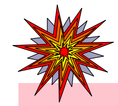
PROBLEM: You have 50.0 mL of 3.0 M NaOH and you want 0.50 M NaOH. What do you do?



Conclusion:

add 250 mL of water to 50.0 mL of 3.0 M NaOH to make 300 mL of 0.50 M NaOH.

Preparing Solutions by Dilution



A shortcut

$$M_{initial} \cdot V_{initial} = M_{final} \cdot V_{final}$$