## Standard Solutions

**"A solution whose concentration is accurately known"**

Made by

- Dissolving a known mass of a substance in a volumetric flask. E.g. 1.00 L of a 2.00 mol $L^{-1}$ standard solution of sodium hydroxide (NaOH), requires 2.00 mol of NaOH (80.0g), dissolve it in some distilled water and make it up to a volume of 1 L in a volumetric flask.
- Making up a rough solution and standardizing it in a titration reaction with a solution of a known concentration

**Example: Finding the concentration of a standard solution**

Calculate the concentration of a solution of sodium carbonate made by dissolving 23.9 g of $Na_2CO_3$ in water and made up to 250 mL. $M(Na_2CO_3)$ = 106.0 g $mol^{-1}$

| | | | |
|---|---|---|---|
| m | = 23.9 g | c | = **0.902 mol $L^{-1}$** |
| M | = 106.0 g $mol^{-1}$ | V | = 0.250 L |
| n | = 0.225 mol | n | = 0.225 mol |

## Making up Solutions

**Example 1**

How many moles of NaOH are contained in 25.0 mL of 0.100 mol $L^{-1}$ sodium hydroxide solution?

c(NaOH) = 0.100 mol $L^{-1}$

V(NaOH) = 0.025 L

n(NaOH) = cV
= 0.100 mol $L^{-1}$ x 0.025 L
= **0.00250 mol**

**Example 2**

What mass of potassium permanganate ($KMnO_4$) is required to make up 100 mL of a 0.0200 mol $L^{-1}$ solution? $M(KMnO_4)$ = 158.0 g $mol^{-1}$

| | | | |
|---|---|---|---|
| $c(KMnO_4)$ | = 0.0200 mol $L^{-1}$ | $m(KMnO_4)$ | = **0.316 g** |
| $V(KMnO_4)$ | = 0.100 L | $M(KMnO_4)$ | = 158.0 g $mol^{-1}$ |
| $n(KMnO_4)$ | **= 0.00200 mol** | $n(KMnO_4)$ | **= 0.00200 mol** |

## Solution Calculations

We have already used the relationship m = nM combined with a balanced equation to calculate the mass of substances.

We can use n = cV in the same way

**Steps**

**1.** Write a balanced equation
**2.** Find the number of moles of the known substance
**3.** Use the balanced equation to find the number of moles of the unknown substance
**4.** Find the mass / volume / concentration of the unknown substance

**Example**

What volume of 2.00 mol $L^{-1}$ HCl solution will react with 0.430 g of magnesium ribbon

[1]Mg + **2**HCl → $MgCl_2$ + $H_2$

| | | |
|---|---|---|
| m(Mg) | = 0.430g | c(HCl) = 2.00 mol $L^{-1}$ |
| M(Mg) | = 24.3 g $mol^{-1}$ | [4]V(HCl) = 0.0354 mol / 2.00 mol $L^{-1}$ **= 0.0177 L (3sf)** |
| [2]n(Mg) | = 0.43 g / 24.3 g $mol^{-1}$ = **0.0177 mol** | [3]n(HCl)= **0.0354 mol** |

**x2** due to stoichiometry