Preparing solutions

# Preparing Solutions from solids

First of all, you need to know how much of the solution you require and what concentration.

Then you need to work out how many moles of solute you need. This will depend on the concentration of the solution (the more concentrated, the more solid you need) and the volume (the more volume, the more you need)

**Molar solutions**

These are solutions that are made up in terms of moles.

For example, the gram formula mass of sodium hydroxide is 40g. We can therefore say that 1 mole of sodium hydroxide is 40g.

If a solution has one mole of a substance in one litre of solution, we say it has a concentration of **1 mole per litre**. This is written as **1 mol l-1**.

40g of NaOH in 1 litre of solution is **1 mol l-1** NaOH, as is 20g in 500 cm3, 4g in 100 cm3 or 80g in 2 litres.

**Making up molar solutions**

***Example***

*You need to make up 250 cm3 of a 0.5* mol l-1 *solution of copper sulphate-5-water*

*A 1* mol l-1 *solution contains 1 mole in a litre of solution*

*So a 0.5* mol l-1 *solution contains half that, 0.5 moles in a litre*

*250 cm3 is ¼ of a litre*

*So you need ¼ of the amount of copper sulphate to make this amount*

*= 0.5 ÷ 4 = 0.125 of a mole (1/8)*

*The gram formula mass of copper sulphate hydrate is 249.685*

*So you need 249.685 ÷ 8 = 31.2106g (Which you will probably round to 31.21g)*

It is all about simple ratios really. You need to bear in mind

a) What effect will the concentration have? 2 mol l-1 has 2 moles per litre, 0.1 mol l-1 has 1/10 mole per litre

b) What effect will the volume have? 500 cm3 of a 1 mol l-1 solution only has 0.5 moles in it. 100 cm3 of the same solution will contain 0.1 moles.

**Other Concentrations**

% solutions.

Sometimes, particularly in Biology, concentrations are given in percentage terms rather than molar – this is usually because the gram formula masses of biological compounds are often highly variable or not known.

Concentrations can be given as w/v or v/v.

The first letter refers to the solute and the second to the solution. Concentrations written like this indicate the weight or volume of a given dissolved substance dissolved in a given volume of solution. i.e.

* w/v means weight/volume
* v/v means volume/volume

These are given as a percentage e.g. 2% w/v starch solution. (If it does not specify, assume m/v for a solid and v/v for a liquid)

A 2% w/v starch solution is made by dissolving 2g of starch in distilled/deionised water and making up to 100 cm3 of solution.

A 2% v/v solution of ethanol would be made by mixing 2 cm3 of ethanol with water and making up to 100 cm3.

*For example:*

*To make up 250 cm3 of a 1% starch solution.*

*1% of 250 is 2.5*

*So weigh out 2.5g of starch.*

*Dissolve it in 50 - 100cm3 of boiling water then make up to the final volume (250 cm3) with cold distilled water.*

*(NB do not put very hot liquids in a volumetric flask as it can cause them to crack)*

# Preparing Solutions by Diluting Others

It is sometimes easier to prepare solution by diluting a less concentrated one rather than starting from scratch.

This is fine if very accurate concentrations are not required, e.g. for everyday experiments (solutions used for qualitative measurements such as just observing a gas being made or something changing colour, are called bench solutions).

***Example***

*Suppose you had some 5* mol l-1 *HCl and wished to prepare 250 cm3 of a 1* mol l-1 *HCl solution from it. The volume of acid you will need to measure out can be calculated using the following formula:*

*Volume to measure out = New Molarity x Volume Required*

 *Original Molarity*

*The new molarity is 1* mol l-1

*The volume required is 250 cm3*

*The original molarity is 5* mol l-1

*The volume of acid to measure out = 1 x 250*

 *5*

 *= 50 cm3*

*In other words, measure out 50 cm3 of the 5* mol l-1 *HCl and make the total volume up to 250 cm3 with distilled water.*