Salt preparations and making crystals

In general you are expected to be able to suggest a way of making a salt (pretty much any ionic compound that is not an acid or a base) from two different chemicals. You are expected to know whether the salt will be soluble or not in water **so learn the "solubility rules".**

Preparing insoluble salts

- Mix solutions of appropriate substances that will form the salt as a precipitate
- collect the precipitate by filtration (and wash it in the filter funnel with water)
- dry the solid between two pieces of filter paper.

Examples:
To make PbI_2: need solutions of a soluble lead compound (lead(II) nitrate) and a soluble iodide (e.g. potassium iodide).

$$Pb(NO_3)_{2\,(aq)} + 2KI_{\,(aq)} \rightarrow 2KNO_{3\,(aq)} + PbI_{2\,(s)}$$

To make AgCl: need solutions of a soluble silver compound (silver nitrate) and a soluble chloride (e.g. sodium chloride).

$$AgNO_{3\,(aq)} + NaCl_{\,(aq)} \rightarrow NaNO_{3\,(aq)} + AgCl_{\,(s)}$$

Preparing soluble salts

This can get quite involved, but there are some basic ideas that apply to all preparations:

- Mix appropriate substances that will form a solution of the salt in water (this solution must not contain anything else such as reactants or indicators)
- Heat this solution to evaporate off **some** of the water (making the solution concentrated)
- Allow the solution to **cool and crystallise** (this happens because nearly all salts are less soluble in water at lower temperatures -the main thing is that you do not evaporate off all the water)
- collect the crystals by filtration
- dry the crystals between two pieces of filter paper.

The reactions you should use to make soluble salts usually fall into four categories, all of which involve a reaction with an acid. In all cases choose the correct acid to give you the negative ion and the other compound to give the positive ion:

Type of salt	Acid required
chloride	Hydrochloric acid
nitrate	Nitric acid
sulphate	Sulphuric acid
ethanoate	Ethanoic acid

Positive ion required	Possible starting material(s)
Copper(II)	Copper(II) oxide, copper(II) carbonate
Zinc	Zinc metal, zinc oxide, zinc carbonate
magnesium	Magnesium metal, magnesium oxide, magnesium carbonate
ammonium	Ammonia solution (titration method)
sodium	Titration method with any of sodium hydroxide, sodium hydrogen carbonate or sodium carbonate
potassium	Titration method with any of potassium hydroxide, potassium hydrogen carbonate or potassium carbonate

Methods involving insoluble starting materials:

- Add excess insoluble solid (e.g. metal, metal oxide or metal carbonate) to a limited amount of the appropriate acid (remember that some metals like copper do not react with acids)
- Ensure the reaction has finished, so all of the acid is used up. (This is usually done by heating and/or stirring; looking for no effervescence; checking the pH of the solution by putting a drop of it onto some blue litmus paper)
- Filter the mixture to remove excess solid
- Heat the filtrate (solution) to evaporate off **some** of the water (making the solution concentrated)
- Allow the solution to **cool and crystallise** (this happens because nearly all salts are less soluble in water at lower temperatures -the main thing is that you do not evaporate off all the water)
- collect the crystals by filtration
- dry the crystals between two pieces of filter paper.

Titration method:

Needed when all starting materials and the desired salt are soluble (i.e. making ammonium and group I salts)

- Titrate the alkali (e.g. Gp.I metal hydroxide or ammonia solution) with the acid, using an indicator such as methyl orange
- Find the accurate titre required and then discard this solution
- Start again without the indicator, adding exactly the right amounts of acid and base to give a neutral solution
- Heat the solution to evaporate off **some** of the water
- Allow the solution to **cool and crystallise**
- Collect the crystals by filtration
- Dry the crystals between two pieces of filter paper.