Making and identifying salts

How do we make salts?

- Reacting a metal with an acid
- Reacting an insoluble base with an acid
- Neutralizing an alkali with an acid by titration
- By precipitation

Salts from metals

- This method is only suitable for metals above hydrogen in the reactivity series, such as: magnesium, zinc, aluminum and iron
- It is not appropriate for metals such as copper, lead and silver as they are too close to hydrogen in the reactivity series
- It is also not a good idea to prepare salts of sodium and potassium using this method as the reaction is too violent

Procedure:

1. Add the metal to the acid in a flask so that the metal is in excess. The acid is the limiting reagent.
2. Warm the flask gently to complete the reaction
3. Filter off the excess metal. The filtrate is a solution of the metal salt
4. Put the filtrate into an evaporating basin and evaporate the water until crystallization point. Allow crystals to form at room temperature
5. Filter off crystals and wash them with small volumes of distilled water so that they do not dissolve
6. Dry between the folds of filter paper

Salts from insoluble bases

- We can make salts with many metals by reacting an insoluble base with an acid
- Used for making salts of metals that are low on the reactivity series
- For example:

$$CuO(s) + H_2SO_4(aq) \rightarrow CuSO_4(aq) + H_2O(l)$$

Titrations

- Titration is used to make a soluble salt from a soluble base and an acid
- This method is used to make salts of Group 1 metals and ammonium salts
- We use an acid-alkali titration to find out how much acid is needed to react exactly with the solution of an alkali
- We use an indicator to find when the acid has just reacted with the alkali (called the end point)
- At the end point the indicator changes color.
- The titration is first carried out with an indicator and then without any indicator
- The acid usually goes in the burette and the alkali in the flask
- The indicator depends on whether you use a strong or weak acid or alkali:
    - For a strong acid and alkali use any indicator
    - For a weak alkali (ammonia) we titrate with a strong acid. The indicator used is methyl orange which goes from orange to red when there is excess acid

- For a weak acid, we used a strong base. The indicator used is phenolphalein which changes from pink to colorless when there is excess acid

Procedure

1. Rinse the pipette with alkali, measure a known volume of alkali into the flask using a volumetric pipette
2. Add a few drops of indicator solution
3. Rinse the burette with acid, fill burette with acid using a funnel
4. Record the burette reading
5. Allow acid to flow into flask, swirl the flask to mix solution until the indicator changes color
6. Record burette reading

$$Titre = Final\ reading - intial\ reading$$

7. Repeat this 3 times, add acid drop by drop without indicator
8. Do calculation to find the concentration of alkali using accurate titres (taken on average)

Precipitation

- This is used to make insoluble salts
- It is made by mixing 2 soluble compounds that contain the cation and anion of the insoluble salt you wish to make
- The cation and anion will react to form a precipitate

Procedure

1. Identify the ions present in the insoluble salt
2. Use the solubility table to choose soluble compounds including these ions
3. Add one solution to the other
4. Filter off the precipitate then wash and dry the solid

Soluble Compounds	Insoluble Compounds
All salts of Group 1 elements	
All nitrates	
All ammonium salts	
Most chlorides, bromides and iodides	Chlorides, bromides and iodides of silver and lead
Most sulfates	Sulfates of calcium, barium and lead
Group 1 hydroxides and carbonates (calcium hydroxide is slightly soluble)	Most hydroxides and carbonates
Group 1 and 2 oxides react with water	Most metal oxides

Testing for cations

Procedure

1. Put $1cm^3$ of solution into a test tube
2. Add $1cm^3$ of NaOH (aq)
3. Observe color of the precipitate
4. Add excess NaOH (aq) and shake
5. Record if precipitate dissolves or any color change

Results

Al^{3+} -White precipitate; soluble in excess (colorless solution)

Zn^{2+}- White precipitate; soluble in excess (colorless solution)

Ca^{2+}-White precipitate; insoluble in excess

Cu^{2+}-Light blue precipitate; insoluble in excess

Fe^{2+}-Light green precipitate; insoluble in excess

Fe^{3+}-Red/brown precipitate; insoluble in excess

6. Repeat the procedure using $NH_3(aq)$

Results

Al^{3+}-White precipitate; insoluble in excess

Zn^{2+}-White precipitate; soluble in excess (colorless solution)

Ca^{2+}-No precipitate

Cu^{2+}-Light blue precipitate; soluble in excess (dark blue solution)

Fe^{2+}-Light green precipitate; insoluble in excess

Fe^{3+}-Brown precipitate, insoluble in excess

Testing for ammonium ions

Procedure

1. Put $1cm^3$ of the solution in a test tube
2. Add $1cm^3$ of NaOH (aq)
3. Heat with damp red litmus paper attached to the mouth of the test tube

Positive result: Ammonia gas is given off, choking smell and turns the red litmus blue

Testing for anions

Testing for Halides

Procedure

1. Add $1cm^3$ of halide solution
2. Add the same volume of nitric acid
3. Add a few drops of silver nitrate solution
4. Observe color of precipitate

Results

Cl^--White

Br^- -Cream

I^--Pale yellow

Identifying carbonate ions

- If you add an unknown compound that contains a carbonate ion you will see a gas bubbling (effervescence)
- Test the gas using lime water because carbon dioxide turns limewater milky
- Positive result: Carbon dioxide is given off

Identifying nitrates

Procedure

1. Put $1cm^3$ of solution in a test tube
2. Add NaOH (aq) and a few pieces of aluminum foil
3. Heat gently
4. Test the gas given off with damp red litmus paper

Positive result: litmus paper turns blue because ammonia gas is given off

Identifying sulfates

Procedure

1. Put $1cm^3$ of unknown solution
2. Add $1cm^3$ of HCl (aq)
3. Add $1cm^3$ of Barium chloride or Barium nitrate

Positive result: White precipitate