

## **Purity and formulations:**

Pure substance = Made of one type of atom only

Pure substances melts at specific temperatures and also have a specific boiling point

Impure substances melt and boil over a range of temperatures

Formulation = Complex mixture that has been designed as a useful product for use in the real world

In formulations, quantity of each component is measured so that the product has properties we need

Formulations include:

- Fuels
- Cleaning products
- Medicines
- Alloys

## **Chromatography:**

Paper chromatography allows us to separate substances based on their different solubilities

Paper is stationary phase

Solvent is mobile phase

Pure compounds will produce a single spot in all solvents

Compounds in mixtures may separate into different spots depending on the solvent

A compound with higher solubility will travel further up

### **Why we draw the line in pencil:**

- If we drew the line in pen, the pen ink would move up the paper, with the solvent

### **Required practical – Paper Chromatography:**

1. Use a ruler to draw a horizontal pencil line on the chromatography paper, the line should be around 2cm from the bottom of the paper.
2. Mark 5 pencil spots out of equal spaces across the line. Leave at least 1cm clear at each side.
3. Use a capillary tube to put a small spot of each of the known food colours and the unknown colour onto the pencil spots. A capillary tube is simply a very thin glass tube.
4. Now we put water into a beaker to a depth of 1cm.

5. Attach the paper to a glass rod using tape and we lower the paper into the beaker. The bottom of the paper should dip into the water. Now there are three key points here:
  - Firstly, the pencil line with the spot of ink must be above the surface of the water. Otherwise, the water will wash the ink off the line.
  - Secondly, the sides of the paper must not touch the sidewalls of the beaker. If that happens, then it will interfere with the way the water moves.
  - And lastly, we usually put a lid on the beaker to reduce the evaporation of the solvent.
6. Remove the paper when the water travels around 3/4 of. At this stage we use a pencil to mark the point where the water reached
7. We hang the paper to dry

$$R_f = \frac{\text{distance moved by chemical}}{\text{distance moved by solvent}}$$

You can look up the  $R_f$  value up in a database and that will tell us the identity of the chemical

Several different chemicals may have this  $R_f$  value so we may need to repeat this experiment using a different solvent to narrow it down further

If this chemical has not been analysed before then there is no  $R_f$  value in the database

### **Testing for gases:**

**Test for hydrogen:**

- Insert a burning splint into the test tube
- Produces a squeaky pop sound

**Test for oxygen:**

- Place glowing splint into test tube
- Glowing splint relights

**Test for Carbon dioxide:**

- Draw some gas into plastic pipette
- Bubble gas through limewater
- Limewater will turn cloudy

Limewater is an aqueous solution of calcium hydroxide (calcium hydroxide dissolved in water)

**Test for chlorine:**

- Insert damp litmus paper into mouth of test tube
- Chlorine bleaches litmus paper and turns it white

**Flame tests:**

Flame tests are used to test for metal ions

1. Place a small amount of the chemical on a wire mounted in the handle
2. Place the end into a blue Bunsen burner flame

### **Test for anions:**

Lithium – Produces crimson flame

Sodium – Produces a yellow flame

Potassium – Produces a lilac flame

Calcium – Produces an orange-red flame

Copper – Produces a green flame

### **Problems:**

- Colour of flame may be difficult to distinguish, especially if there's a low concentration of the metal compound
- Samples may contain a mixture of metal ions which can mask the colour of the flame

### **Flame emission spectroscopy:**

Sample of metal ion in solution is placed into flame

Light given out is passed into spectroscope

Spectroscope converts light into line spectrum

Lines on line spectrum become more intense at a higher concentration

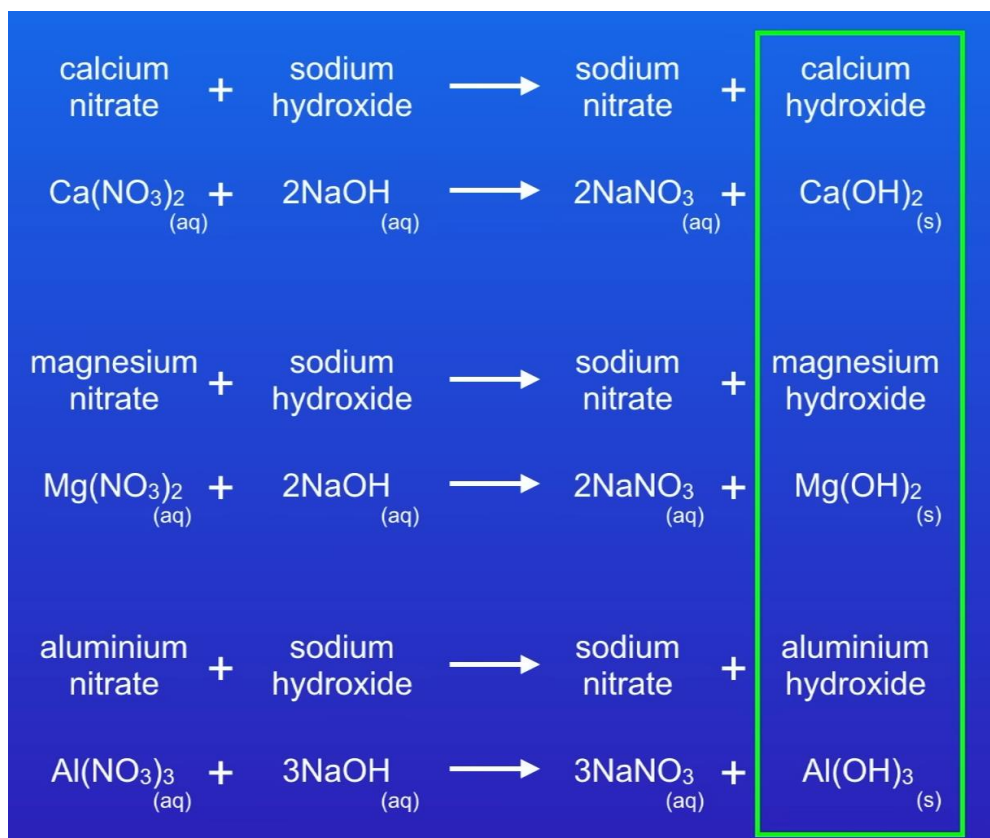
**Advantages:**

- Instrumental methods are rapid
- Instrumental methods are sensitive (will work even with tiny sample)
- Instrumental methods are accurate

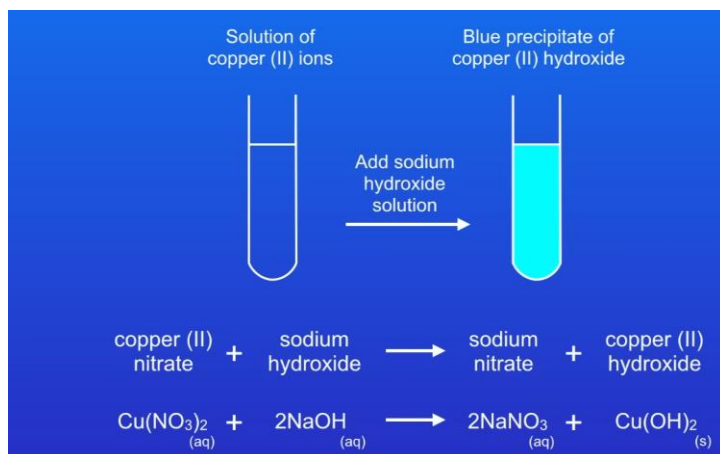
**Metal hydroxide precipitate:**

Adding sodium hydroxide to calcium ions, magnesium ions, aluminium ions, produces a white precipitate

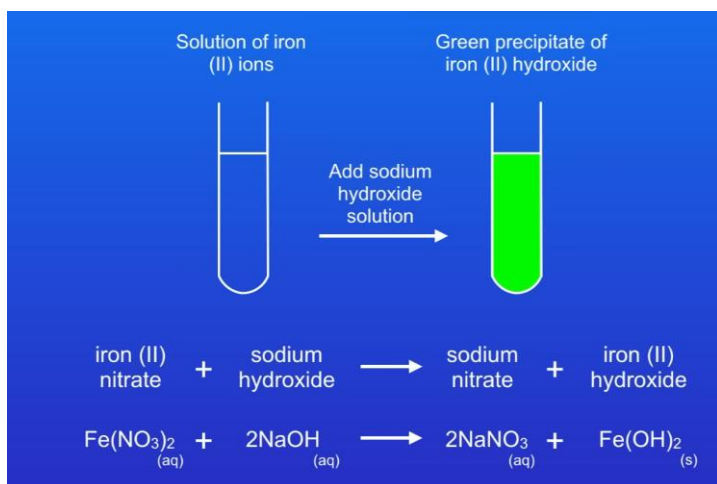
Adding excess sodium hydroxide to aluminium causes it to redissolve



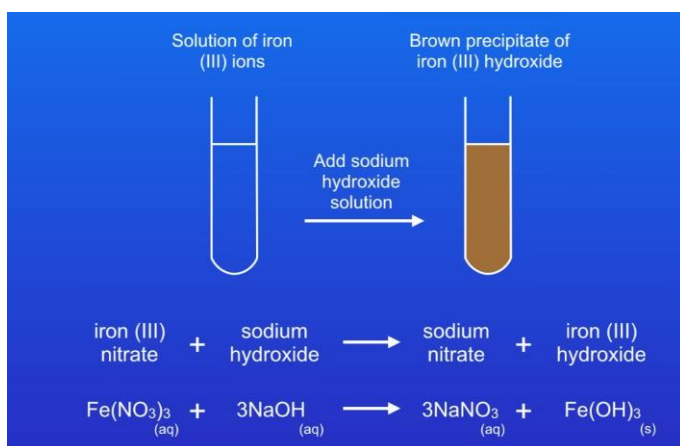
Copper (II) ions react with sodium hydroxide to form blue precipitate of copper (II) hydroxide



Iron (II) ions react with sodium hydroxide to form green precipitate of iron (II) hydroxide



Iron (III) ions react with sodium hydroxide to form, brown precipitate of iron (III) hydroxide



## Identifying non-metal ions:

### Testing for carbonate ion:

1. Add dilute acid to sample
2. Acid will react with carbonate to make  $\text{CO}_2$ 
  - You will see effervescence (does not prove  $\text{CO}_2$  is present)
3. Bubble gas through limewater. If limewater goes cloudy, then  $\text{CO}_2$  present so it means we have started with carbonate ion



### **Testing for halide ions:**

1. Add dilute nitric acid to sample
2. Add dilute silver nitrate solution
3. Halide ions produce a precipitate of the silver halide
  - Chloride ions → White precipitate (silver chloride)
  - Bromide ions → Cream precipitate (silver bromide)
  - Iodine ions → Yellow precipitate (silver iodide)

### **Testing for sulphate ions:**

1. Add dilute HCl to sample
2. Add barium chloride solution
3. If sulfate ions present, white precipitate forms

### **Required practical – Identifying ions**