Smart Edu Hub

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IGCSE/A LEVELS/IB Coaching Academy

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SUPPLIERS OF TOPIC WISE PAST PAPERS FOR CHECKPOINTS/IGCSE/A LEVELS/IB

- **Identifying cations and anions**
- **Identifying gases**
- **Salt making**
- **Solubility rules (with Mnemoic)*****
- **Reactivity Series (with Mnemoic)*****

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-------Identifying Cations-----

There are two ways of testing for cations:

A. By using sodium hydroxide or aqueous ammonia solution.
B. Flame test

A: By using sodium hydroxide or aqueous ammonia solution.

Procedure:

- 1.Put a small amount of solution you want to identify into a test tube.
- 2.Add a few drops of aqueous sodium hydroxide.
- Observe the colour of the precipitate formed.
- Add excess sodium hydroxide and shake the test tube.
- Record whether or not the precipitate dissolves and any colour change.

Note :

- Sodium hydroxide and ammonia react in a similar way with some of the ions. However we use these two alkalis to distinguish between the colourless solutions containing the aluminum and zinc ions.
- If the alkalis are not in excess, the precipitates formed are metal hydroxides.

Identifying Cations

Metal cation	Result with aqueous NaOH	Result with aqueous ammonia
Al^{3+}	White precipitate	White precipitate
	Soluble in excess (Colourless solution)	Soluble in excess (Colourless solution)
Ca^{2+}	White precipitate	No precipitate or very slight white precipitate
	Insoluble in excess (Colourless solution)	
Cu^{2+}	Light blue precipitate	Light blue precipitate
	Insoluble in excess	Soluble in excess (Dark blue solution)
Cr^{3+}	Grey-green precipitate	Grey-green precipitate
	Soluble in excess , green solution	Soluble in excess , green solution, partly dissolves on standing to form a violet solution
Fe^{2+}	Grey-green precipitate	Grey-green precipitate
	Insoluble in excess	Insoluble in excess
Fe^{3+}	Reddish brown precipitate	Reddish brown precipitate
	Insoluble in excess	Insoluble in excess
Zn^{2+}	White precipitate	White precipitate
	Soluble in excess (Colourless solution)	Soluble in excess (Colourless solution)

Test for ammonium ions:

Heat the solution with sodium hydroxide solution. If the solution contains ammonium ions, then ammonia gas will be given off which will turn damp red litmus paper blue.

$$NH_4^+ + OH^- \longrightarrow NH_3 + H_2O$$

ammonium ions	hydroxide ions	ammonia gas	water

Flame tests for cations:

A flame test can be used to identify some cations especially those in compounds containing elements from Group1 and 2.

Procedure:

- Clean a platinum or a nichrome wire by dipping it in concentrated hydrochloric acid.
- Place a sample of a compound on the end of the wire.
- Hold the wire on the edge of a non-luminous(blue) Bunsen flame.
- Note any change in the colour of the flame.

Metal ion	Flame colour
Li^+	Red/Bright red
Na^+	Golden yellow/orange
K^+	Purple/lilac
Cu^{2+}	Blue-green
Ba^{2+}	Apple green
Ca^{2+}	Brick red

Testing for anions

Test for halides:(Cl^-,Br^-,I^-)

Procedure

- Take the solution to be tested.
- Take an equal volume of dilute nitric acid.
- Add a few drops of aqueous silver nitrate solution.
- Observe the colour of the precipitate.
  Note: The ppt obtained are all silver halides

Results:

- ❖ Cl^- gives a white ppt
- ❖ Br^- gives a cream ppt
- ❖ I^- gives a yellow ppt

Identifying carbonate ions

Procedure:

- Add dilute acid to a solution which can either be a solid or a solution.

Result:

If a carbonate is present then we will see effervescence(bubbles of the gas). Lime water test can be used to check for the presence of carbon dioxide gas.

Identifying nitrates

Nitrate ions can be tested by reducing them to ammonia. If ammonia is given off then the compound is likely to be a nitrate.

Procedure:

- Put an aqueous solution of an unknown compound into a test tube.
- Add sodium hydroxide then aluminium foil and warm gently.

Result:

If ammonia is given off it will turn damp red litmus paper blue.

Identifying sulfates

Barium chloride solution or barium nitrate solution is used to test for sulfates.

Procedure:

- Put an aqueous solution of an unknown compound into a test tube.
- Add equal volume of dilute hydrochloric acid an d then add an aqueous barium salt.

Result:

- ❖ If a white ppt is formed , then the compound is a sulfate.
  Note: HCL is added so that the carbonate ions are removed. so that they would not interfere with the results of this test.

Identifying sulfites

Most sulfites are insoluble except Gr2 sulphites and ammonium sulfites.

Procedure:

- Put an aqueous solution of an unknown compound into a test tube.
- Add dilute hydrochloric acid and then warm it gently.
- Test the gas that is given off with a paper soaked in acidified potassium manganate (V11)

Result:

- ❖ If sulfur dioxide is given off then sulfite is present the paper turns from purple to colourless.

IDENTIFYING GASES

1. Identifying hydrogen:

Put a lighted splint at the mouth of a test tube . If hydrogen is present then it will burn with a squeaky pop sound. This is because hydrogen burns with the oxygen in the air with a squeaky pop sound.

2. Identifying oxygen:

Put a glowing splint at the mouth of a test tube . If oxygen is present then it will burn even much better than before and it will relight. This is because the test tube filled with oxygen has no nitrogen to dilute it.

3. Identifying ammonia:

Put a damp red litmus paper at the mouth of a test tube containg the gas to be tested . If ammonia is present then it will turn the blue litmus red and give out a sharp pungent smell.

4. Identifying carbon dioxide gas:

Bubble the gas given out in a reaction into a test tube containing lime water (which is $Ca(OH)_2$). If carbondioxide [CO_2] is present then it will turn the lime water cloudy(milky).

Lime water [$Ca(OH)_2$] ; is a colourless base that reacts with carbondioxide CO_2 which is an acidic oxide to form a white solid salt(precipitate) of calcium carbonate ; $CaCO_3$.

Reaction: $Ca(OH)_2(aq) + CO_2(g) \dashrightarrow CaCO_3(s) + H_2O(l)$

calcium hydroxide carbondioxide calcium carbonate water

5. Identifying chlorine

Put a damp litmus paper or universal indicator paper at the mouth of a test tube containing the gas to be tested . If chlorine is present then it will appear as a green gas and turn the litmus red and the universal indicator paper white give out a sharp pungent smell. It is a poisonous gas so it should be tested in a fume cupboard only.

6. Identifying sulfur dioxide gas

Sulfur dioxide gas is a colourless poisonous gas . So it should be tested in a fume cupboard. When the gas is bubbled through an acidified solution of purple coloured potassium manganate (VII) , the solution turns colourless.

Preparing salts

There are 4 ways of making salts:

1. Reacting a metal with an acid.
2. Reacting an insoluble base with an acid.
3. Neutralising an alkali with an acid by titration method.
4. By precipitation. (Making insoluble salts)

General reactions:

1. Reacting a metal with an acid.

Metal + Acid ------> Metal Salt + Water

2. Reacting an insoluble base with an acid.

Insoluble base + Acid ------> Metal Salt + Water

3. Neutralising an alkali with an acid by titration method.

Alkali + Acid ------> Metal Salt + Water

4. By precipitation.

Soluble Compound + Soluble Compound->Soluble Salt + Insoluble Salt

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1. Reacting a metal with an acid.

Metal + Acid ------> Metal Salt + Hydrogen

Note:

- This method of salt making is used for metals above hydrogen in the reactivity series
- The series has the most reactive metals on the top and the least reactive metals at the bottom.
- Carbon and hydrogen are non-metals. They have been included for comparison only.
- We cannot make salts of copper, lead and silver which are below hydrogen in the reactivity series.
- Salts of highly reactive metals cannot be prepared in this way.
- So we can make salts of Mg, Al, Zn and Fe in this way.

Reactivity series:

Mnemonics	Metals	Metal Ions
People	Potassium	K^+
Should	Sodium	Na^+
Carefully	Calcium	Ca^{2+}
Make	Magnesium	Mg^{2+}
All	Aluminium	AL^{3+}
COMEDY	CARBON	
Zoo	Zinc	Zn^{2+}
Insects	Iron	Fe^{2+}
Tall	Tin	Sn^{2+}
Like	Lead	Pb^{2+}
HOW	HYDROGEN	
Camel	Copper	Cu^{2+}
Should	Silver	Ag^+
Get	Gold	Au^{3+}
Pepsi	Platinum	Pt^{2+}

Examples for:

Metal + Acid ------> Metal Salt + Hydrogen

$Zn\ (s) + H_2SO_4(aq) \longrightarrow Zn(SO)_4(aq) + H_2(g)$ Zinc sulfate

$Mg(s) + HCl\ (aq) \longrightarrow MgCl_2\ (aq) + H_2(g)$ magnesium chloride

$Mg(s) + HNO_3(aq) \longrightarrow Mg(NO)_3(aq) + H_2(g)$ magnesium nitrate

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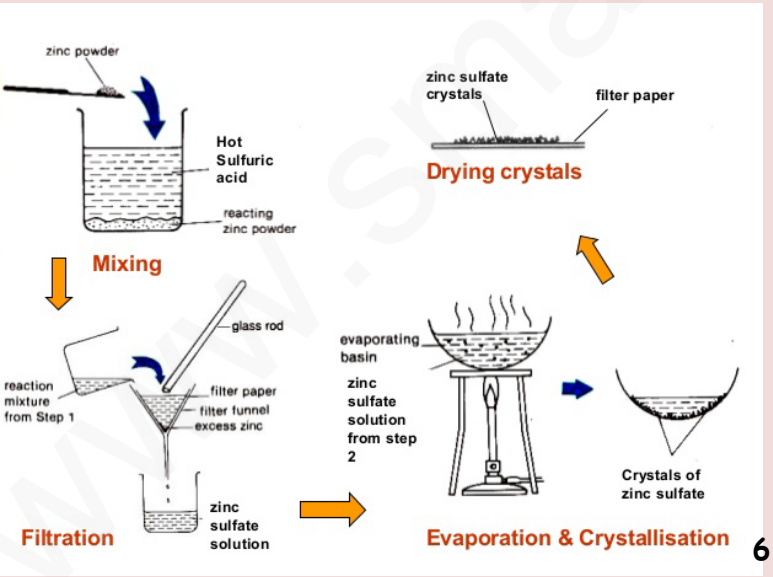
- When a metal reacts with hydrochloric acid the salt produced is a chloride.
- When a metal reacts with sulfuric acid the salt produced is a sulfate.
- When a metal reacts with nitric acid the salt produced is a nitrate.

Metal + Acid ------> Metal Salt + Hydrogen

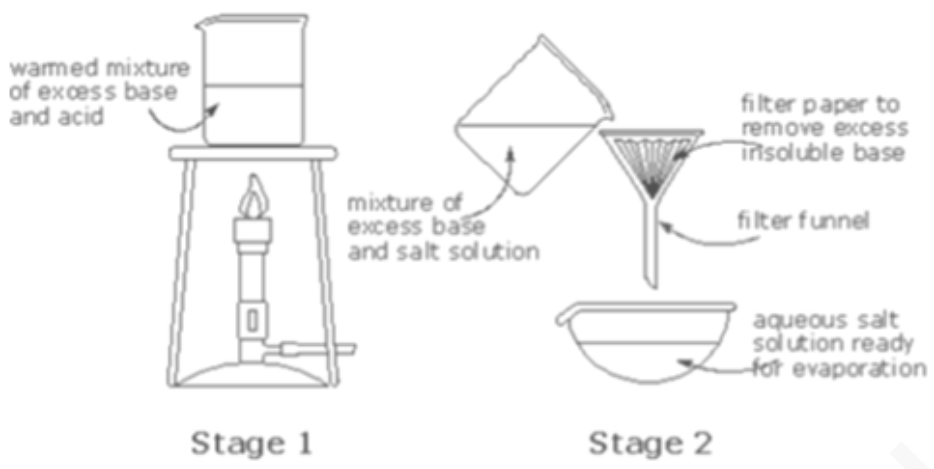


Steps for salt making:

1. Add excess metal to the acid in the flask.
2. Complete the reaction by warming the flask and filtering off excess metal.
3. The filtrate is the metal salt.
4. Evaporate the water from the filtrate till the crystallisation point is reached.
5. Filter off the crystals and wash them with a tiny amount of solvent to remove the soluble impurities.
6. Dry the crystals between sheets of filter paper. The salt is ready.

Salts from insoluble bases:

This method is used to make salts from metals that are low in the reactivity series.



1. Add excess metal oxide to the acid in the beaker.
2. Complete the reaction by warming the beaker and filtering off excess metal oxide.
3. The filtrate is the metal salt.
4. Evaporate the water from the filtrate till the crystallisation point is reached.

Filter off the crystals and wash them with a tiny amount of solvent to remove the soluble impurities.

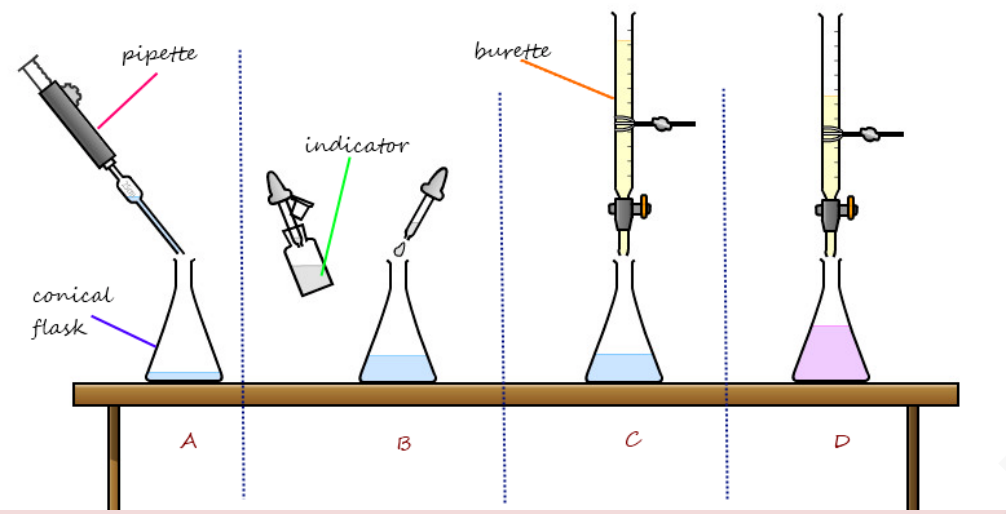
6. Dry the crystals between sheets of filter paper. The salt is ready.

Examples of insoluble basic oxides:

List of bases:

They are usually metal oxides, metal hydroxides, metal carbonates or metal hydrogencarbonates.

Bases			
Insoluble metal oxides	Insoluble metal carbonates	Insoluble metal hydrogen carbonates	Insoluble metal hydroxides
Magnesium Oxide /MgO	Magnesium carbonate/$MgCO_3$	All bicarbonates are soluble	Aluminium hydroxide $Al(OH)_3$
Copper (II) Oxide /CuO	Calcium carbonate $CaCO_3$		Magnesium hydroxide/$Mg(OH)_2$
Lead(II) Oxide/ PbO	All carbonates are insoluble except those of sodium, potassium and ammonium		Iron(II) hydroxide/$Fe(OH)_2$
Iron (III) Oxide/Fe_2O_3			Iron(III) hydroxide/$Fe(OH)_3$
Iron (II) Oxide/FeO			Copper hydroxide/$Cu(OH)_2$
Zinc oxide/ZnO	$ZnCO_3$		Zinc Hydroxide/$Zn(OH)_2$



Making soluble salts from acids and alkalis by titration

A titration involves finding the unknown concentration of one solution by reacting it with a solution of known concentration. The solution of unknown concentration (the analyte) is usually placed in a flask, while the solution of known concentration (titrant) is placed in a burette. The titrant is added to the analyte until the endpoint is reached usually determined by a color change. Calculations are then performed to find the unknown concentration of the analyte. Titrations are typically performed on acid/base reactions but are not limited to them.

$$M_{acid} \times V_{acid} = M_{base} \times V_{base}$$

M_{acid} = Molarity of the acid

V_{acid} = Volume of the acid

M_{base} = Molarity of the base

V_{base} = Volume of the base

Steps:

- **Measure known volume of alkali/acid in a titration flask using a pipette. Clean this pipette with a few drops of alkali/acid that you will be using in the flask.**
- **Add a few drops of indicator solution to the alkali/acid in the flask.**
  Clean the burette with the acid/alkali that you would want to use for titration.
- **Record the burette reading.(V_1)**
- **Open the burette tap and let the acid/alkali flow into the flask. Keep swirling to keep the acid and alkali in the flask mix properly.**
- **Keep adding the alkali/acid slowly till the indicator changes colour. This is the end point.A salt has been formed.**
- **Record the reading on the burette(V_2).**
- **V_2-V_1 is the rough titre or the ' range finder ' titre.**
- **Repeat the experiment 4-5 times and get the accurate titre by taking the average of the tires. Ignore the inconsistent titre.**

Note: Titre: It is the minimum volume of a solution needed to reach the end point in a titration.

Making insoluble salts (precipitate) from two soluble salts

In this method we make insoluble salts with the help of two soluble compounds.
For this you need to know the solubility rules

Method:

- Identify the ions that are present in the salt you need to make.
- Choose soluble compounds based on this information.
- Mix the two soluble compounds together.
- Filter off the precipitate.
- Then wash and dry to obtain solid crystals.

Solubility Rules:

" Some Group1 High Courts NAG that the CBI's are slower than Some Giant Snail named CaBaLe

Remember: When you use "Most " for soluble, obviously the insoluble contains the word" some" and vice-versa.

Mnemonic	Soluble compounds	Insoluble exceptions
Some Group1 High Courts	Grp 1 hydroxides and carbonates. (calcium hydroxide is slightly soluble)	Mostly
N	Nitrates	----------
A	Ammonium salts	----------
G that the	Group 1 salts	----------
CBI' s are	Chlorides, Bromides and Iodides	Slower than (Silver and Lead)
Some Giant	Group 1-2-oxides	Most metal oxides
Snail	sulphates	named CaBaLe (Calcium/barium/Lead)