

Inorganic Qualitative Analysis

Identification of Nine Unknown Ionic Solids

In this exercise, you will be given a results table (pages 5-7) containing observations from several tests carried out on 9 unknown ionic compounds **R** to **Z**.

Once you have worked out the identity of each of the compounds, you should cut out the names and formulae (page 8) and stick them on the table in the boxes containing letters **R** to **Z**.

In some of the boxes in the tables, there are precipitates whose identities you need to write down.

Before you begin:

You will need to be familiar with the tests for a number of **anions** and **cations**.

e.g.

- Barium ions
- Sulfate ions
- Carbonate ions
- Halide ions
- Ammonium ions

You will also need to know when the addition of hydroxide ions causes **precipitation with metal ions**.

The first part of the exercise is to '**cut and stick**' results statements on page 4 onto the tables of common tests for anions and cations.

Assume that all of the reactions are carried out in test tubes.

Summary of tests:

Test for Halides ions.

Halide ion solution	Addition of silver nitrate solution	Addition of dilute ammonia solution to the silver halide	Addition of concentrated ammonia solution to the silver halide
$F^-_{(aq)}$			
$Cl^-_{(aq)}$			
$Br^-_{(aq)}$			
$I^-_{(aq)}$			

Test for Sulphate (SO_4^{2-}) and Carbonate (CO_3^{2-}) ions.

Anion solution	Addition of barium chloride solution	Addition of dilute hydrochloric acid to white precipitate formed after addition of barium chloride
$SO_4^{2-}_{(aq)}$		
$CO_3^{2-}_{(aq)}$		

Reaction of Hydroxide ions the Metal Ions

Metal Ion	Reaction with dilute sodium hydroxide solution
M^+ (aq)	
M^{2+} (aq)	
M^{3+} (aq)	

Flame tests for some Group 1 Metal Ions

Group 1 Ion	Colour produced when a small sample of solid is heated in a blue Bunsen flame
Li^+	
Na^+	
K^+	



Test for the Ammonium Ion NH_4^+

Compound	Effect of adding $NaOH_{(aq)}$
NH_4Cl	

Action of Heat on some compounds

Compound	Effect of heating the solid
$CaCO_3$	
$MgCO_3$	
$NaCl$	
NH_4Cl	
$CuSO_4 \cdot 5H_2O$	
ZnO	

Results statements

Precipitate dissolves	Yellow/orange	Precipitate dissolves
Precipitate doesn't dissolve	No reaction	Precipitate of $M(OH)_2$ forms which is coloured when it is a transition metal ion
Precipitate dissolves	White solid turns yellow which returns to white upon cooling	Reacts with sodium hydroxide soln making a gas that turns red litmus paper blue.
Precipitate of $M(OH)_3$ forms which is coloured when it is a transition metal ion	Precipitate doesn't dissolve	Dense white precipitate
Cream precipitate	Precipitate doesn't dissolve	No reaction
Decomposes only with prolonged heating giving a gas that turns lime water cloudy	Releases water vapour (cobalt chloride paper turns pink) and solid turns from blue to white.	Decomposes easily producing a gas that turns lime water cloudy
Precipitate dissolves with effervescence	Pale yellow precipitate	Precipitate doesn't dissolve
The solid sublimates producing a resublimed solid higher up the test tube.	Dense white precipitate	No reaction
red	White precipitate	lilac
No reaction	No reaction	

Compound (in crystalline form)	Stability on heating	Solubility in water	Addition of sodium carbonate solution to a solution of unknown	Addition of dilute hydrochloric acid (only if ppt formed with $\text{Na}_2\text{CO}_{3(aq)}$)	Addition of barium chloride solution to a solution of unknown	Addition of sulphuric acid (dilute) solution to a solution of unknown	Addition of silver nitrate solution to a solution of unknown	Addition of dilute ammonia (only if ppt formed with $\text{AgNO}_{3(aq)}$)	Addition of sodium hydroxide solution to a solution of unknown
R	The solid sublimes producing a resublimed solid higher up the test tube.	soluble	no reaction	no reaction	no reaction	no reaction	a white precipitate is formed Identity of ppt: _____	white precipitate dissolves	A colourless gas is produced which turns damp litmus paper blue. Identity of gas: _____
S	stable	soluble	a white precipitate is formed Identity of ppt: _____	effervescence is produced and the ppt dissolves Identity of gas: _____	no reaction	a white precipitate is formed Identity of ppt: _____	a cream precipitate is formed Identity of ppt: _____	cream precipitate does not dissolve unless concentrated NH_3 is added	no reaction
T	stable	soluble	no reaction	N/A	no reaction	no reaction	a pale yellow precipitate is formed Identity of ppt: _____	pale yellow precipitate doesn't dissolve even with the addition of concentrated ammonia	no reaction

Compound (in crystalline form)	Stability on heating	Solubility in water	Addition of sodium carbonate solution to a solution of unknown	Addition of dilute hydrochloric acid (only if ppt formed with $\text{Na}_2\text{CO}_{3(\text{aq})}$)	Addition of barium chloride solution to a solution of unknown	Addition of sulphuric acid (dilute) solution to a solution of unknown	Addition of silver nitrate solution to a solution of unknown	Addition of dilute ammonia (only if ppt formed with $\text{AgNO}_{3(\text{aq})}$)	Addition of sodium hydroxide solution to a solution of unknown
U	stable	soluble	a white precipitate is formed	effervescence is produced and the ppt dissolves	no reaction	a white precipitate is formed Identity of ppt: _____	a white precipitate is formed Identity of ppt: _____	white precipitate dissolves	no reaction
V	stable	soluble	no reaction	N/A	a dense white precipitate is formed which dissolves when it is acidified. Identity of ppt: _____	Effervescence. Gas given off which turns limewater, cloudy.	no reaction	N/A	no reaction
W	releases water vapour and solid turns from blue to white	soluble dissolves to produce a blue solution	Forms a blue precipitate	effervescence is produced and the ppt dissolves	a dense white precipitate is formed which doesn't dissolve when acidified Identity of ppt: _____	no reaction	no reaction	N/A	pale blue ppt of the metal hydroxide is formed Identity of ppt: _____

Compound (in crystalline form)	Stability on heating	Solubility in water	Addition of sodium carbonate solution to a solution of unknown	Addition of dilute hydrochloric acid (only if ppt formed with $\text{Na}_2\text{CO}_3(\text{aq})$)	Addition of barium chloride solution to a solution of unknown	Addition of sulphuric acid (dilute) solution to a solution of unknown	Addition of silver nitrate solution to a solution of unknown	Addition of dilute ammonia (only if ppt formed with $\text{AgNO}_3(\text{aq})$)	Addition of sodium hydroxide solution to a solution of unknown
X	unstable with strong heating. A gas is produced that reacts with lime water.	insoluble	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Y	unstable producing a liquid and a steamy vapour that turns blue litmus paper red.	soluble	a white precipitate is formed Identity of ppt: _____	effervescence is produced and the ppt dissolves Identity of gas: _____	no reaction	no reaction	a white precipitate is formed Identity of ppt: _____	white precipitate dissolves	a white precipitate is formed Identity of ppt: _____
Z	stable	soluble	no reaction	no reaction	a white precipitate is formed which doesn't dissolve when acidified Identity of ppt: _____	no reaction	no reaction	N/A	no reaction

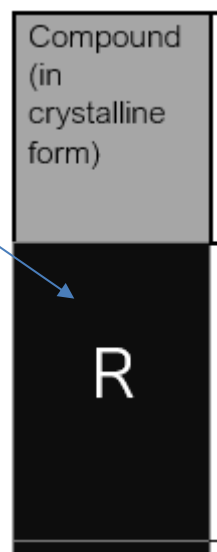
Additional information

T produces an intense yellow/orange flame when small samples of the solid are heated in a blue Bunsen flame.

V produces a pale lilac flame when small samples of the solid are heated in a blue Bunsen flame.

Z produces a red flame when small samples of the solid are heated in a blue Bunsen flame.

These are the compounds and their formulae. You should cut them out and stick them over the compound boxes that contain letters R-Z.



ammonium chloride NH_4Cl	hydrated magnesium chloride $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$	sodium iodide NaI
potassium carbonate K_2CO_3	barium chloride BaCl_2	hydrated copper sulfate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
lithium sulfate Li_2SO_4	calcium carbonate CaCO_3	barium bromide BaBr_2