

Secondary 4 Chem Experiment 5.5: Thermal Decomposition

Name: _____ () Class: _____ Date: _____

Aim: To investigate the effect of heat on some common substances e.g. hydroxides, carbonates and nitrates.

Theory of Thermal Decomposition

Thermal decomposition is defined as a chemical reaction when a chemical substance breaks down into more than one simpler substances when heated.

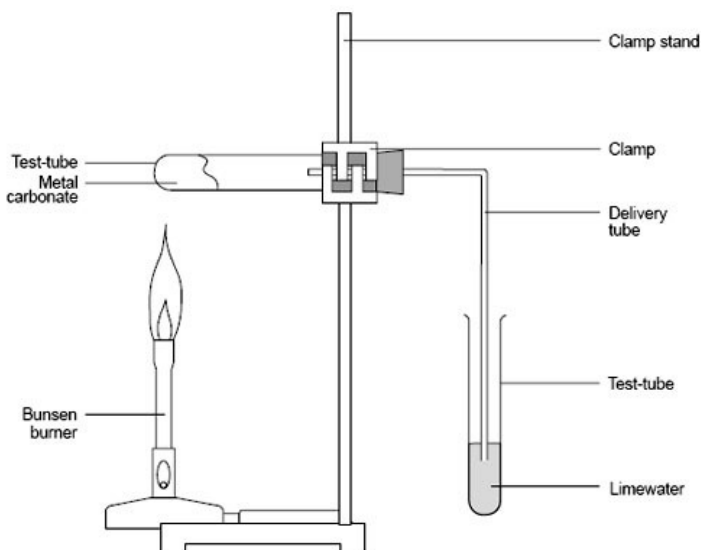
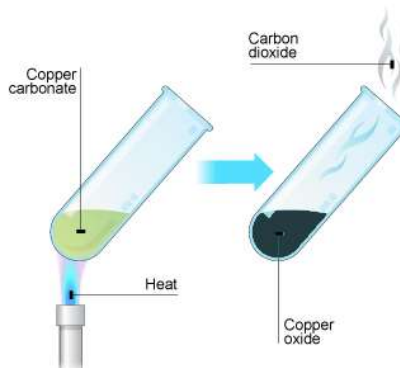
The reaction is usually endothermic as heat is required to break chemical bonds in the compound undergoing decomposition.

The *decomposition temperature* of a substance is the temperature at which the substance decomposes into smaller substances or into its constituent atoms.

Thermal Decomposition of metal carbonates

The temperature of decomposition depends upon the reactivity of the metal. The more reactive metals, the more stable is the carbonate. Thus, the carbonates of sodium and potassium are stable at the highest temperatures of a Bunsen burner flame, whereas, the carbonates of silver and copper are easily decomposed.

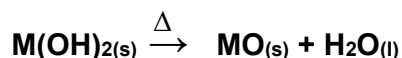
Common examples of the carbonate decomposition



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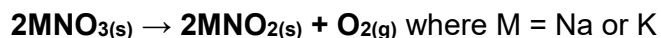
Thermal Decomposition of metal hydroxides

On heating the Metal hydroxides, it decompose to form the metal oxide and water vapour.



Thermal Decomposition of metal nitrates

1. The Group I Alkali Metal nitrates (NO_3) decompose to form the nitrite (NO_2^-) salt and oxygen gas.



so when M = Na: **sodium nitrate** ==> **sodium nitrite + oxygen**

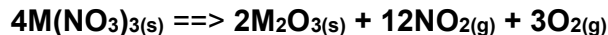
Nitrates are colourless crystals and nitrites are white solids and are all soluble in water giving neutral solutions.

2. The Group II, Lead, Aluminium and Transition Metal nitrates decompose to form the metal oxide, **nasty brown nitrogen dioxide gas** and oxygen gas when strongly heated.

The nitrates are all water soluble neutral salts, all colourless crystals except Cu^{2+} is blue and Fe^{2+} is green.



3. Aluminium and Iron(III) nitrates will decompose to form the metal oxide, nitrogen dioxide and oxygen gas too.



If M = Al, it gives white aluminium oxide, if M = Fe it gives give reddish-brown iron(II) oxide.

Colours of the oxides

Type of oxides	Colour
Most main group metal oxides	White
Zinc oxide	Yellow when hot, white when cool
Copper(II) oxide and iron(II) oxide	Black
Iron(III) oxide	Reddish brown
Lead(II) oxide	Yellow

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Thermal Dissociation of Ammonium Carbonate

Heating of ammonium carbonate gives off ammonia gas and carbon dioxide.

Procedure:

1. Place about 2-3 spatula full of solid into a clean, dry hard glass test tube.
2. Note its colour change and texture before heating. Record in the table below.
3. Heat strongly until no further change.
4. Test for any gas evolved.
5. Note the colour of the residue when it is still hot. Allow the residue to stand and observe the colour of the residue again when it is cooled.

Substance	Appearance before heating	Describe test for the Gas evolved	Appearance of residue when hot	Appearance of residue when cold
Calcium carbonate				
Zinc carbonate				
Copper(II) carbonate				
Potassium nitrate				
Zinc Nitrate				
Copper(II) nitrate				

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1. Explain the following safety precautions undertaken when strong heating is performed on a test tube of solid sample.

a) When heating, the test tube is tilted such that its mouth is facing the safety board.

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b) The test tube must be dry before adding the solid sample for heating.

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c) After heating, the test tube should not be washed immediately.

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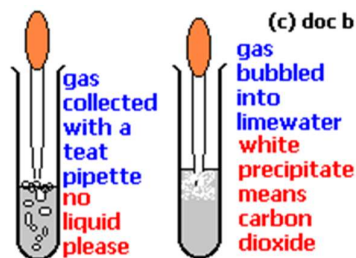
2. State two other safety precautions that you have taken when you are conducting the experiment.

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3. State the observations for the strong heating of copper(II) nitrate that indicates the presence of the nitrate ion.

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4. The test for carbon dioxide produced can be conducted by using a teat pipette to withdraw the gas from the test tube before bubbling the gas through limewater as shown below.



Predict the problem that will be faced for this method.

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