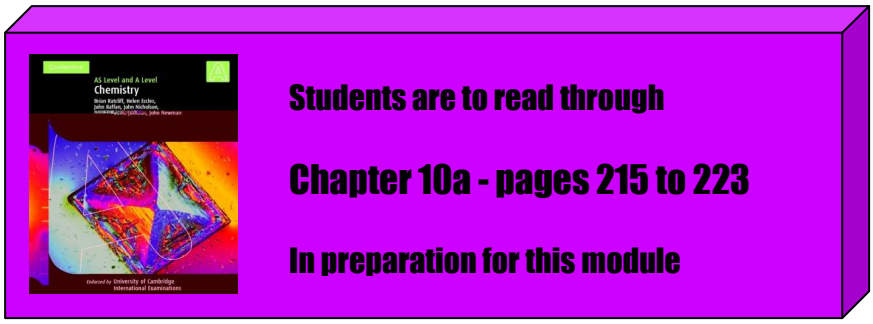
9. 2 GROUP II

Content

I Similarities and trends in the properties of the Group II metals magnesium to barium and their compounds

II Some uses of Group II compounds



The elements in group II are known as the alkaline earth metals, the elements which are examinable and relevant to this chapter are Magnesium, Calcium, Strontium and Barium

Learning Outcomes

Once you have completed this section you should be should be able to:

(a) Describe the reactions of the elements with oxygen and water

Metal + Oxygen → Metal Oxide

The reaction of magnesium and oxygen to form magnesium oxide

$$2Mg(s)+O_2(g)\rightarrow 2MgO(s)$$

Magnesium burns in oxygen with a bright white flame to produce a white solid magnesium oxide.

© flickr.com

This link is for a you-tube video of the reaction when magnesium burns in the presence of oxygen
http://www.youtube.com/watch?v=o6q0PRm_r68&feature=related

The reaction of calcium and oxygen to form calcium oxide

$$2Ca(s) + O_2(g) \rightarrow 2CaO(s)$$

The reaction between calcium and oxygen takes a while to start burning, but then bursts dramatically into flame, burning with an intense white flame with a red tinge the end.

This link is for a you-tube video of the reaction when calcium burns in the presence of oxygen, the footage is not great but it really conveys the intensity of the bright white flame
http://www.youtube.com/watch?v=mTpYIM1ZxMg

The reaction of strontium and oxygen to form strontium oxide

$$2Sr(s)+O_2(g)\rightarrow 2SrO(s)$$

Strontium also burns rather reluctantly at first in the presence of oxygen but then burns in a very similar manner to calcium with an intense almost white flame which quickly becomes red

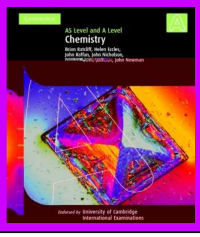
This link is for a you-tube video of the reaction when strontium burns in the presence of oxygen.
http://www.youtube.com/watch?v=kDuE3CVWjUk

The reaction of barium and oxygen to form barium oxide

Some descriptions of this reaction mention a green flame, however in the accompanying video the flame appears bright white with a red glow

$$2Ba(s)+O_2(g)\rightarrow 2BaO(s)$$

This link is for a you-tube video of the reaction when barium burns in the presence of oxygen.
http://www.youtube.com/watch?v=in2QVK3DRXs



Student Activity 10.1

Complete Self Assessment Question (SAQ) 10.2 on page 219
Complete Self Assessment Question (SAQ) 10.3 on page 219

Metal + water → Metal hydroxide + hydrogen gas

This link is for a you-tube video of the reaction of all of the group II metals when placed in water…HIGHLY RECOMMENDED!!!
http://www.youtube.com/watch?v=pPnnXD_K0BU

The reaction of magnesium and water to form magnesium hydroxide

Magnesium Oxide dissolves slightly in water to give a weakly alkaline solution of pH 9. It is rather insoluble in water because of its high lattice energy.

$$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2$$

The reaction of calcium and water to form calcium hydroxide

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(aq) + H_2$$

This link is for a you-tube video of the reaction when calcium reacts with water
http://www.youtube.com/watch?v=nSgIr1Wba_g&feature=related

For a series of images of Calcium reacting with water air and acid see
http://jchemed.chem.wisc.edu/JCESoft/CCA/CCA4/MAINPT/CCl_elt/Ca.HTM

The reaction of strontium and water to form strontium hydroxide

$$Sr(s) + 2H_2O(l) \rightarrow Sr(OH)_2(aq) + H_2$$

This link is for a you-tube video of the reaction when strontium reacts with water, the effervescence shows the production of hydrogen gas
http://www.youtube.com/watch?v=M59eUubadz0&feature=related

The reaction of barium and water to form barium hydroxide

$$Ba(s) + 2H_2O(l) \rightarrow Ba(OH)_2(aq) + H_2$$

This link is for a you-tube video of the reaction when barium reacts with water, the effervescence shows the production of hydrogen gas
http://www.youtube.com/watch?v=QhYpEY2A1hg

(b) Describe the behaviour of the oxides with water

Metal oxide + water → Metal hydroxide

The metal oxides of all group II metals form basic hydroxide solutions when reacted with water, magnesium oxide reacts slowly with water but all other oxides have a much faster rate of reaction. The solubility of the group II hydroxides increases as you go down the group

The reaction of magnesium oxide and water to form magnesium hydroxide

$$MgO(s) + H_2O(l) \rightarrow Mg(OH)_2(aq)$$

The reaction of calcium oxide and water to form calcium hydroxide

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$$

This link is for a you-tube video of the reaction when calcium oxide reacts with water, the heat from the reaction is then used to cook an egg!
http://www.youtube.com/watch?v=zePrQamwLw0

The reaction of strontium oxide and water to form strontium hydroxide

$$SrO(s) + H_2O(l) \rightarrow Sr(OH)_2(aq)$$

The reaction of barium oxide and water to form barium hydroxide

$$BaO(s) + H_2O(l) \rightarrow Ba(OH)_2(aq)$$

All of the reactions of metal oxides with water are exothermic but since they do not produce a gas or create a flame there are no you-tube video's of the reactions.

(c) Describe the thermal decomposition of the nitrates and carbonates

Metal nitrate → Metal oxide + Nitrogen dioxide +Oxygen

This web link provides a you tube video of the decomposition of a metal nitrate (although this is a group I metal the principals behind the reaction are the same)
http://www.youtube.com/watch?v=L7qRoYQEBPk&feature=related
The glowing splint used at the end of the reaction is used to indicate that oxygen is produced during the reaction

Metal carbonate → Metal oxide + carbon dioxide

This web link provides a you tube video of the decomposition of a metal carbonate
http://www.youtube.com/watch?v=BXoWjGH-ilM

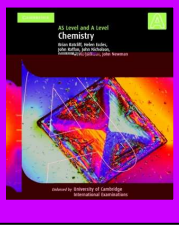
All metal nitrates and carbonates decompose when they are heated, as you go down the group more and more energy must be added in order for the decomposition reaction to occur.

This web link provides an amazing explanation as to why the group II metal carbonates and nitrates are more stable as you go down a group
http://www.chemguide.co.uk/inorganic/group2/thermstab.html

(d) Interpret, and make predictions from, the trends in physical and chemical properties of the elements and their compounds

Group II metals are generally rather reactive, as we move down the group their reactivity decreases slightly. All group II metals react with oxygen to form an alkaline metal oxide. The metal also reacts to produce a metal hydroxide when dissolved in water.

Group II metals are harder and denser than group I metals



Student Activity 10.2

Complete Self Assessment Question (SAQ) 10.1 on page 216

(e) Explain the use of magnesium oxide as a refractory lining material and calcium carbonate as a building material

Magnesium oxide has a high melting point of 2800°C and one of its many uses is a lining material in high temperature refractories. Crucibles (ceramic containers in which solids are melted at high temperatures) are often coated with magnesium oxide to ensure that they can reach very high temperatures.

Handy Tip

A refractory material is a material with a high melting point. Magnesium oxide is an ionic solid with a high melting point hence it is used as a refractory lining material

Calcium carbonate is widely used in the building and construction industry, it is used for marble and as an ingredient in cement. It also contributes to the making of mortar used in bonding bricks, concrete blocks, stones, roofing shingles, rubber compounds, and tiles.

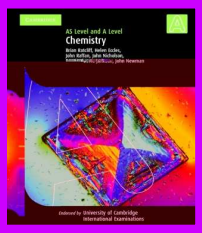
(f) Describe the use of lime in agriculture

Agricultural lime is a soil additive made from crushed limestone. The main active component is calcium carbonate though additional chemicals like calcium oxide, magnesium oxide and magnesium carbonate can be present in the limestone. Dolomitic lime supplies magnesium as well as calcium.

Lime increases the pH of acidic soil because all carbonates are alkaline. Lime also permits improved water penetration for acidic soils. Lime provides a rich source of calcium for the plants, calcium is an essential part of the cell wall structure and it is essential for the growth of roots and shoots.

Hydrated lime is used in livestock farming to produce a dry alkaline environment where the multiplication rate of bacteria is slowed; in horticulture hydrated lime can also be used as an insect repellant without killing or harming either the insect or the plant.

This link is for a detailed but very interesting web page on the uses of lime in agriculture
http://www.stoltzfusmfg.com/lime_1.html



Final Student Activity 10

Complete all questions in the Summative assessment activity on pg 223.
These questions are to be submitted as assignment 10

W E E K 18