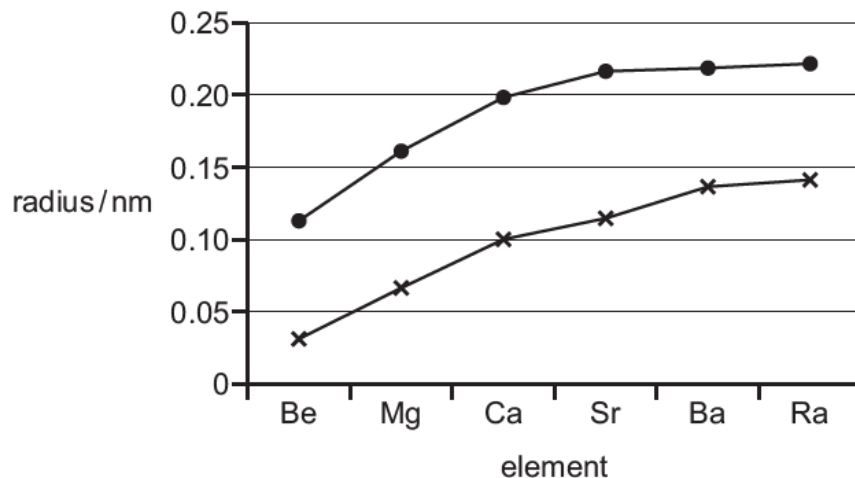


**Group 2 – 2016**

1. 9701/21/O/N/16/No.3

The elements in Group 2 and their compounds show various trends in their physical and chemical properties.

(a) The graph below shows the radius values of the atoms and 2+ ions of the elements in Group 2.



(i) Explain why both lines show a steady increase in the values of the radii down the group.

.....  
 .....  
 ..... [2]

(ii) State and explain which line represents the atomic radii and which represents the ionic radii.

.....  
 .....  
 ..... [2]

(b) L is a salt of a Group 2 element M.

When L is heated strongly a brown gas is observed and a white solid remains.

The white solid dissolves in water to form a colourless solution of the metal hydroxide  $M(OH)_2$ .

Addition of dilute sulfuric acid to this colourless solution produces a dense white precipitate.

(i) Identify the anion in salt L.

..... [1]

(ii) Identify the element **M** and write an **ionic** equation for the formation of the white precipitate with sulfuric acid.

**M** = .....

equation ..... [1]

(iii) Give the formula of salt **L** and use it to write an equation for the thermal decomposition of salt **L**.

formula of salt **L** .....

equation ..... [2]

(c) Calcium carbonate and calcium hydroxide can both be used in agriculture to neutralise acidic soils.

(i) Write **ionic** equations for the neutralisation of acid by each of calcium hydroxide and calcium carbonate.

calcium hydroxide .....

calcium carbonate ..... [2]

(ii) Suggest and explain why calcium carbonate is a better choice than calcium hydroxide for this purpose in areas of high rainfall.

.....  
.....  
..... [2]

(d) Magnesium reacts with both cold water and steam.

Give the formula of the magnesium-containing product of each of these reactions.

with cold water .....

with steam ..... [2]

[Total: 14]

2. 9701/21/M/J/16/No.3

The elements in Group 2, and their compounds, show many similarities and trends in their properties.

(a) Magnesium, calcium, strontium and barium all react with cold water.

(i) Describe what you would **see** when some calcium is added to cold water.

.....  
.....  
..... [3]

(ii) Write an equation for the reaction taking place in (i).

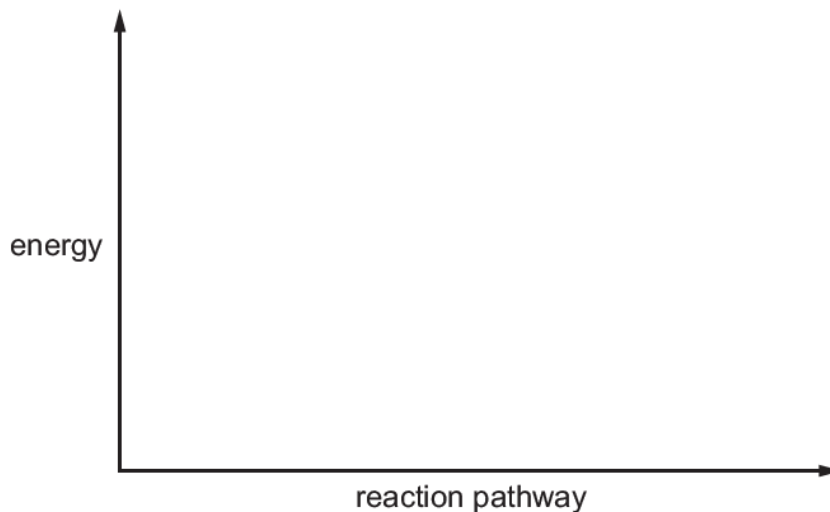
..... [1]

(iii) Describe how the reaction of barium with cold water would differ from the reaction of calcium in (i) in terms of what you would **see**.

.....  
..... [1]

(b) Magnesium oxide can be formed by the reaction of magnesium and oxygen in the air.

(i) Draw a **fully labelled** reaction pathway diagram for the reaction between magnesium and oxygen.



[2]

(ii) Explain why there is no visible reaction when a piece of magnesium ribbon is exposed to the air.

.....  
.....  
..... [2]

- (iii) Magnesium oxide is used to manufacture heat-resistant bricks for furnace linings in the steel-making industry.

State and explain the property of magnesium oxide that makes it suitable for this use.

.....  
.....  
.....  
..... [2]

- (iv) Suggest a reason why magnesium oxide cannot be used as a lining for any furnaces containing acidic materials.

.....  
..... [1]

- (c) The nitrates and carbonates of the Group 2 elements, from magnesium to barium, decompose when heated.

- (i) State the trend in the temperature of thermal decomposition of these Group 2 nitrates and carbonates.

.....  
..... [1]

- (ii) Give the equation for the thermal decomposition of magnesium carbonate.

..... [1]

- (iii) Give the equation for the thermal decomposition of calcium nitrate.

..... [1]

[Total: 15]