

1. **Nov/2023/Paper\_9701/11/No.19**

Which row correctly describes the separate reactions of calcium and strontium with water?

	substance reduced	substance oxidised	more vigorous reaction
<b>A</b>	calcium or strontium	water	calcium + water
<b>B</b>	calcium or strontium	water	strontium + water
<b>C</b>	water	calcium or strontium	calcium + water
<b>D</b>	water	calcium or strontium	strontium + water

2. **Nov/2023/Paper\_9701/11/No.20**

L and M are both compounds of Group 2 elements.

L and M are both soluble in water.

When solutions of L and M are mixed, a white precipitate is formed.

What could be L and M?

- A** barium chloride and magnesium sulfate
- B** barium sulfate and magnesium chloride
- C** barium nitrate and magnesium chloride
- D** barium carbonate and magnesium nitrate

3. **Nov/2023/Paper\_9701/11/No.21**

A 5.00 g sample of an anhydrous Group 2 metal nitrate loses 3.29 g in mass when heated strongly.

Which metal is present?

- A** magnesium
- B** calcium
- C** strontium
- D** barium

4. Nov/2023/Paper\_9701/12/No.21

What happens when a piece of magnesium ribbon is placed in cold water?

- A A vigorous effervescence occurs.
- B Bubbles of gas form slowly on the magnesium.
- C The magnesium floats on the surface of the water and reacts quickly.
- D The magnesium glows and a white solid is produced.

5. Nov/2023/Paper\_9701/12/No.22

The table gives some data for compounds of two elements from Group 2 of the Periodic Table.

element	decomposition temperature of carbonate / °C	solubility of sulfate in mol / 100 g of water	solubility of hydroxide in mol / 100 g of water
calcium	840	$4.66 \times 10^{-3}$	$1.53 \times 10^{-3}$
Z	?	?	$2.00 \times 10^{-5}$

What is the missing data for element Z?

	decomposition temperature of carbonate / °C	solubility of sulfate in mol / 100 g of water
A	350	$1.83 \times 10^{-1}$
B	350	$7.11 \times 10^{-5}$
C	1100	$1.83 \times 10^{-1}$
D	1100	$7.11 \times 10^{-5}$

6. Nov/2023/Paper\_9701/12/No.23

Q is a mixture of two compounds of Group 2 elements.

Q undergoes thermal decomposition to produce a white solid and only two gaseous products. One of the gaseous products relights a glowing splint.

What could be the components of mixture Q?

- A  $MgCl_2$  and  $CaCO_3$
- B  $MgCO_3$  and  $Ca(NO_3)_2$
- C  $Mg(NO_3)_2$  and  $Ca(NO_3)_2$
- D  $MgO$  and  $CaO$

Barium hydroxide,  $\text{Ba}(\text{OH})_2$ , is a strong base used in inorganic and organic reactions.

Fig. 2.1 shows a reaction scheme involving  $\text{Ba}(\text{OH})_2$ .

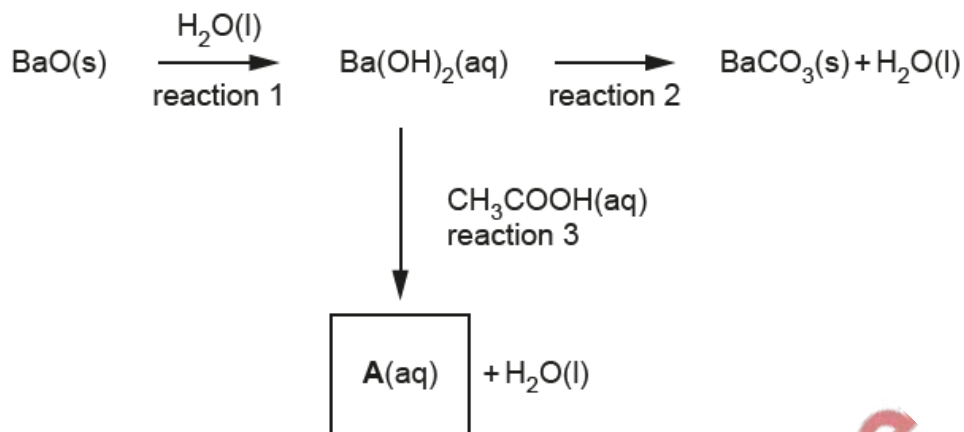


Fig. 2.1

- (a) (i) State the variation in solubilities of group 2 hydroxides.  
 ..... [1]
- (ii) State what is observed in reaction 1.  
 ..... [1]
- (iii) Suggest a reactant for reaction 2.  
 ..... [1]
- (iv) Identify A.  
 ..... [1]
- (v)  $\text{Ba}(\text{OH})_2$  is made by the reaction of Ba with water.  
 Write an equation for this reaction.  
 ..... [1]

(b) The mineral barytocalcite contains both  $\text{BaCO}_3$  and  $\text{CaCO}_3$ . Both compounds decompose on heating.

(i) State which compound decomposes first when barytocalcite is heated.

Explain your answer.

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

(ii) Construct an equation for the complete thermal decomposition of barytocalcite.

The formula of barytocalcite is  $\text{BaCa}(\text{CO}_3)_2$ .

$\text{BaCa}(\text{CO}_3)_2$  ..... [1]

(c)  $\text{Ba}(\text{OH})_2$  is used to hydrolyse organic compounds.

Fig. 2.2 shows the reaction of **B** with  $\text{Ba}(\text{OH})_2$ , followed by acidification.

Draw the structures of the organic products of the process shown in Fig. 2.2.

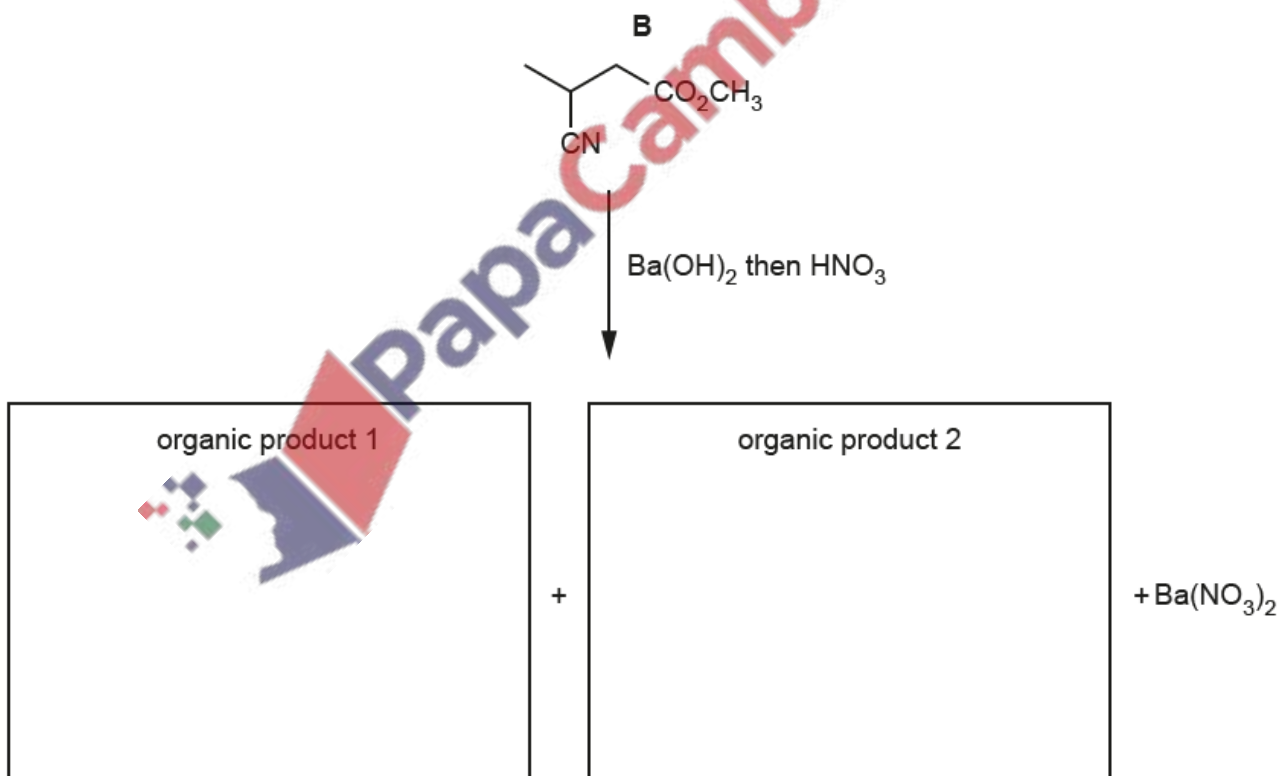


Fig. 2.2

[3]

[Total: 10]

8. Nov/2023/Paper\_9701/22/No.2(f)

(f) A student titrates nitric acid with a base to form a solution containing aqueous magnesium nitrate.

(i) Identify a base that the student could use.

..... [1]

(ii) The student evaporates the water to obtain magnesium nitrate solid. When this solid is heated it decomposes.

Write an equation for the decomposition of magnesium nitrate.

..... [1]

(iii) State how the thermal stability of Group 2 nitrates changes down the group.

..... [1]

9. June/2023/Paper\_9701/11/No.23

A solution contains both  $Mg^{2+}(aq)$  and  $Sr^{2+}(aq)$  at the same concentration.

The solution is divided into two equal portions. Aqueous sodium hydroxide is added dropwise to one portion. Dilute sulfuric acid is added dropwise to the other portion.

Which row is correct?

	precipitate seen first when NaOH(aq) is added	precipitate seen first when H <sub>2</sub> SO <sub>4</sub> (aq) is added
A	magnesium hydroxide	magnesium sulfate
B	magnesium hydroxide	strontium sulfate
C	strontium hydroxide	magnesium sulfate
D	strontium hydroxide	strontium sulfate

**10. June/2023/Paper\_9701/12/No.20**

The table compares calcium with barium and calcium carbonate with barium carbonate.

Which row is correct?

	reactivity of the element with water	thermal stability of the metal carbonate
<b>A</b>	barium is more reactive	barium carbonate is more stable
<b>B</b>	barium is more reactive	calcium carbonate is more stable
<b>C</b>	calcium is more reactive	barium carbonate is more stable
<b>D</b>	calcium is more reactive	calcium carbonate is more stable

**11. June/2023/Paper\_9701/12/No.21**

Solutions P and Q each contain a different Group 2 ion at the same concentration. One contains  $\text{Mg}^{2+}$  and the other contains  $\text{Ba}^{2+}$ . Tests are carried out on separate  $5\text{ cm}^3$  samples of P and Q.

test 1: add  $1\text{ cm}^3$  of  $0.1\text{ mol dm}^{-3}\text{ Na}_2\text{SO}_4(\text{aq})$

test 2: add  $1\text{ cm}^3$  of  $0.1\text{ mol dm}^{-3}\text{ NaOH}(\text{aq})$

What are the results of these tests?

	results in test 1	results in test 2
<b>A</b>	more precipitate with $\text{Ba}^{2+}$	more precipitate with $\text{Ba}^{2+}$
<b>B</b>	more precipitate with $\text{Ba}^{2+}$	more precipitate with $\text{Mg}^{2+}$
<b>C</b>	more precipitate with $\text{Mg}^{2+}$	more precipitate with $\text{Ba}^{2+}$
<b>D</b>	more precipitate with $\text{Mg}^{2+}$	more precipitate with $\text{Mg}^{2+}$

12. June/2023/Paper\_9701/13/No.23

Equal volumes of saturated solutions of magnesium hydroxide, calcium hydroxide and strontium hydroxide are completely neutralised with dilute sulfuric acid.

The water is gently evaporated from each of the resulting solutions, leaving the corresponding solid sulfates.

These solid sulfates are completely dissolved in the minimum volume of water needed to produce saturated solutions.

Which statement about the volumes of water needed to dissolve the sulfates is correct?

- A The calcium sulfate will require the greatest volume of water.
- B The magnesium sulfate will require the greatest volume of water.
- C The strontium sulfate will require the greatest volume of water.
- D They will all require the same volume of water.

13. March/2023/Paper\_9701/12/No.21

A sample containing 0.010 mol of anhydrous calcium nitrate is heated strongly until it fully decomposes.

All the gas produced is collected and its volume measured at room conditions.

What is the volume of gas produced?

- A 120 cm<sup>3</sup>      B 600 cm<sup>3</sup>      C 720 cm<sup>3</sup>      D 840 cm<sup>3</sup>

14. March/2023/Paper\_9701/12/No.23

In Group 2 of the Periodic Table, the properties of the elements and their compounds show regular change down the group.

Which property shows a **decrease** from magnesium to barium?

- A the decomposition temperature of the carbonates
- B the decomposition temperature of the nitrates
- C the solubility of the hydroxides
- D the solubility of the sulfates

15. March/2023/Paper\_9701/12/No.24

Four properties of beryllium, Be, or a beryllium compound are listed.

Which property is different from the property of magnesium or the equivalent magnesium compound?

- A Be reacts with  $O_2$  when heated in air; Mg does not.
- B Be reacts with aqueous  $H_2SO_4$  to form a metal sulfate and  $H_2$ ; Mg does not.
- C  $Be(NO_3)_2$  decomposes on heating to form a metal oxide,  $NO_2$  and  $O_2$ ;  $Mg(NO_3)_2$  does not.
- D  $BeCl_2$  reacts with water to form fumes of  $HCl$ ;  $MgCl_2$  does not.

16. March/2023/Paper\_9701/22/No.2(b\_d)

The Group 2 elements Mg to Ba are all silvery-white reactive metals.

(b) Write an equation for the reaction of magnesium with cold water.

..... [1]

(c) Identify a single reagent that can be used to distinguish separate samples of dilute  $Mg(NO_3)_2(aq)$  and dilute  $Ba(NO_3)_2(aq)$ .

Explain your answer.

reagent .....

explanation .....

..... [2]



(d) (i) Describe what is observed when  $\text{SrI}_2(\text{aq})$  reacts with concentrated sulfuric acid.

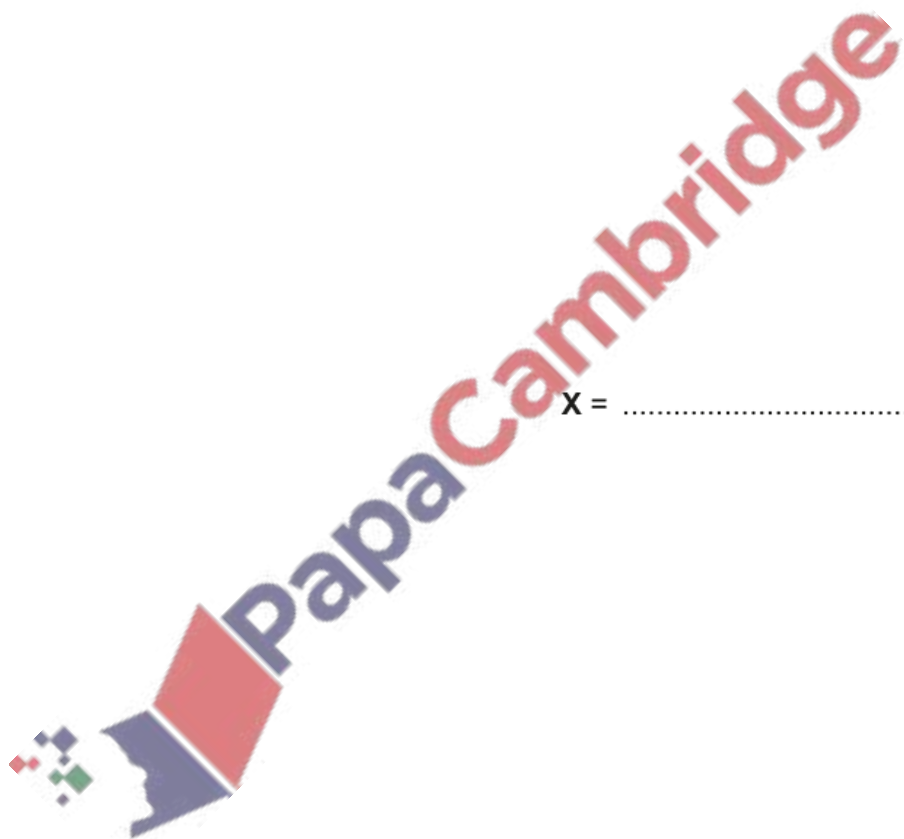
.....  
..... [2]

(ii) Compound **X**, an anhydrous Group 2 bromide, is dissolved in water and titrated against aqueous silver nitrate.

A solution containing 0.250 g of **X** requires  $33.65 \text{ cm}^3$  of  $0.0500 \text{ mol dm}^{-3} \text{ AgNO}_3(\text{aq})$  for complete reaction.

Identify **X**.

Show your working.



**X** = ..... [3]