

# Group 2

## Question Paper 4

<b>Level</b>	International A Level
<b>Subject</b>	Chemistry
<b>Exam Board</b>	CIE
<b>Topic</b>	Group 2
<b>Sub-Topic</b>	
<b>Paper Type</b>	Theory
<b>Booklet</b>	Question Paper 4

**Time Allowed:** 66 minutes

**Score:** /55

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 This question is about the elements in Group II of the Periodic Table, magnesium to barium.

(a) Complete the table below to show the electronic configuration of calcium atoms and of strontium ions,  $\text{Sr}^{2+}$ .

	1s	2s	2p	3s	3p	3d	4s	4p	4d
Ca	2	2	6						
$\text{Sr}^{2+}$	2	2	6						

[2]

(b) Explain the following observations.

(i) The atomic radii of Group II elements increase down the Group.

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(ii) The strontium ion is smaller than the strontium atom.

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(iii) The first ionisation energies of the elements of Group II decrease with increasing proton number.

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[4]

(c) Samples of magnesium and calcium are placed separately in cold water and left for some time. In **each case**, describe what you would see and write a balanced equation for each reaction.

(i) magnesium

observation .....

.....

equation .....

(ii) calcium

observation .....

.....

equation .....

[6]

(d) Strontium nitrate,  $\text{Sr}(\text{NO}_3)_2$  undergoes thermal decomposition.

(i) State one observation you would make during this reaction.

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(ii) Write a balanced equation for this reaction.

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[4]

[Total: 16]

- 2 (a) Write an equation showing the reaction that occurs when calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ , is heated.

.....[1]

- (b) Describe and explain the trend in thermal stability of the nitrates of the Group II elements.

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.....[3]

- (c) Gently heating ammonium nitrate,  $\text{NH}_4\text{NO}_3$ , in a test tube produces a mixture of two gases **A** and **B**. No residue remains in the tube.  
The mass spectrum of gas **A** contains peaks at  $m/e$  (mass number) values of 16, 17 and 18, whereas that of gas **B** has peaks at  $m/e$  values of 14, 16, 28, 30 and 44.

- (i) Identify the peaks in the mass spectra, and suggest the molecular formulae of the gases **A** and **B**.

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- (ii) Hence suggest an equation for the thermal decomposition of ammonium nitrate.

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[5]

[Total: 9]

3 (a) (i) Write an equation showing the thermal decomposition of calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ .

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(ii) State and explain how the thermal stabilities of the nitrates vary down Group II.

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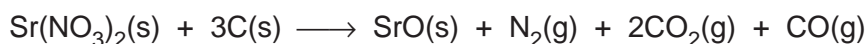
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[4]

(b) The nitrates of calcium, strontium or barium are often added to firework mixtures to produce red or green flames. The equation for the decomposition of one such mixture is as follows.



Calculate the volume of gas given off (measured at room temperature and pressure) when a 10.0 g sample of this mixture decomposes. [ $M_r$ :  $\text{Sr}(\text{NO}_3)_2$ , 211.6]

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..... [2]

(c) Explain in detail how carbon monoxide, produced in this reaction, is poisonous.

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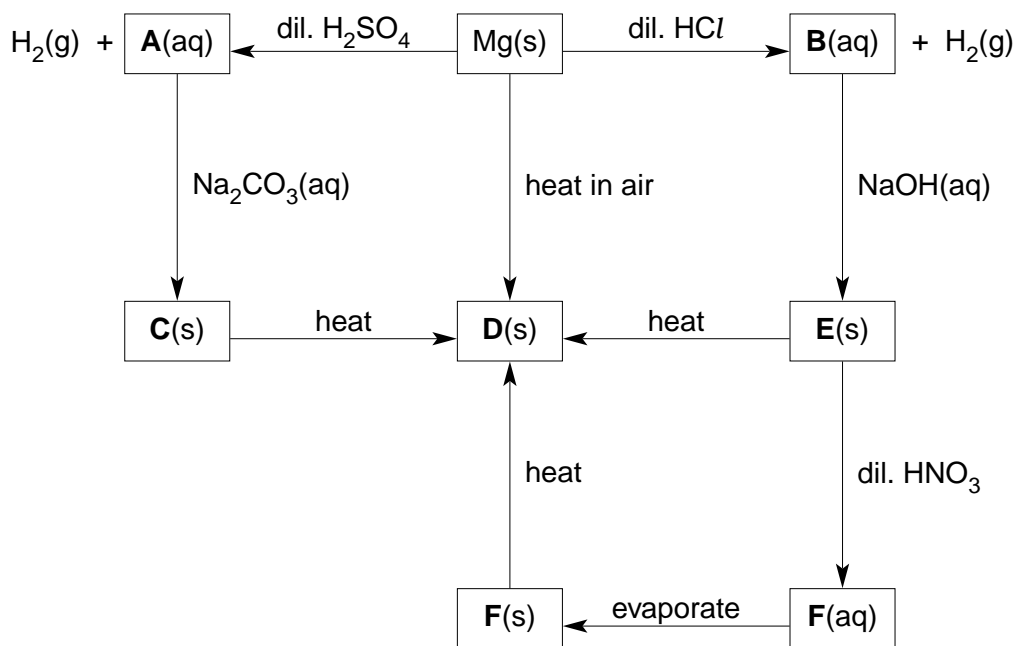
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[Total: 8]

4 Magnesium is the eighth most common element in the Earth’s crust.

The metal is widely used in alloys which are light and strong.

Some reactions of magnesium and its compounds are shown in the reaction scheme below.



(a) Identify, by name or formula, compounds **A** to **F**.

- A** .....
- B** .....
- C** .....
- D** .....
- E** .....
- F** .....

**(b) (i)** Construct balanced equations for the following reactions.

magnesium to compound **A**

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compound **C** to compound **D**

.....

compound **F** to compound **D**

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**(ii)** Suggest a balanced equation for the effect of heat on compound **E**.

..... [4]

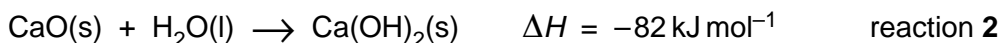
[Total: 10]

- 5 Limestone is an important raw material, used in building, steel making and agriculture.

The first stage in using limestone is often to heat it in a kiln.



Water is then added to the ‘quicklime’ produced in the kiln, to make ‘slaked lime’.



- (a) (i) Suggest **two** reasons why reaction 1 needs heating to a high temperature.

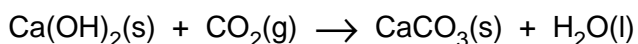
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- (ii) Explain whether  $\text{MgCO}_3$  would require a higher or a lower temperature than  $\text{CaCO}_3$  for its decomposition.

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[5]

Before the widespread use of cement, bricks and stones used for buildings were bonded together with a mixture of slaked lime, sand and water, known as lime mortar. On exposure to the air, the lime mortar gradually set hard due to the following reaction.



- (b) Use the data given above to calculate the enthalpy change for this reaction.

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



- (c) One of the major ores of magnesium is the mixed carbonate called dolomite,  $\text{CaMg}(\text{CO}_3)_2$ .

Calculate the percentage loss in mass that would be observed when a sample of dolomite is heated at a high temperature until the reaction had finished.

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..... [2]

[Total: 8]

