

A



Surname \_\_\_\_\_

Other Names \_\_\_\_\_

Centre Number \_\_\_\_\_

Candidate Number \_\_\_\_\_

Candidate Signature \_\_\_\_\_

I declare this is my own work.

**GCSE  
CHEMISTRY**

**H**

Higher Tier Paper 1

**8462/1H**

**Time allowed: 1 hour 45 minutes**

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**



J U N 2 2 8 4 6 2 1 H 0 1

**For this paper you must have:**

- a ruler
- a scientific calculator
- the periodic table (enclosed).

## **INSTRUCTIONS**

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Answer ALL questions in the spaces provided. Do not write on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.



## **INFORMATION**

- **The maximum mark for this paper is 100.**
- **The marks for questions are shown in brackets.**
- **You are expected to use a calculator where appropriate.**
- **You are reminded of the need for good English and clear presentation in your answers.**

**DO NOT TURN OVER UNTIL TOLD TO DO SO**

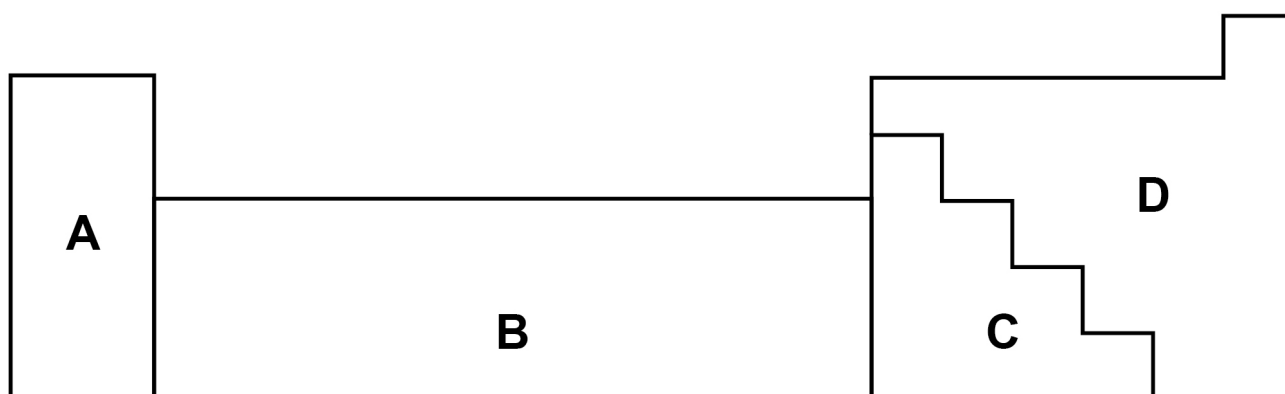


01

This question is about metals and non-metals.

FIGURE 1 shows an outline of part of the periodic table.

FIGURE 1



0	1	.	1
---	---	---	---

Element Q is a dull solid with a melting point of 44 °C.

Element Q does not conduct electricity.

Which section of the periodic table in FIGURE 1 is most likely to contain element Q? [1 mark]

Tick (✓) ONE box.

A

B

C

D

[Turn over]



**BLANK PAGE**



## REPEAT OF FIGURE 1



0	1	.	2
---	---	---	---

Element R forms ions of formula  $R^{2+}$  and  $R^{3+}$

Which section of the periodic table in FIGURE 1 is most likely to contain element R? [1 mark]

Tick (✓) ONE box.

A

B

C

D

[Turn over]



**01.3**

**Give TWO differences between the physical properties of the elements in Group 1 and those of the transition elements. [2 marks]**

**1**

---

**2**

---



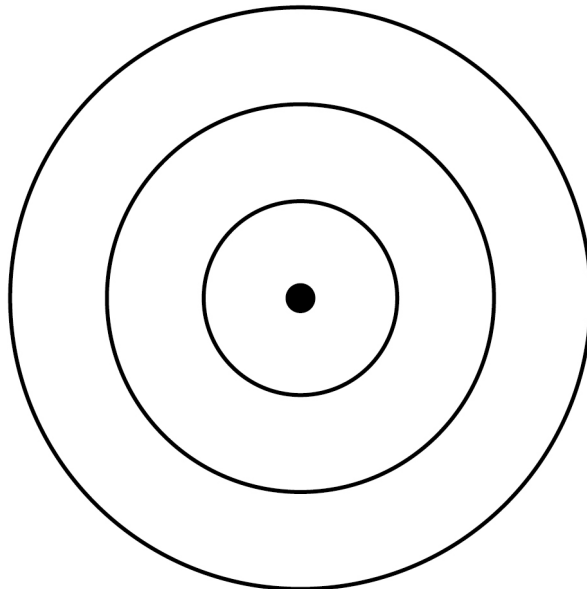


**01.4**

**Complete FIGURE 2 to show the electronic structure of an aluminium atom.**

**Use the periodic table. [1 mark]**

**FIGURE 2**



**[Turn over]**



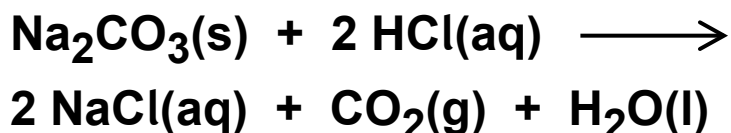




0	2
---	---

**Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.**

**The equation for the reaction is:**



**A student investigated the effect of changing the mass of sodium carbonate powder on the highest temperature reached by the reaction mixture.**

0	2	.	1
---	---	---	---

**Plan a method to investigate the effect of changing the mass of sodium carbonate powder on the highest temperature reached. [6 marks]**

---

---

---

---

---

---

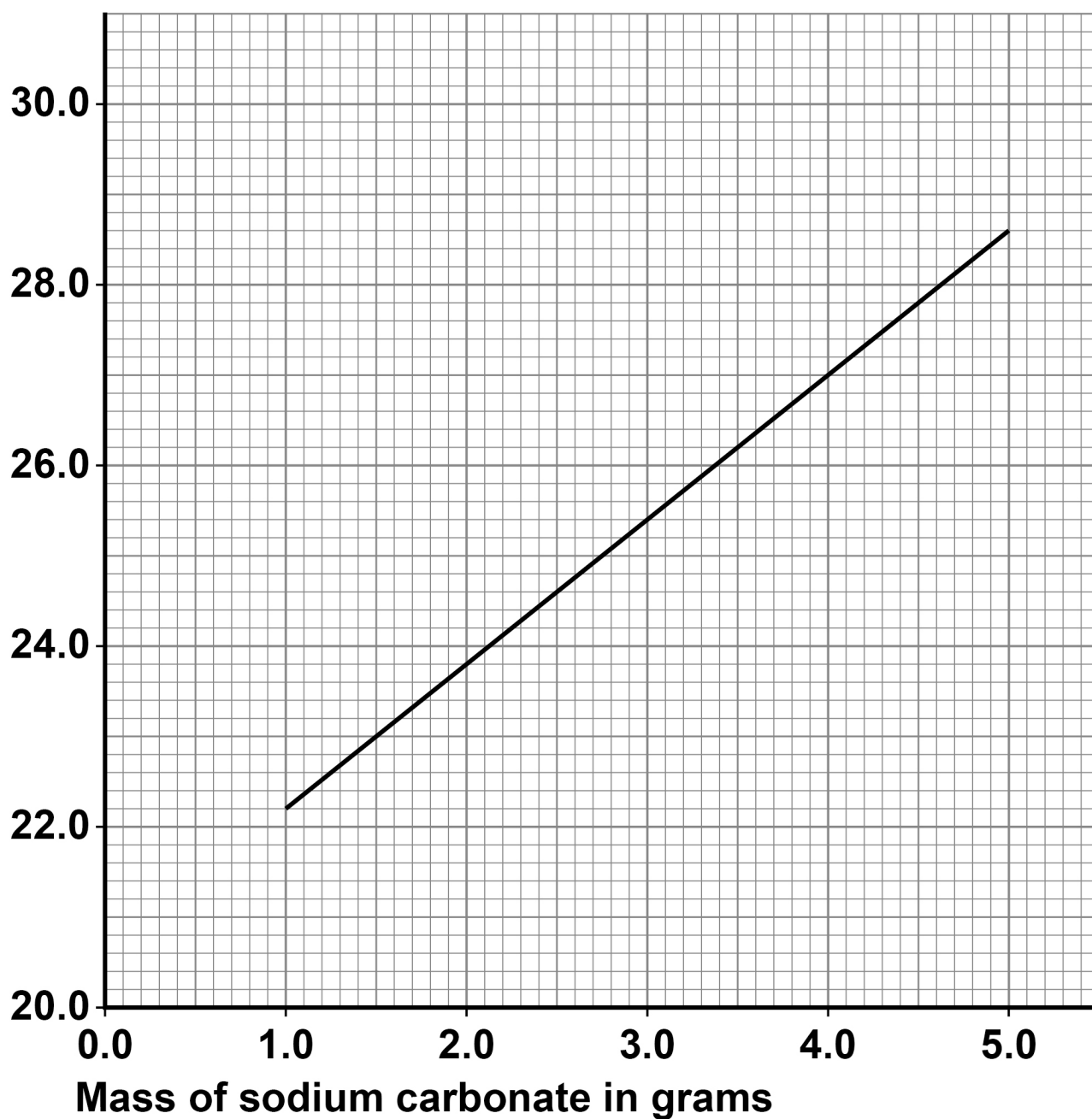




FIGURE 3 shows a line of best fit drawn through the student's results.

FIGURE 3

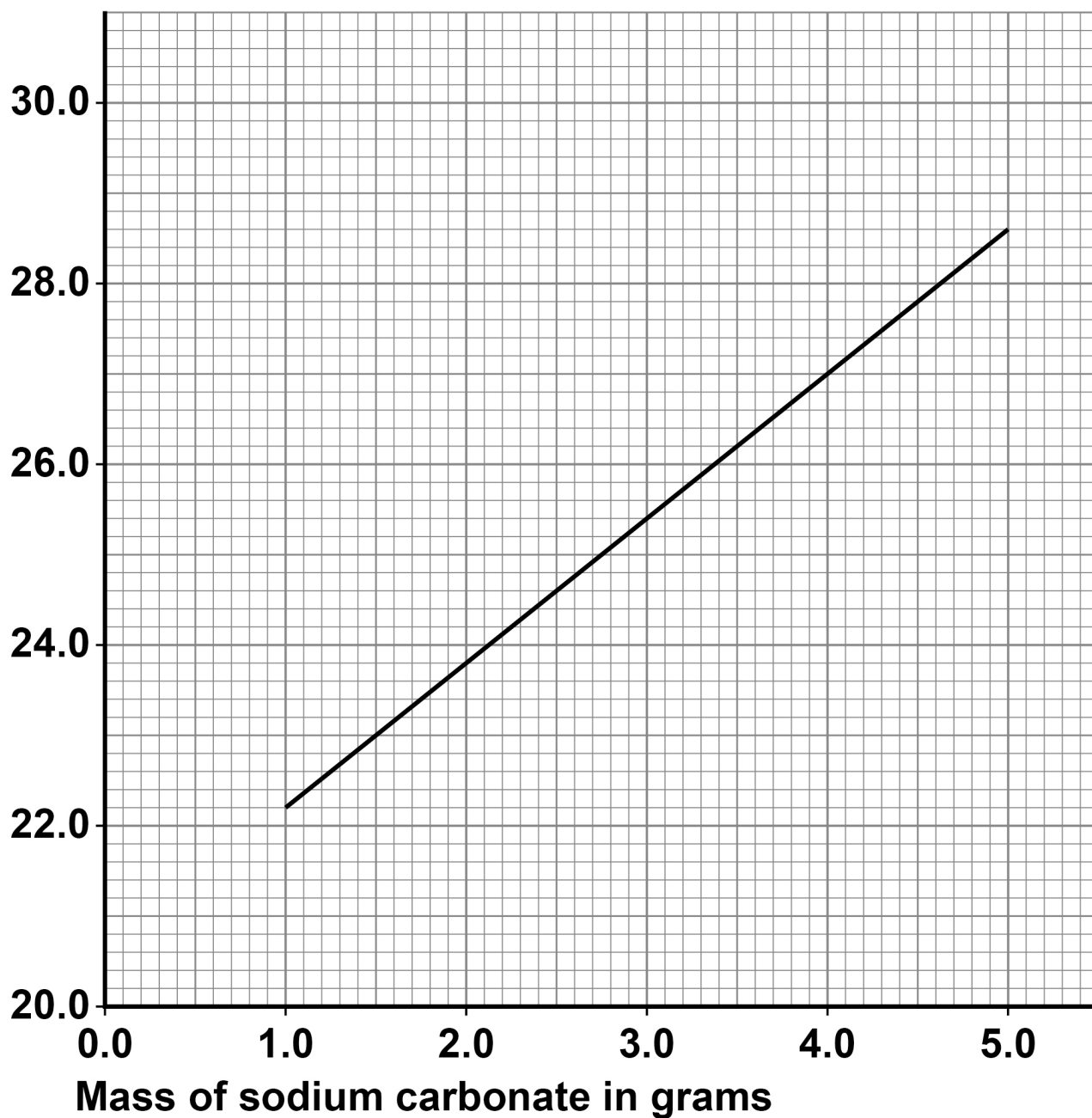
Highest temperature reached by  
the reaction mixture in °C





## REPEAT OF FIGURE 3

Highest temperature reached by  
the reaction mixture in °C





**0 2 . 3**

The initial temperature of the reaction mixture is where the line of best fit would meet the y-axis.

Determine the initial temperature of the reaction mixture.

Show your working on FIGURE 3, on page 16. [2 marks]

Initial temperature of the reaction mixture =

\_\_\_\_\_ °C

[Turn over]



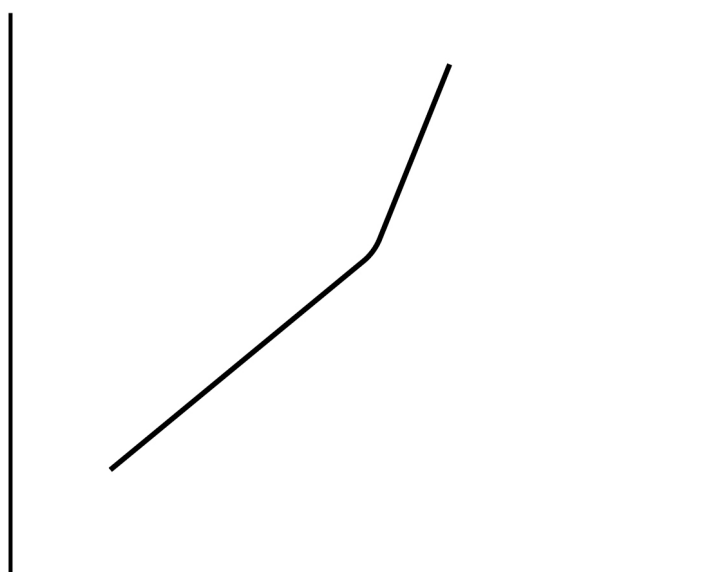
02.4

Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

Which sketch graph shows the results obtained when sodium carbonate was added until in excess? [1 mark]

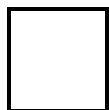
Tick (✓) ONE box.

A Highest temperature reached by the reaction mixture in °C

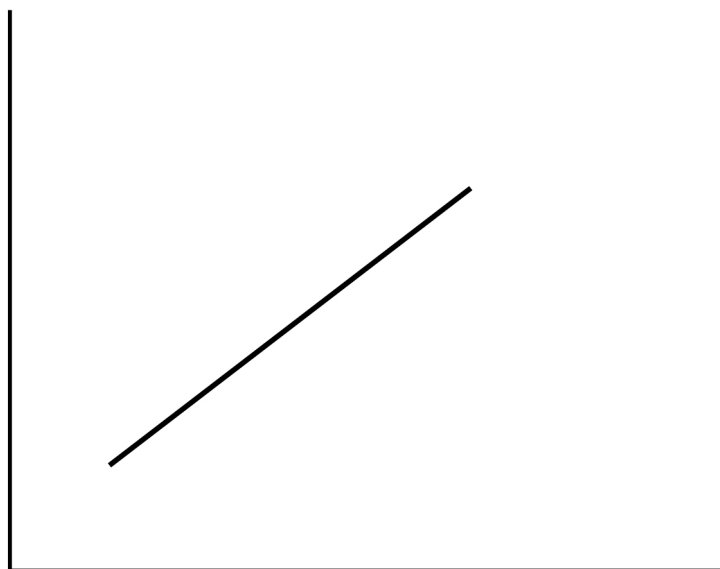


Mass of sodium carbonate in grams

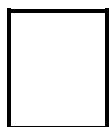




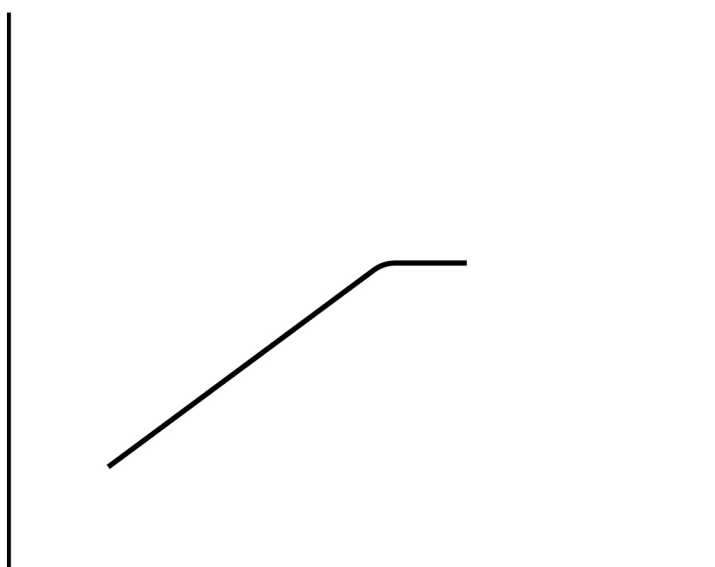
**B** Highest temperature reached by the reaction mixture in °C



Mass of sodium carbonate in grams



**C** Highest temperature reached by the reaction mixture in °C



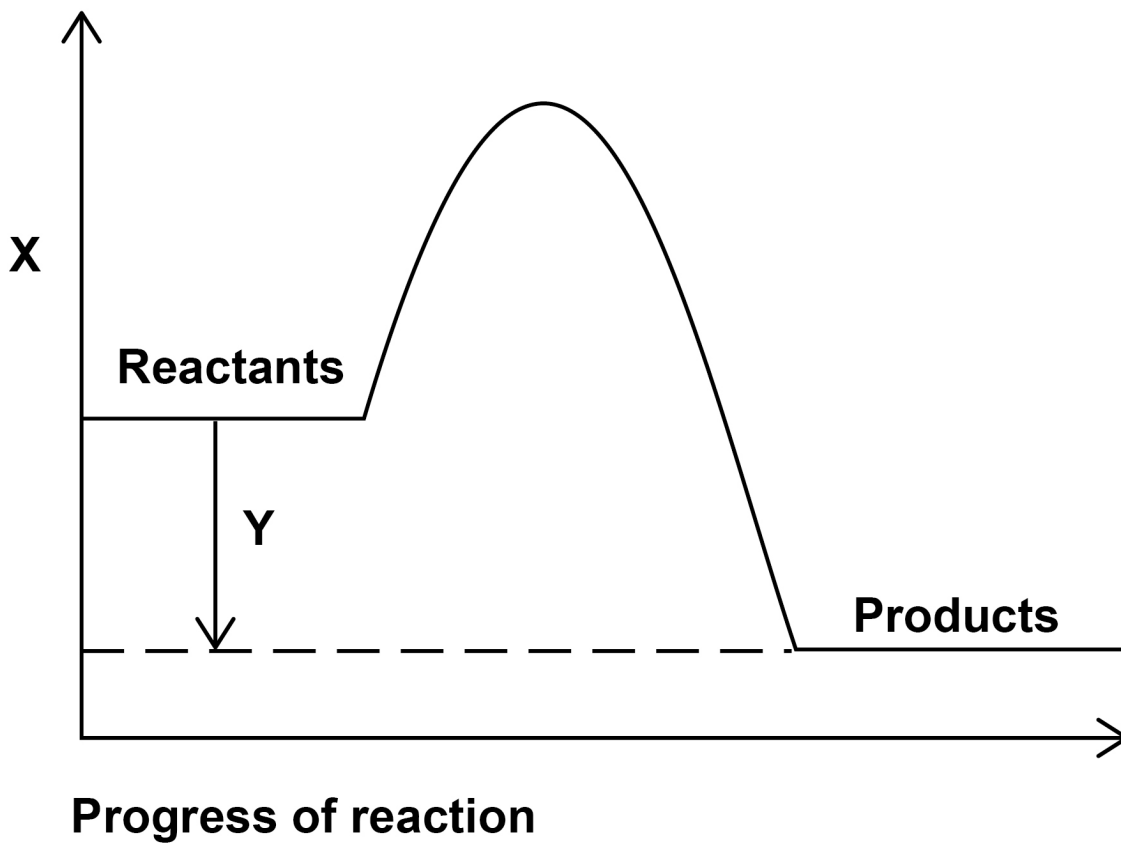
Mass of sodium carbonate in grams

[Turn over]



**FIGURE 4** shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

**FIGURE 4**



**0 2 . 5**

**What do labels X and Y represent on FIGURE 4?**  
**[2 marks]**

**X** \_\_\_\_\_

**Y** \_\_\_\_\_



**0 2 . 6**

**How does the reaction profile show that the reaction is exothermic?**

**Use FIGURE 4. [1 mark]**

---

---

---

**[Turn over]**

17

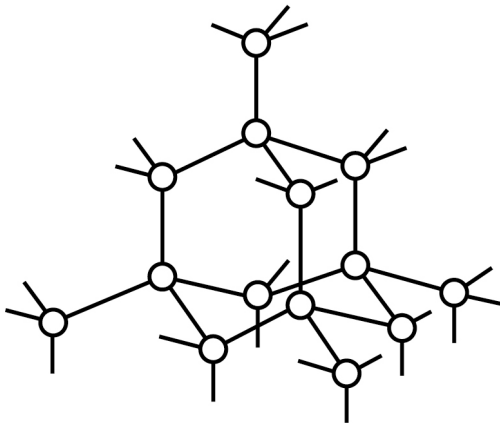


0	3
---	---

This question is about different forms of carbon.

FIGURE 5 represents the structure of diamond.

FIGURE 5



**KEY**

○ Carbon atom



03.1

**Describe the structure and bonding of diamond.  
[3 marks]**

---

---

---

---

---

---

---

---

---

---

---

**[Turn over]**



0	3	.	2
---	---	---	---

**Explain why diamond has a very high melting point.  
[3 marks]**

---

---

---

---

---

---

---

---

---

---

---





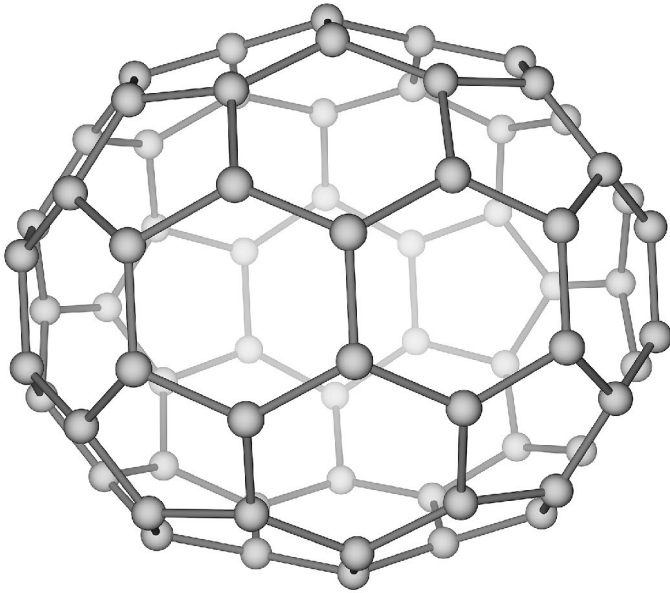
**BLANK PAGE**

**[Turn over]**



**FIGURE 6** represents the molecule  $C_{70}$

**FIGURE 6**



03.3

What is the name of this type of molecule? [1 mark]

Tick (✓) ONE box.

Fullerene

Graphene

Nanotube

Polymer

03.4

Molecules such as  $C_{70}$  can be used in medicine to move drugs around the body.

Suggest ONE reason why the  $C_{70}$  molecule is suitable for this use. [1 mark]

---

---

---

[Turn over]





**BLANK PAGE**

**[Turn over]**

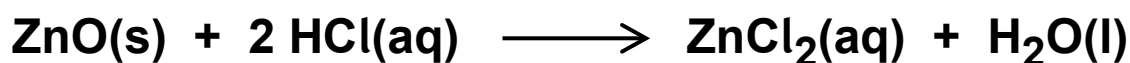


0	4
---	---

This question is about zinc and compounds of zinc.

A student produces pure crystals of zinc chloride by reacting zinc oxide with hydrochloric acid.

The equation for the reaction is:



0	4	.	1
---	---	---	---

The student adds zinc oxide to hydrochloric acid until the zinc oxide is in excess.

Give ONE observation that the student could make to show that the zinc oxide is in excess. [1 mark]

---

---

---



0	4	.	2
---	---	---	---

**Why is excess zinc oxide used rather than excess hydrochloric acid? [1 mark]**

---

---

---

0	4	.	3
---	---	---	---

**Name ONE OTHER compound that the student could add to hydrochloric acid to produce zinc chloride. [1 mark]**

---

---

**[Turn over]**



0	4	.	4
---	---	---	---

**Describe how the student should obtain crystals of zinc chloride from a solution of zinc chloride. [2 marks]**

---

---

---

---

---

---

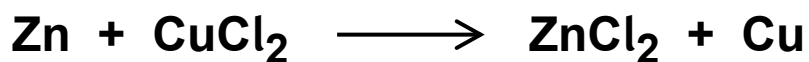
---





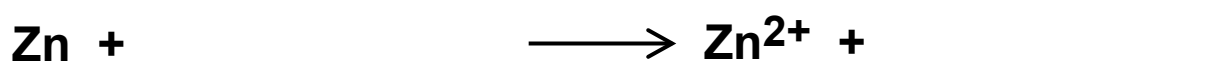
Zinc chloride is also produced in a displacement reaction between zinc and copper chloride solution.

The equation for the reaction is:



04.5

Complete the ionic equation for this reaction. [1 mark]



04.6

Why is zinc described as being oxidised in this reaction? [1 mark]

---

---

---

[Turn over]



**04.7**

**Zinc and copper can be used with another substance to produce electricity.**

**Complete FIGURE 7, on the opposite page, to show how zinc, copper and another substance can be used to light a lamp.**

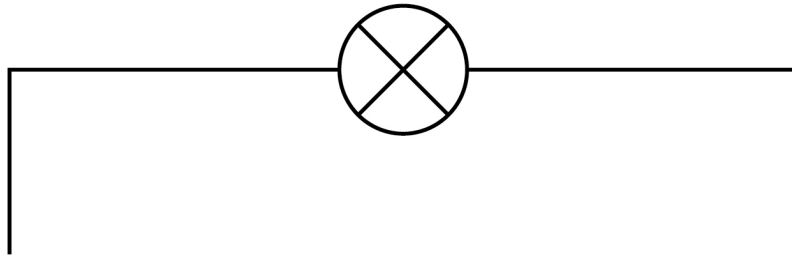
**Label:**

- **zinc**
- **copper**
- **the other substance used.**

**The symbol  represents the lamp. [3 marks]**



FIGURE 7



[Turn over]



3 5

10

0	5
---	---

**This question is about groups in the periodic table.**

**The elements in Group 1 become more reactive going down the group.**

**Rubidium is below potassium in Group 1.**

0	5	.	1
---	---	---	---

**Rubidium and potassium are added to water.**

**Predict ONE observation you would see that shows that rubidium is more reactive than potassium. [1 mark]**

---

---

---



0	5	.	2
---	---	---	---

**Explain why rubidium is more reactive than potassium.  
[3 marks]**

---

---

---

---

---

---

---

---

---

---

---

**[Turn over]**



**05.3**

Complete the equation for the reaction of rubidium with water.

You should balance the equation. [3 marks]



The noble gases are in Group 0.

**05.4**

Which is a correct statement about the noble gases?  
[1 mark]

Tick (✓) ONE box.

- The noble gases all have atoms with eight electrons in the outer shell.
- The noble gases have boiling points that increase going down the group.
- The noble gases have molecules with two atoms.
- The noble gases react with metals to form ionic compounds.



**BLANK PAGE**

**[Turn over]**



**05.5**

**TABLE 1** shows information about the three isotopes of neon.

**TABLE 1**

<b>Mass number</b>	<b>Percentage abundance (%)</b>
<b>20</b>	<b>90.48</b>
<b>21</b>	<b>0.27</b>
<b>22</b>	<b>9.25</b>

**Calculate the relative atomic mass ( $A_r$ ) of neon.**

**Give your answer to 3 significant figures. [3 marks]**

---

---

---

---

---

---





---

---

---

---

**Relative atomic mass (3 significant figures) =**

---

**[Turn over]**

<hr/>
11



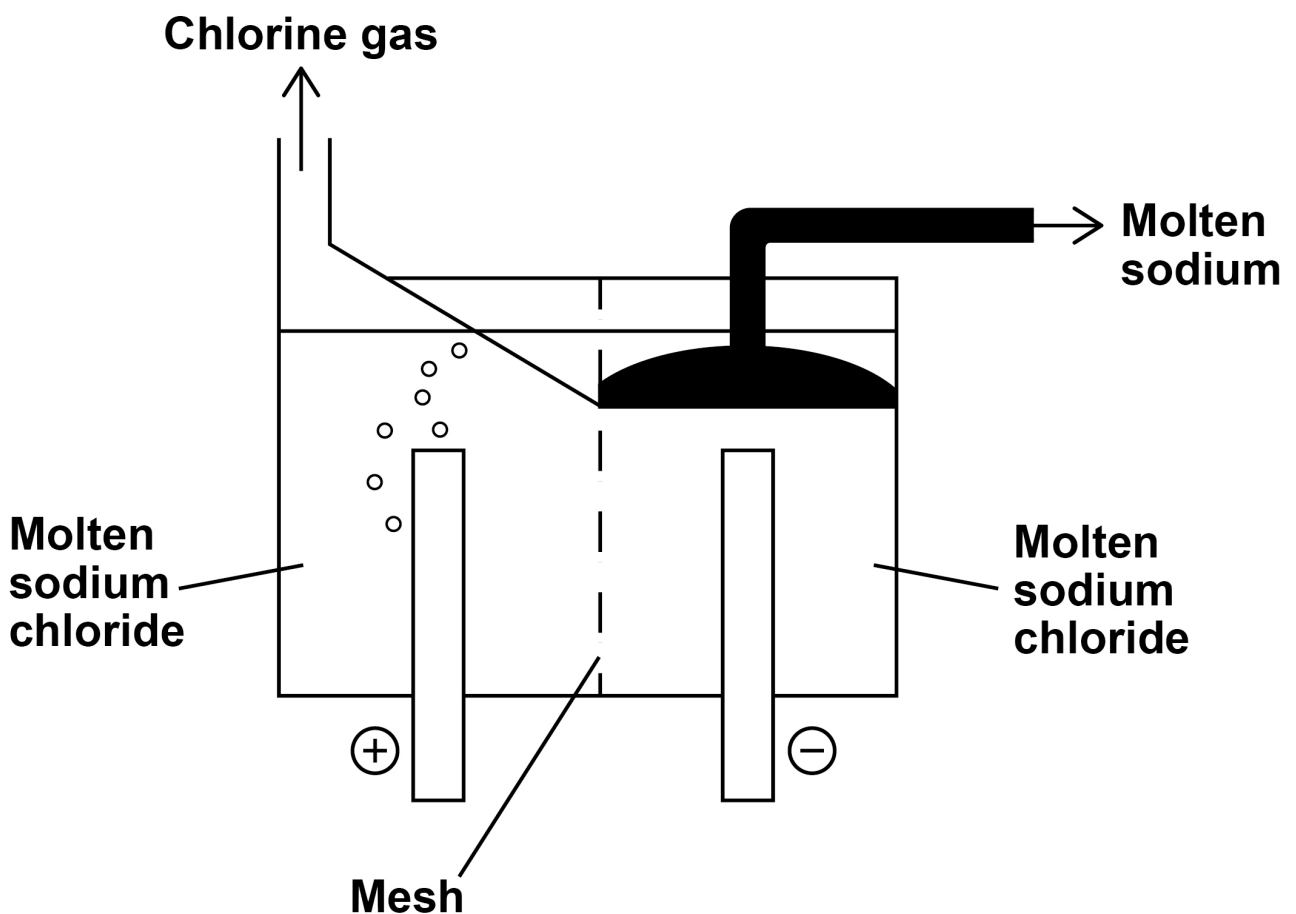
06

This question is about electrolysis.

Molten sodium chloride is electrolysed in an industrial process to produce sodium.

FIGURE 8 shows a simplified version of the electrolysis cell used.

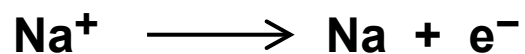
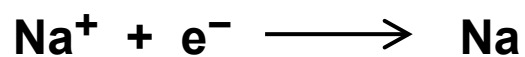
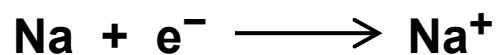
FIGURE 8



06.1

Which is the correct half equation for the production of sodium? [1 mark]

Tick (✓) ONE box.



[Turn over]



A mesh is used to keep the products of the electrolysis apart.

06.2

Suggest ONE reason why the products of the electrolysis must be kept apart. [1 mark]

---

---

---

06.3

Which type of particle passes through the mesh in the electrolysis of molten sodium chloride? [1 mark]

Tick (✓) ONE box.

Atom

Electron

Ion

Molecule



**Aqueous sodium chloride solution is electrolysed in a different industrial process.**

**Two gases and an alkaline solution are produced.**

**06.4**

**Which TWO ions are present in aqueous sodium chloride solution in addition to sodium ions and chloride ions? [2 marks]**

**1** \_\_\_\_\_

**2** \_\_\_\_\_

**06.5**

**Name the alkaline solution produced. [1 mark]**

\_\_\_\_\_

**[Turn over]**





**BLANK PAGE**

**[Turn over]**



0	7
---	---

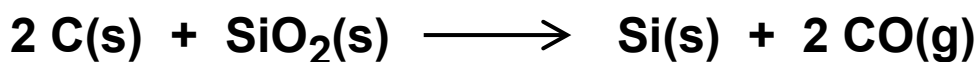
**This question is about silicon and compounds of silicon.**

0	7	.	1
---	---	---	---

**The reactivity series sometimes includes non-metals such as carbon, hydrogen and silicon.**

**Silicon can be extracted by reducing silicon dioxide with different substances.**

**The equation for one possible reaction is:**



**Explain what this reaction shows about the position of silicon in the reactivity series. [2 marks]**

---

---

---

---

---

---

---

---





07.2

Aluminium also reduces silicon dioxide.

Carbon is used rather than aluminium to reduce silicon dioxide because carbon is cheaper than aluminium.

Carbon can be obtained by heating coal.

Aluminium is obtained from aluminium oxide.

Explain why aluminium is more expensive than carbon.  
[2 marks]

---

---

---

---

---

---

---

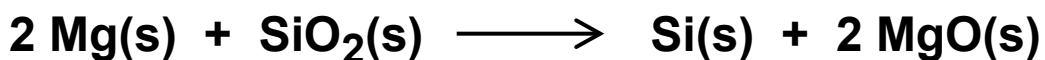
---

[Turn over]



Magnesium also reduces silicon dioxide.

The equation for the reaction is:



07.3

Give ONE reason why the products are difficult to separate if magnesium is used to reduce silicon dioxide. [1 mark]

---

---

---

07.4

Calculate the minimum mass in grams of magnesium needed to completely reduce 1.2 kg of silicon dioxide.

Relative atomic masses ( $A_r$ ):

O = 16    Mg = 24    Si = 28

[5 marks]

---

---





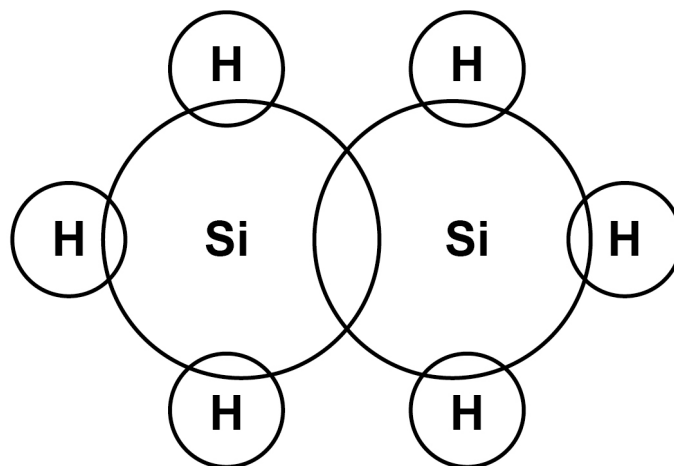
$\text{Si}_2\text{H}_6$  is a covalent compound of silicon and hydrogen.

07.5

Complete FIGURE 9 to show the outer shell electrons in a molecule of  $\text{Si}_2\text{H}_6$

[1 mark]

FIGURE 9



**BLANK PAGE**

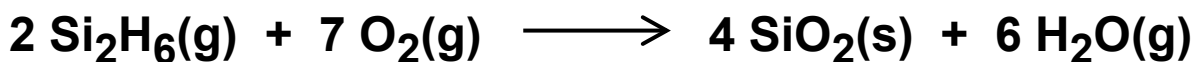
**[Turn over]**



**07.6**

**Si<sub>2</sub>H<sub>6</sub> reacts with oxygen.**

**The equation for the reaction is:**



**30 cm<sup>3</sup> of Si<sub>2</sub>H<sub>6</sub> is reacted with 150 cm<sup>3</sup> (an excess) of oxygen.**

**Calculate the total volume of gases present after the reaction.**

**All volumes of gases are measured at the same temperature and pressure. [4 marks]**

---

---

---

---

---

---

---

---

---

---



---

---

---

---

---

---

Volume of gases = \_\_\_\_\_ cm<sup>3</sup>

[Turn over]

15







---

---

---

---

---

---

---

**[Turn over]**



**08.2**

A student titrated 25.00 cm<sup>3</sup> of hydrochloric acid with 0.100 mol/dm<sup>3</sup> barium hydroxide solution.

TABLE 2 shows the results.

TABLE 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm <sup>3</sup>	23.90	23.45	23.55	23.55	23.45



The student calculated the volume of barium hydroxide solution to be used in the titration calculation as  $23.50 \text{ cm}^3$ .

Explain why the student used a volume of  $23.50 \text{ cm}^3$  of barium hydroxide solution in the titration calculation.  
[2 marks]

---

---

---

---

---

---

---

---

[Turn over]





---

---

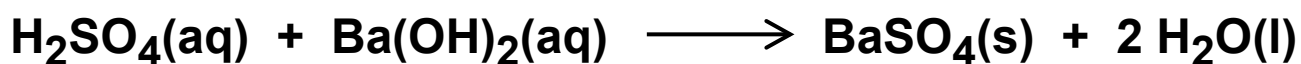
---

Concentration of the hydrochloric acid =

\_\_\_\_\_ mol/dm<sup>3</sup>

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:



The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

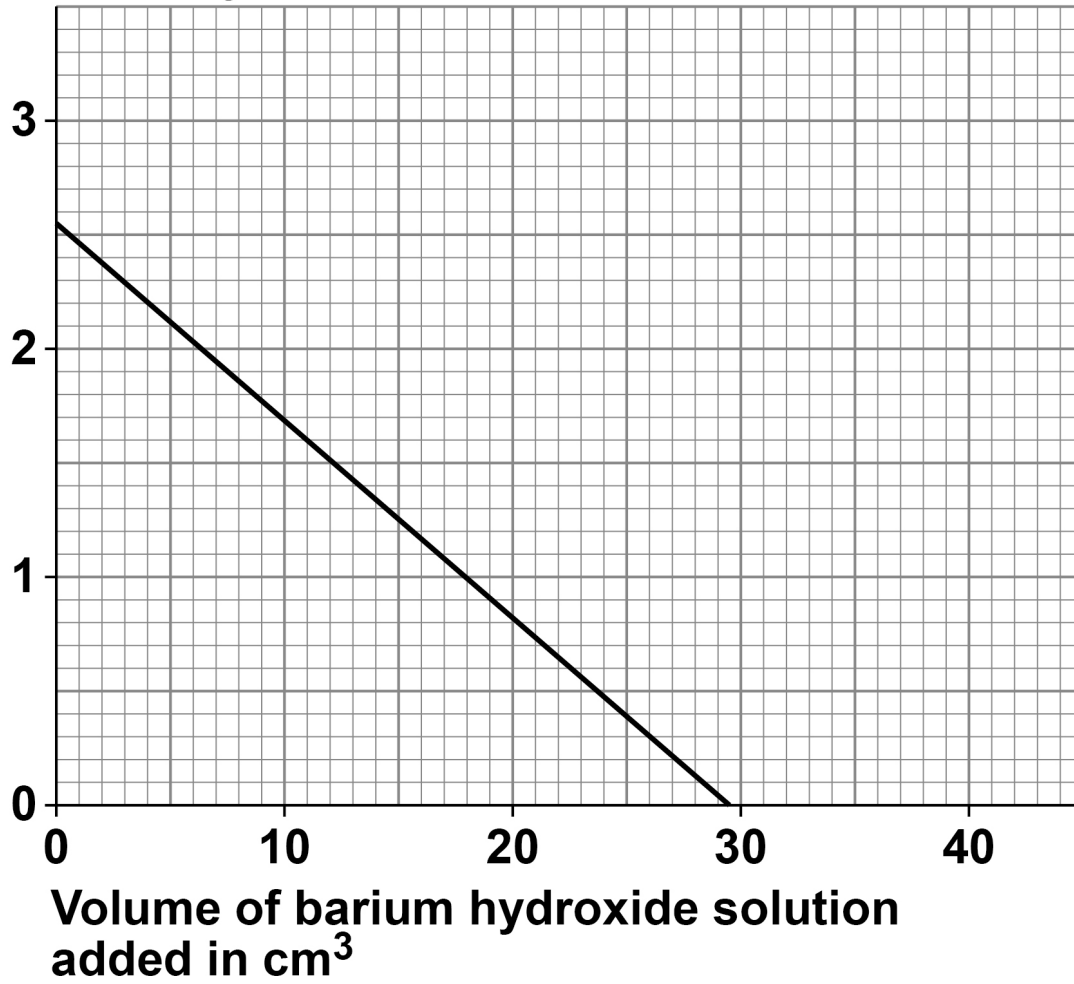
FIGURE 10, on page 62, shows the results.

[Turn over]



FIGURE 10

Electrical conductivity  
in arbitrary units





0	8	.	5
---	---	---	---

The student then added a further 10 cm<sup>3</sup> of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give ONE reason why. [1 mark]

---

---

---

**END OF QUESTIONS**

14











**BLANK PAGE**

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
<b>TOTAL</b>	

**Copyright information**

For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from [www.aqa.org.uk](http://www.aqa.org.uk).

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team.

Copyright © 2022 AQA and its licensors. All rights reserved.

**IB/M/CH/Jun22/8462/1H/E3**