

Please write clearly in block capitals.

Centre number

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I declare this is my own work.

# GCSE CHEMISTRY

# H

Higher Tier Paper 1

Time allowed: 1 hour 45 minutes

## Materials

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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or 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.

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

## 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.

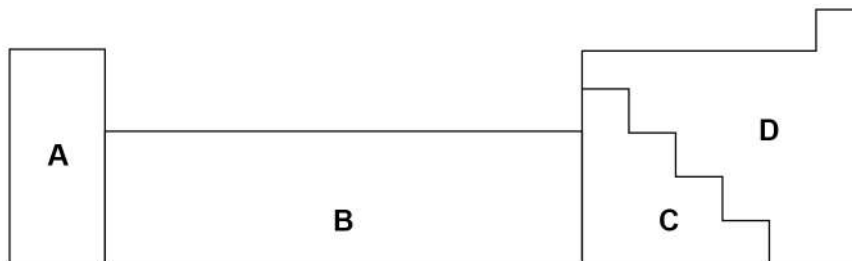


0 1

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

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

0 1 . 3

Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

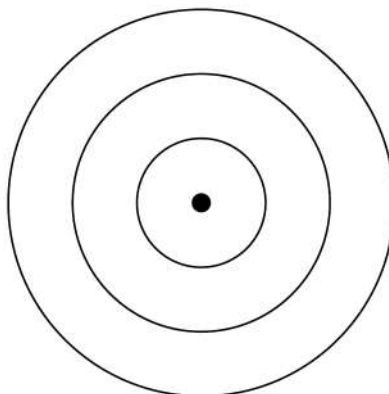


**0 1 . 4** Complete **Figure 2** to show the electronic structure of an aluminium atom.

Use the periodic table.

**[1 mark]**

**Figure 2**



**0 1 . 5** Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

**[3 marks]**

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**0 1 . 6** Name the type of bonding in compounds formed between metals and non-metals.

**[1 mark]**

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**Turn over ►**



0 1 . 7

Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

**[4 marks]**

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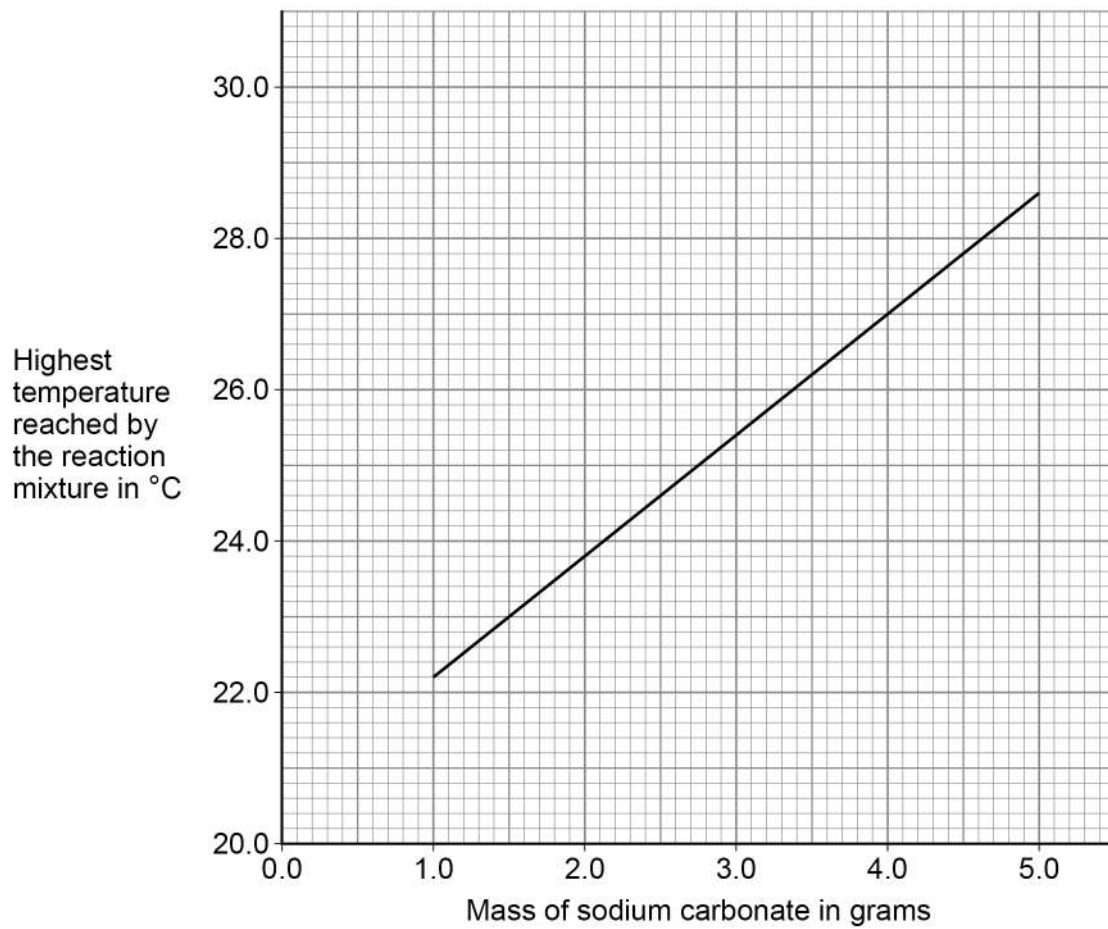
13





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

Figure 3



**0 2 . 2** Determine the gradient of the line of best fit in **Figure 3**.

Use the equation:

$$\text{Gradient} = \frac{\text{Change in highest temperature}}{\text{Change in mass}}$$

Give the unit.

**[5 marks]**

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Gradient = \_\_\_\_\_ Unit \_\_\_\_\_

**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**.

**[2 marks]**

Initial temperature of the reaction mixture = \_\_\_\_\_ °C

Turn over ►



0 2 . 4

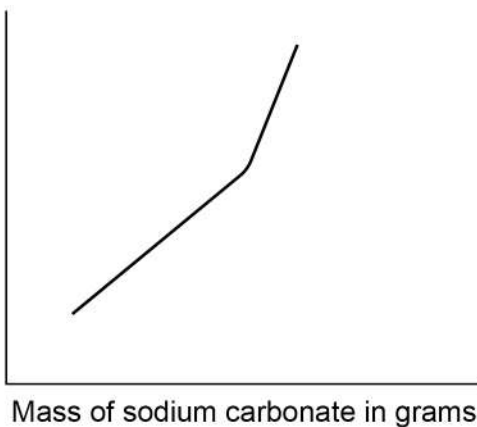
Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

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

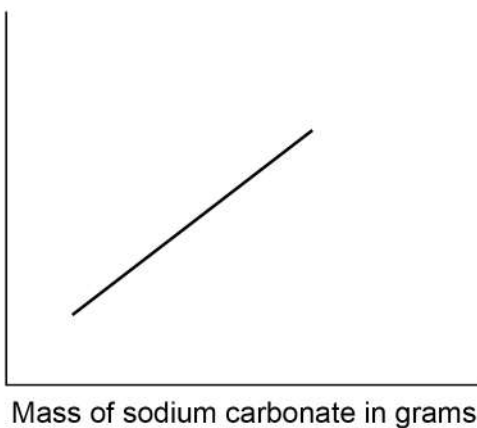
**[1 mark]**

Tick (✓) **one** box.

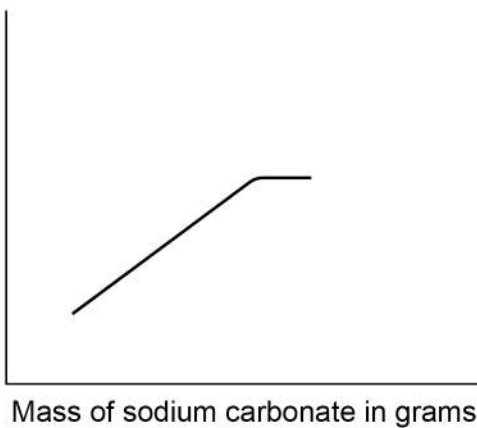
**A** Highest temperature reached by the reaction mixture in °C



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

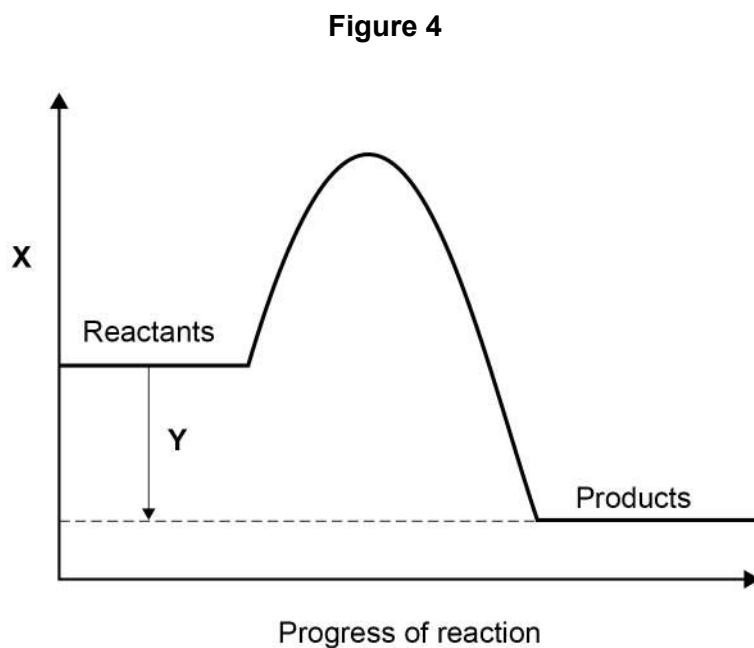


**C** Highest temperature reached by the reaction mixture in °C





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



**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]

\_\_\_\_\_

\_\_\_\_\_

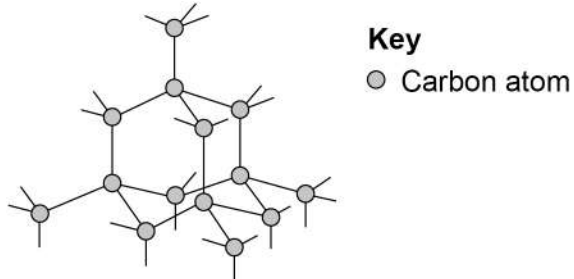


**0 3**

This question is about different forms of carbon.

**Figure 5** represents the structure of diamond.

**Figure 5**

**0 3 . 1**

Describe the structure and bonding of diamond.

**[3 marks]**

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**0 3 . 2**

Explain why diamond has a very high melting point.

**[3 marks]**

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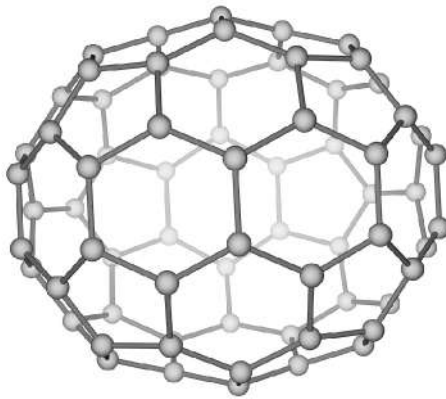
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Figure 6 represents the molecule  $C_{70}$

Figure 6



0 3 . 3 What is the name of this type of molecule?

[1 mark]

Tick (✓) **one** box.

Fullerene

Graphene

Nanotube

Polymer

0 3 . 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]

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Turn over ►



|   |   |   |   |
|---|---|---|---|
| 0 | 3 | . | 5 |
|---|---|---|---|

Calculate the number of  $C_{70}$  molecules that can be made from one mole of carbon atoms.

The Avogadro constant =  $6.02 \times 10^{23}$  per mole

**[3 marks]**

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Number of molecules = \_\_\_\_\_

|       |
|-------|
| _____ |
| 11    |

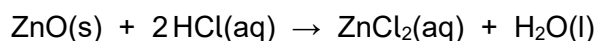


0 4

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]

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0 4 . 2

Why is excess zinc oxide used rather than excess hydrochloric acid?

[1 mark]

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0 4 . 3

Name **one other** compound that the student could add to hydrochloric acid to produce zinc chloride.

[1 mark]

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0 4 . 4

Describe how the student should obtain crystals of zinc chloride from a solution of zinc chloride.

[2 marks]

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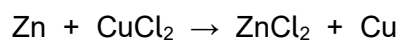
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Turn over ►



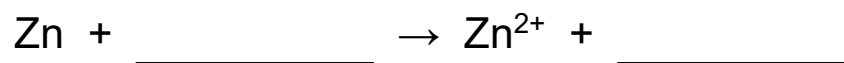
Zinc chloride is also produced in a displacement reaction between zinc and copper chloride solution.

The equation for the reaction is:



0 4 . 5 Complete the ionic equation for this reaction.

[1 mark]



0 4 . 6 Why is zinc described as being oxidised in this reaction?

[1 mark]

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**0 4 . 7** Zinc and copper can be used with another substance to produce electricity.

Complete **Figure 7** to show how zinc, copper and another substance can be used to light a lamp.

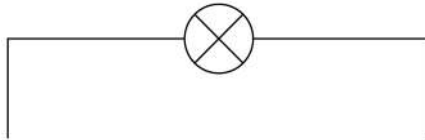
Label:

- zinc
- copper
- the other substance used.

The symbol  represents the lamp.

**[3 marks]**

**Figure 7**



**Turn over for the next question**

**10**

**Turn over ►**



**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]**

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**0 5 . 2**

Explain why rubidium is more reactive than potassium.

**[3 marks]**

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**0 5 . 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.

**0 5 . 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.

**0 5 . 5** **Table 1** shows information about the three isotopes of neon.

**Table 1**

| Mass number | Percentage abundance (%) |
|-------------|--------------------------|
| 20          | 90.48                    |
| 21          | 0.27                     |
| 22          | 9.25                     |

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

Give your answer to 3 significant figures.

**[3 marks]**

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Relative atomic mass (3 significant figures) = \_\_\_\_\_

**11**

**Turn over ►**



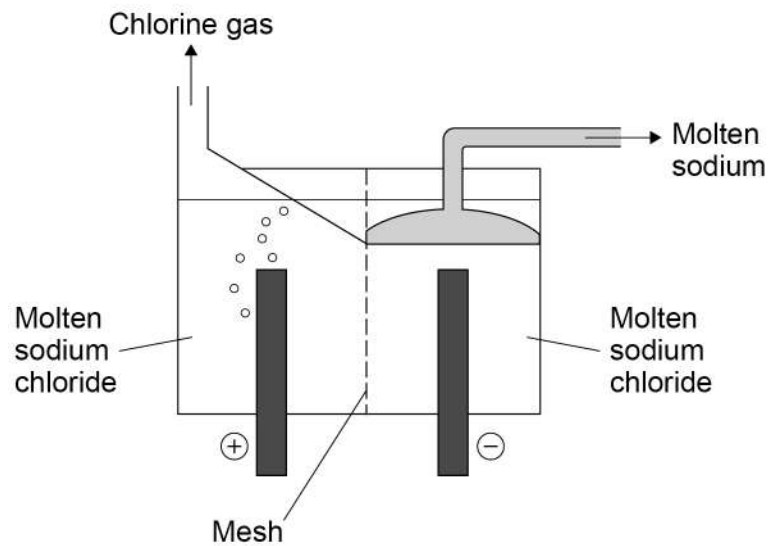
0 6

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**



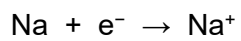
0 6

. 1

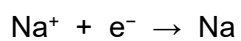
Which is the correct half equation for the production of sodium?

[1 mark]

Tick (✓) **one** box.











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

**0 6 . 2** Suggest **one** reason why the products of the electrolysis must be kept apart.

[1 mark]

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**0 6 . 3** Which type of particle passes through the mesh in the electrolysis of molten sodium chloride?

[1 mark]

Tick (✓) **one** box.

|          |                          |
|----------|--------------------------|
| Atom     | <input type="checkbox"/> |
| Electron | <input type="checkbox"/> |
| Ion      | <input type="checkbox"/> |
| Molecule | <input type="checkbox"/> |

Question 6 continues on the next page

Turn over ►



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

Two gases and an alkaline solution are produced.

**0 6 . 4** Which **two** ions are present in aqueous sodium chloride solution in addition to sodium ions and chloride ions?

**[2 marks]**

1 \_\_\_\_\_

2 \_\_\_\_\_

**0 6 . 5** Name the alkaline solution produced.

**[1 mark]**

\_\_\_\_\_

**0 6 . 6** Explain how the alkaline solution is produced.

You should refer to the processes at the electrodes.

**[3 marks]**

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\_\_\_\_\_

9



**0 7**

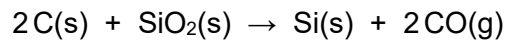
This question is about silicon and compounds of silicon.

**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]**

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**0 7 . 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]**

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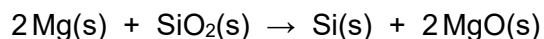
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**Turn over ►**

Magnesium also reduces silicon dioxide.

The equation for the reaction is:



0 7 . 3

Give **one** reason why the products are difficult to separate if magnesium is used to reduce silicon dioxide.

[1 mark]

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0 7 . 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]

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Minimum mass of magnesium = \_\_\_\_\_ g

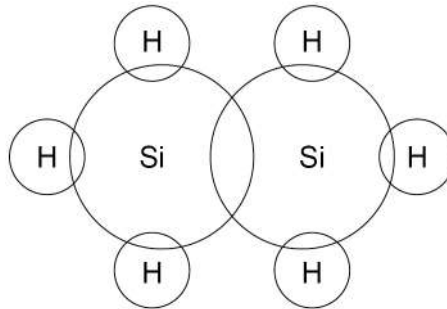


$\text{Si}_2\text{H}_6$  is a covalent compound of silicon and hydrogen.

**0 7 . 5** Complete **Figure 9** to show the outer shell electrons in a molecule of  $\text{Si}_2\text{H}_6$

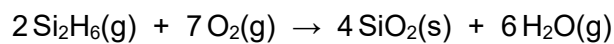
**[1 mark]**

**Figure 9**



**0 7 . 6**  $\text{Si}_2\text{H}_6$  reacts with oxygen.

The equation for the reaction is:



30 cm<sup>3</sup> of  $\text{Si}_2\text{H}_6$  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]**

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

**15**

**Turn over ►**



0 8

This question is about acids and alkalis.

0 8 . 1

Explain why the pH of an acid depends on:

- the strength of the acid
- the concentration of the acid.

**[4 marks]**

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0 8 . 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 cm<sup>3</sup>.

Explain why the student used a volume of 23.50 cm<sup>3</sup> of barium hydroxide solution in the titration calculation.

**[2 marks]**

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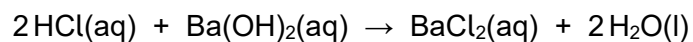




**0 8 . 3**

25.00 cm<sup>3</sup> of the hydrochloric acid reacted with 23.50 cm<sup>3</sup> of the 0.100 mol/dm<sup>3</sup> barium hydroxide solution.

The equation for the reaction is:



Calculate the concentration of the hydrochloric acid in mol/dm<sup>3</sup>.

**[4 marks]**

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Concentration of the hydrochloric acid = \_\_\_\_\_ mol/dm<sup>3</sup>

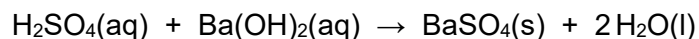
**Question 8 continues on the next page**

**Turn over ►**



Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

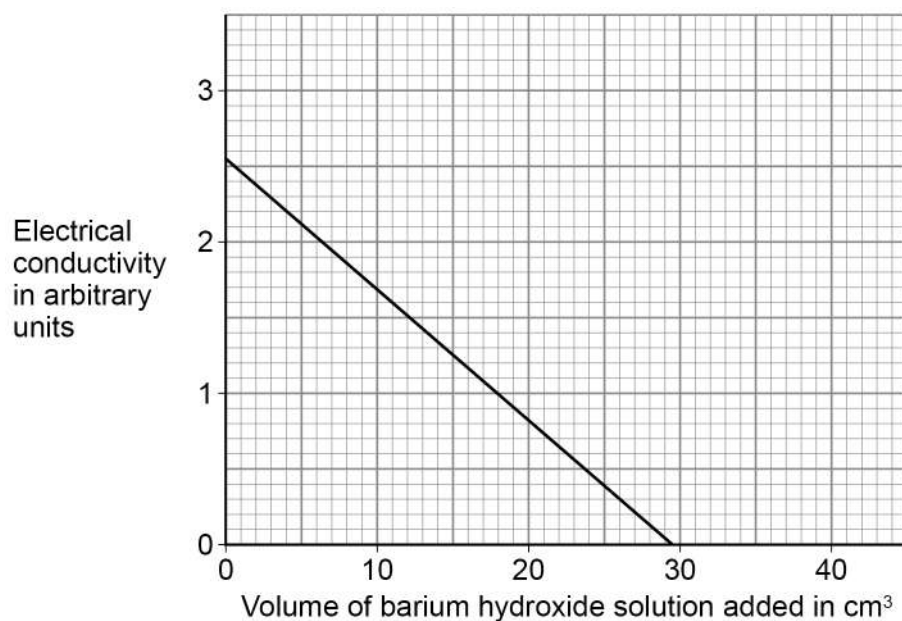


The student measured the electrical conductivity of the mixture during the titration.

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

**Figure 10** shows the results.

**Figure 10**



0 8 . 4

Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

**[3 marks]**

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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]

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14

**END OF QUESTIONS**



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3 2



2 2 6 G 8 4 6 2 / 1 H

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