

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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I declare this is my own work.

# GCSE COMBINED SCIENCE: TRILOGY

# H

Higher Tier  
Chemistry Paper 1H

Time allowed: 1 hour 15 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.
- 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 70.
- 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.

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



J U N 2 2 8 4 6 4 C 1 H O 1

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ANSWER IN THE SPACES PROVIDED**



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|---|---|
| 0 | 1 |
|---|---|

This question is about salts.

Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.

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

**Excess** copper carbonate is added to sulfuric acid.

Give **three** observations you would make.

[3 marks]

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

3 \_\_\_\_\_

\_\_\_\_\_

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

How can the excess copper carbonate be removed?

[1 mark]

\_\_\_\_\_

\_\_\_\_\_

|   |   |   |   |
|---|---|---|---|
| 0 | 1 | . | 3 |
|---|---|---|---|

The pH of the solution changes during the reaction.

What is the pH of the solution at the end of the reaction?

[1 mark]

pH = \_\_\_\_\_

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

Copper carbonate and sulfuric acid react to produce copper sulfate.

What type of reaction is this?

[1 mark]

\_\_\_\_\_

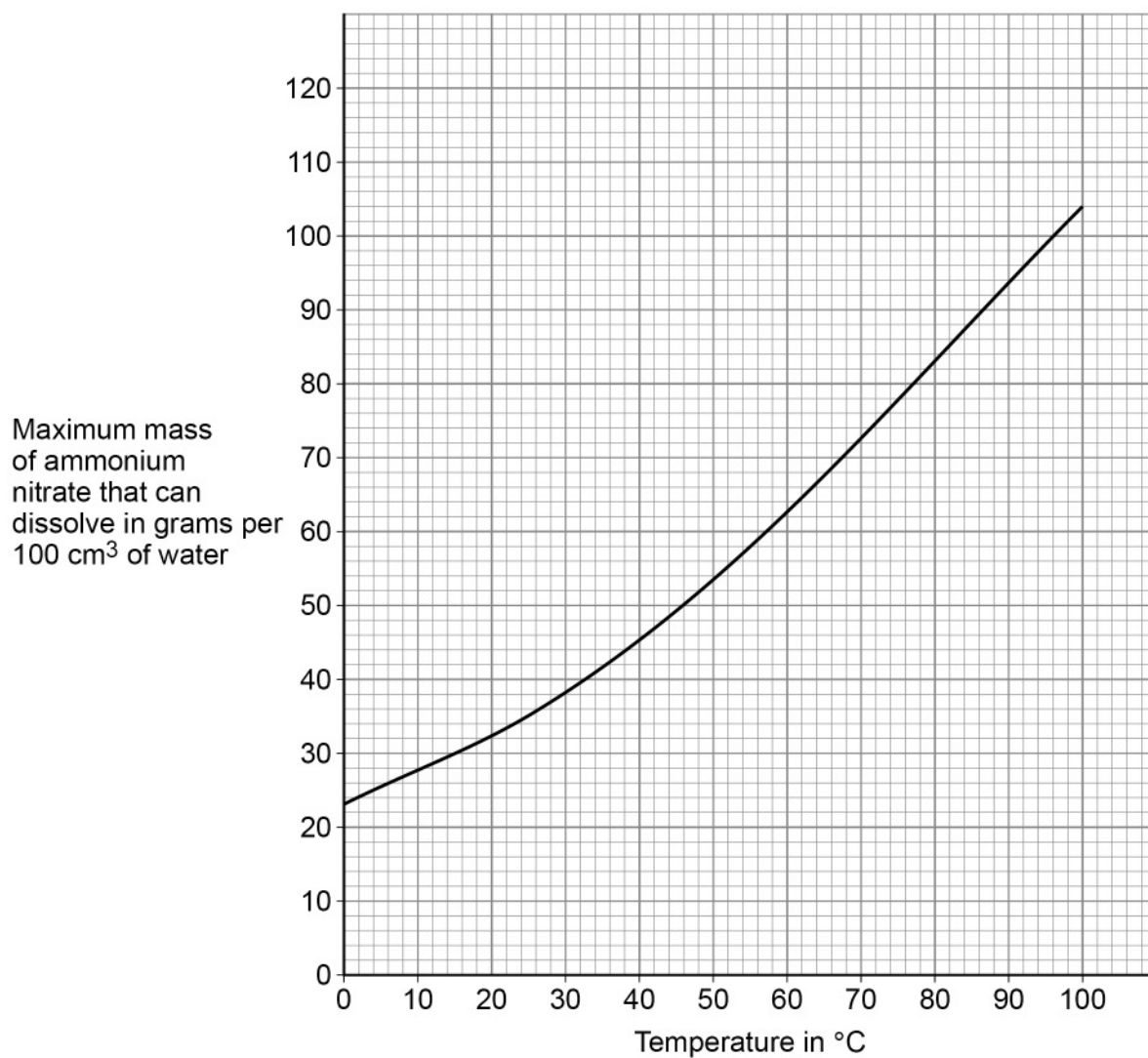
Turn over ►



0 1 . 5 Ammonium nitrate is a salt.

**Figure 1** shows the maximum mass of ammonium nitrate that can dissolve in 100 cm<sup>3</sup> of water at different temperatures.

**Figure 1**



A student adds ammonium nitrate to water at 80 °C until no more dissolves.

The student cools 100 cm<sup>3</sup> of this solution of ammonium nitrate from 80 °C to 20 °C to produce crystals of ammonium nitrate.

Determine the mass of ammonium nitrate that crystallises on cooling 100 cm<sup>3</sup> of this solution from 80 °C to 20 °C

**[3 marks]**

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Mass = \_\_\_\_\_ g

9

**Turn over for the next question**

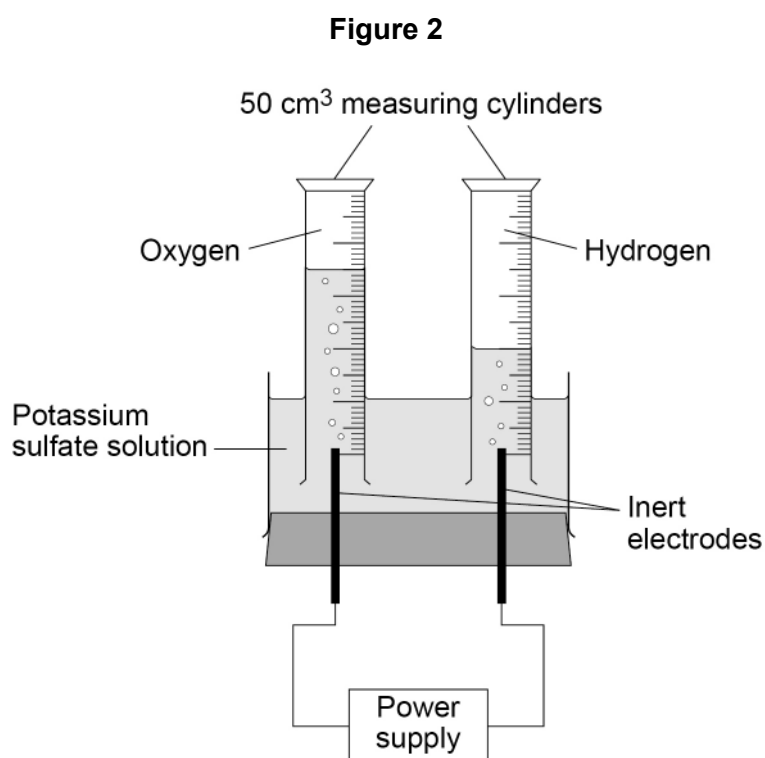
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0 2

This question is about electrolysis.

**Figure 2** shows the apparatus used to investigate the electrolysis of potassium sulfate solution.



0 2 . 1

Potassium sulfate contains  $\text{K}^+$  and  $\text{SO}_4^{2-}$  ions.

What is the formula of potassium sulfate?

[1 mark]

Tick (✓) **one** box.

$\text{KSO}_4$

☐

$\text{K}_2\text{SO}_4$

☐

$\text{K}(\text{SO}_4)_2$

☐

$\text{K}_2(\text{SO}_4)_2$

☐


**0 2 . 2**

What are the volumes of gases collected in the electrolysis experiment?

Use **Figure 2**.**[1 mark]**Volume of hydrogen = \_\_\_\_\_ cm<sup>3</sup>Volume of oxygen = \_\_\_\_\_ cm<sup>3</sup>**0 2 . 3**

A student made the following hypothesis:

‘The volumes of gases collected in this electrolysis experiment are in the same ratio as hydrogen atoms to oxygen atoms in a water molecule.’

Explain how the volumes of gases collected in the experiment in **Figure 2** support the student’s hypothesis.

Use your answer to Question **02.2****[2 marks]**

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**Question 2 continues on the next page****Turn over ►**

0 2 . 4

The experiment is repeated 4 times.

The volumes of oxygen collected in the 4 experiments are:

6 cm<sup>3</sup> 9 cm<sup>3</sup> 10 cm<sup>3</sup> 11 cm<sup>3</sup>

The mean volume of oxygen collected in the 4 experiments is 9 cm<sup>3</sup>

The measure of uncertainty is the range of a set of measurements about the mean.

What is the measure of uncertainty in the 4 experiments?

[1 mark]

Tick (✓) **one** box.

9 ± 1 cm<sup>3</sup>

☐

9 ± 2 cm<sup>3</sup>

☐

9 ± 3 cm<sup>3</sup>

☐

0 2 . 5

The potassium sulfate solution has 0.86 g of potassium sulfate dissolved in 25 cm<sup>3</sup> of water.

Calculate the mass of potassium sulfate needed to make 1.0 dm<sup>3</sup> of solution.

[3 marks]

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Mass = \_\_\_\_\_ g

8



**[6 marks]**

[illegible]

6

**Turn over ►**



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|   |   |
|---|---|
| 0 | 4 |
|---|---|

This question is about Group 7 elements.

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

What are the Group 7 elements known as?

[1 mark]

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|   |   |   |   |
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Why do Group 7 elements react in similar ways?

[1 mark]

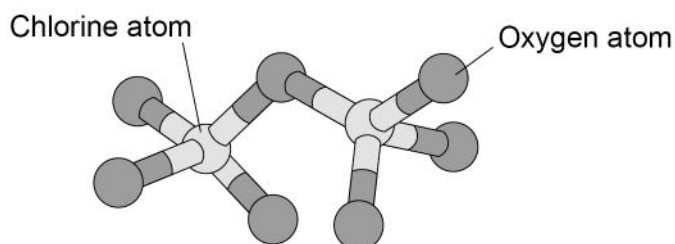
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|   |   |   |   |
|---|---|---|---|
| 0 | 4 | . | 3 |
|---|---|---|---|

**Figure 3** shows the structure of a molecule of chlorine oxide.

**Figure 3**



What is the molecular formula of the chlorine oxide molecule in **Figure 3**?

[1 mark]

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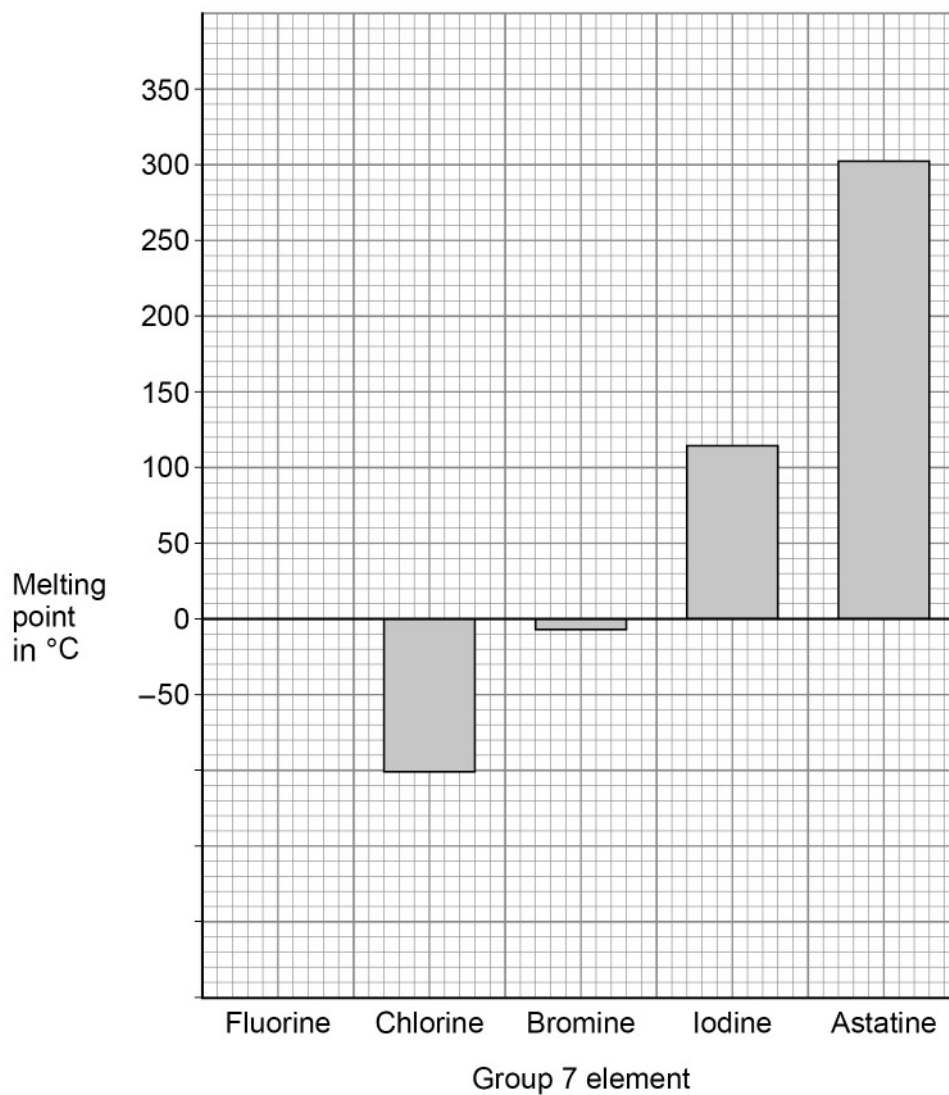
**Question 4 continues on the next page**

**Turn over ►**



**Figure 4** shows the melting points of some Group 7 elements.

**Figure 4**



**0 4 . 4** The melting point of fluorine is  $-220\text{ }^{\circ}\text{C}$

Complete **Figure 4**.

You should:

- complete the scale on the y-axis
- draw the bar for the melting point of fluorine.

**[2 marks]**



**0 4 . 5** Explain the trend in the melting points of the Group 7 elements.

Use **Figure 4**.

**[3 marks]**

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**0 4 . 6** What is the state symbol for bromine at  $-50\text{ }^{\circ}\text{C}$ ?

Use **Figure 4**.

**[1 mark]**

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

**0 4 . 7** Evaporation and boiling occur at the surface of bromine at its boiling point.

Name **one** more process that happens at the surface of bromine at its boiling point.

**[1 mark]**

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**10**

**Turn over for the next question**

**Turn over ►**



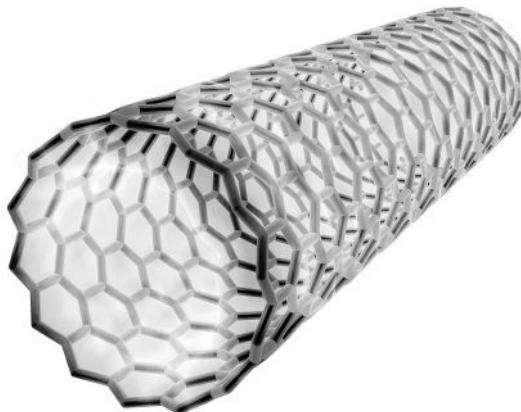
0 5

This question is about structure and bonding.

0 5 . 1

**Figure 5** represents part of a carbon molecule.

**Figure 5**



Name the type of carbon molecule in **Figure 5**.

[1 mark]

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0 5 . 2

Suggest **one** property that makes the carbon molecule in **Figure 5** useful in nanotechnology.

[1 mark]

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0 5 . 3

An alloy of aluminium contains small amounts of other metals.

Explain why other metals are added to aluminium.

[4 marks]

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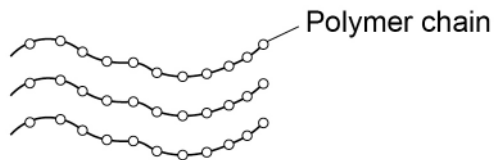
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0 5 . 4

Figure 6 represents part of the structure of a polymer.

Figure 6



Compare the bonding within the chains with the forces between the chains in this polymer.

[3 marks]

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**0 6**

This question is about hydrogen chloride and hydrochloric acid.

**0 6 . 1**

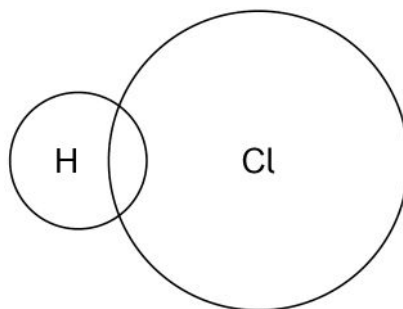
Complete the dot and cross diagram to represent the bonding in hydrogen chloride on **Figure 7**.

Use dots (o) and crosses (x) to represent electrons.

You should show only the electrons in the outer shells.

**[2 marks]**

**Figure 7**

**0 6 . 2**

Hydrogen chloride dissolves in water to produce hydrochloric acid.

Hydrochloric acid is a strong acid.

What is meant by the term strong acid?

**[1 mark]**

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**0 6 . 3**

Describe how magnesium can be used to distinguish between a strong acid and a weak acid of the same concentration.

**[2 marks]**

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0 6 . 4

The concentration of hydrochloric acid is increased by a factor of 100

What is the change in pH?

[2 marks]

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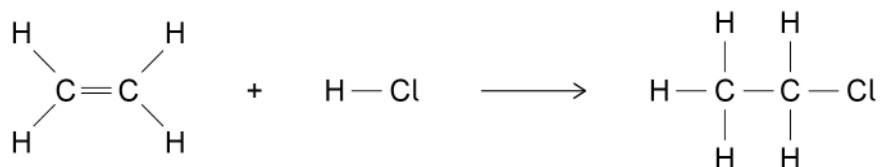
Question 6 continues on the next page

Turn over ►



**0 6 . 5** Ethene and hydrogen chloride react to produce chloroethane.

The displayed formulae equation for the reaction is:



The reaction is exothermic.

In the reaction the energy released forming new bonds is 56 kJ/mol greater than the energy needed to break existing bonds.

**Table 1** shows some bond energies.

**Table 1**

| Bond                  | H—C | C=C      | H—Cl | C—C | C—Cl |
|-----------------------|-----|----------|------|-----|------|
| Bond energy in kJ/mol | 413 | <b>X</b> | 431  | 346 | 339  |

Calculate the bond energy **X**.

**[4 marks]**

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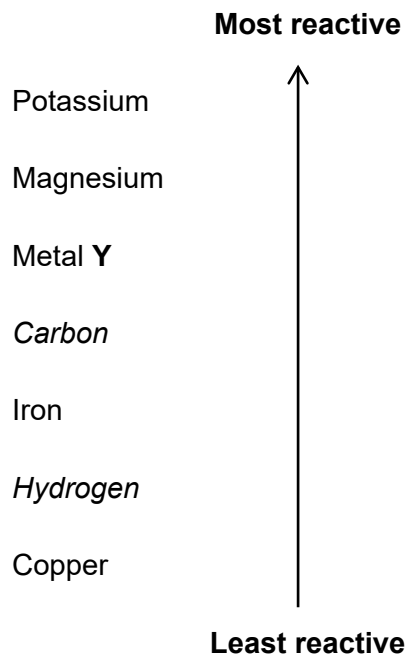
**X** = \_\_\_\_\_ kJ/mol

**11**



**0 7**

This question is about elements and compounds.

**0 7 . 1****Figure 8** shows a reactivity series.**Figure 8**

Give the method and conditions used to extract metal Y from a compound of metal Y.

**[2 marks]**

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**Question 7 continues on the next page****Turn over ►**

Sodium reacts with titanium chloride ( $\text{TiCl}_4$ ) to produce titanium.

**0 7 . 2** Complete the equation.

You should balance the equation.

**[2 marks]**



**0 7 . 3** The reaction between sodium and titanium chloride is a redox reaction.

Write a half-equation to show that sodium is oxidised in this reaction.

**[2 marks]**

\_\_\_\_\_





Sodium metal and sodium chloride are both able to conduct electricity.

0 7 . 5

Describe how sodium metal conducts electricity.

[2 marks]

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0 7 . 6

Explain how sodium chloride can conduct electricity.

[3 marks]

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17

END OF QUESTIONS



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2 8



2 2 6 G 8 4 6 4 / C / 1 H

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