



Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

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

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

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

I declare this is my own work.

**GCSE**

**CHEMISTRY**

**H**

Higher Tier Paper 1

**8462/1H**

Friday 17 May 2024

Morning

Time allowed: 1 hour 45 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]



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

**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.
- 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.



## **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.**
- **In all calculations, show clearly how you work out your answer.**
- **You are reminded of the need for good English and clear presentation in your answers.**

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



0	1
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A student produced a salt by reacting copper carbonate with sulfuric acid.

This is the method used.

1. Measure 50 cm<sup>3</sup> of sulfuric acid into a beaker.
2. Add copper carbonate powder.
3. Stir the mixture.
4. Repeat steps 2 and 3 until copper carbonate is in excess.
5. Filter the mixture.
6. Warm the filtrate gently until crystals start to appear.
7. Leave the solution to cool and crystallise.

0	1	.	1
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Complete the word equation for the reaction. [2 marks]

copper carbonate + sulfuric acid  $\longrightarrow$

\_\_\_\_\_ + \_\_\_\_\_ +

carbon dioxide



**0 1 . 2**

**Give ONE observation the student could make during STEP 4 which shows that the copper carbonate is in excess. [1 mark]**

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**0 1 . 3**

**Give ONE reason for filtering the mixture in STEP 5. [1 mark]**

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**0 1 . 4**

**Name the equipment that can be used to warm the filtrate GENTLY in STEP 6. [1 mark]**

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0 1 . 5

The maximum theoretical mass of the salt that could be produced using 50 cm<sup>3</sup> of the sulfuric acid is 12.5 g.

The percentage yield of the salt is 92.8%.

Calculate the mass of salt actually produced.

Use the equation:

$$\% \text{ yield} = \frac{\text{mass of salt actually produced}}{\text{maximum theoretical mass of salt that could be produced}} \times 100$$

6

[3 marks]

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**Mass of salt actually produced = \_\_\_\_\_ g**

**[Turn over]**

0	1	.	6
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Some salts can be produced by reacting sulfuric acid with a metal.

Neither copper nor sodium is used to produce a salt with sulfuric acid.

Give ONE reason why each metal is NOT used.  
[2 marks]

Copper \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Sodium \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10



0	2
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This question is about the periodic table.

Sodium and potassium are in Group 1 of the periodic table.

0	2	.	1
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Give ONE similarity and ONE difference between the electronic structures of sodium and potassium.

[2 marks]

Similarity \_\_\_\_\_

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Difference \_\_\_\_\_

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[Turn over]



Group 1 elements react with water.

0 2 . 2

Give TWO observations made when potassium reacts with water. [2 marks]

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



0	2	.	3
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**Potassium hydroxide solution is produced when potassium reacts with water.**

**What is the colour of universal indicator when added to potassium hydroxide solution?**

**Give ONE reason for your answer. [2 marks]**

**Colour of universal indicator** \_\_\_\_\_

**Reason** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**TABLE 1, on page 12, shows the densities of some of the elements in Group 0 of the periodic table.**

**[Turn over]**



TABLE 1

ELEMENT	ATOMIC NUMBER	DENSITY IN mg/cm <sup>3</sup>
Helium	2	0.2
Neon	10	0.8
Argon	18	1.6
Krypton	36	X
Xenon	54	5.4
Radon	86	9.1

02.4

Plot the data from TABLE 1 on FIGURE 1, on the opposite page. [2 marks]

02.5

Estimate the density (X) of krypton.

Use FIGURE 1 and TABLE 1. [1 mark]

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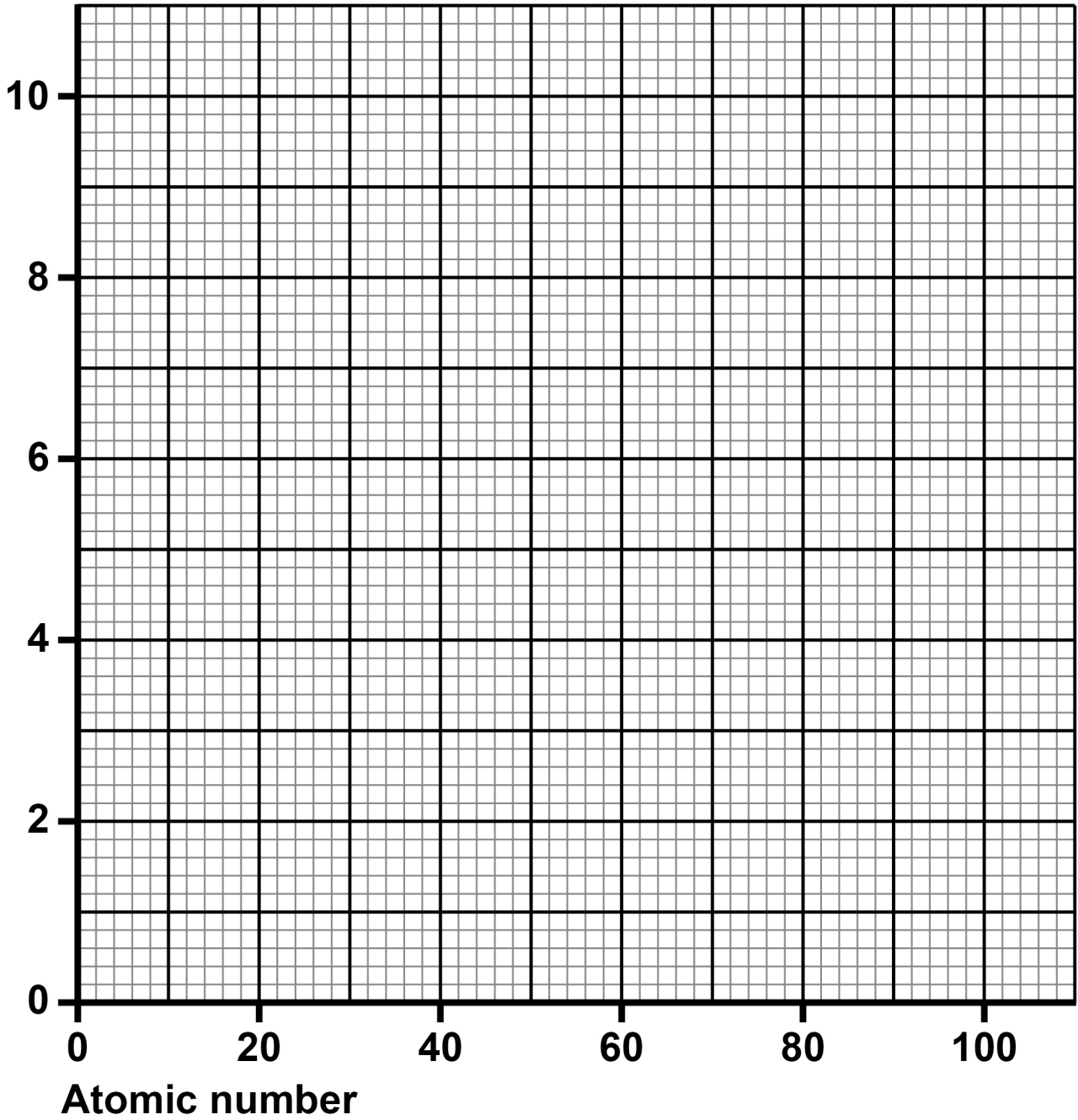
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Density = \_\_\_\_\_ mg/cm<sup>3</sup>



**FIGURE 1**

Density in  
 $\text{mg}/\text{cm}^3$



**[Turn over]**



02.6

The elements in Group 7 are called the halogens.

A more reactive halogen can displace a less reactive halogen from a solution of its salt.

Which combination of solutions will produce a reaction when mixed? [1 mark]

Tick (✓) ONE box.

Chlorine and potassium fluoride

Chlorine and potassium bromide

Bromine and potassium fluoride

Bromine and potassium chloride



02.7

Which of the following describes the trends going down Group 7? [1 mark]

Tick (✓) ONE box.

- Relative molecular mass decreases and boiling point decreases.
- Relative molecular mass decreases and boiling point increases.
- Relative molecular mass increases and boiling point decreases.
- Relative molecular mass increases and boiling point increases.

[Turn over]

11



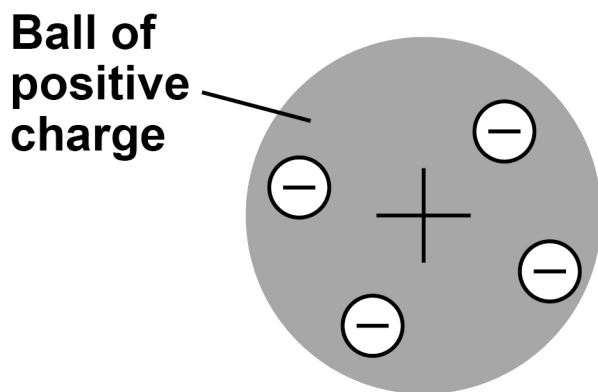
03

This question is about models of the atom.

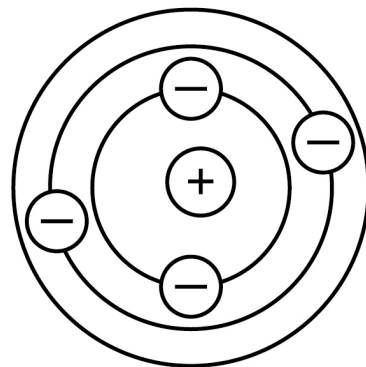
FIGURE 2 shows two early models of the atom.

FIGURE 2

MODEL A



MODEL B



03.1

Name the models of the atom shown in FIGURE 2.  
[2 marks]

Model A \_\_\_\_\_

Model B \_\_\_\_\_





0	3	.	3
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**Chadwick's experiments showed the existence of neutrons in an atom.**

**This led to an understanding of isotopes.**

**Define the term 'isotopes'.**

**Refer to subatomic particles in your answer. [2 marks]**

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<b>8</b>



0	4
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**A student investigated the energy change of the reaction between zinc and copper sulfate solution.**

**This is the method used.**

- 1. Measure 25 cm<sup>3</sup> of copper sulfate solution into a polystyrene cup.**
- 2. Measure the temperature of the copper sulfate solution.**
- 3. Add 0.20 g of zinc powder to the copper sulfate solution.**
- 4. Stir the reaction mixture.**
- 5. Record the highest temperature reached.**
- 6. Repeat steps 1 to 5 with different masses of zinc powder.**

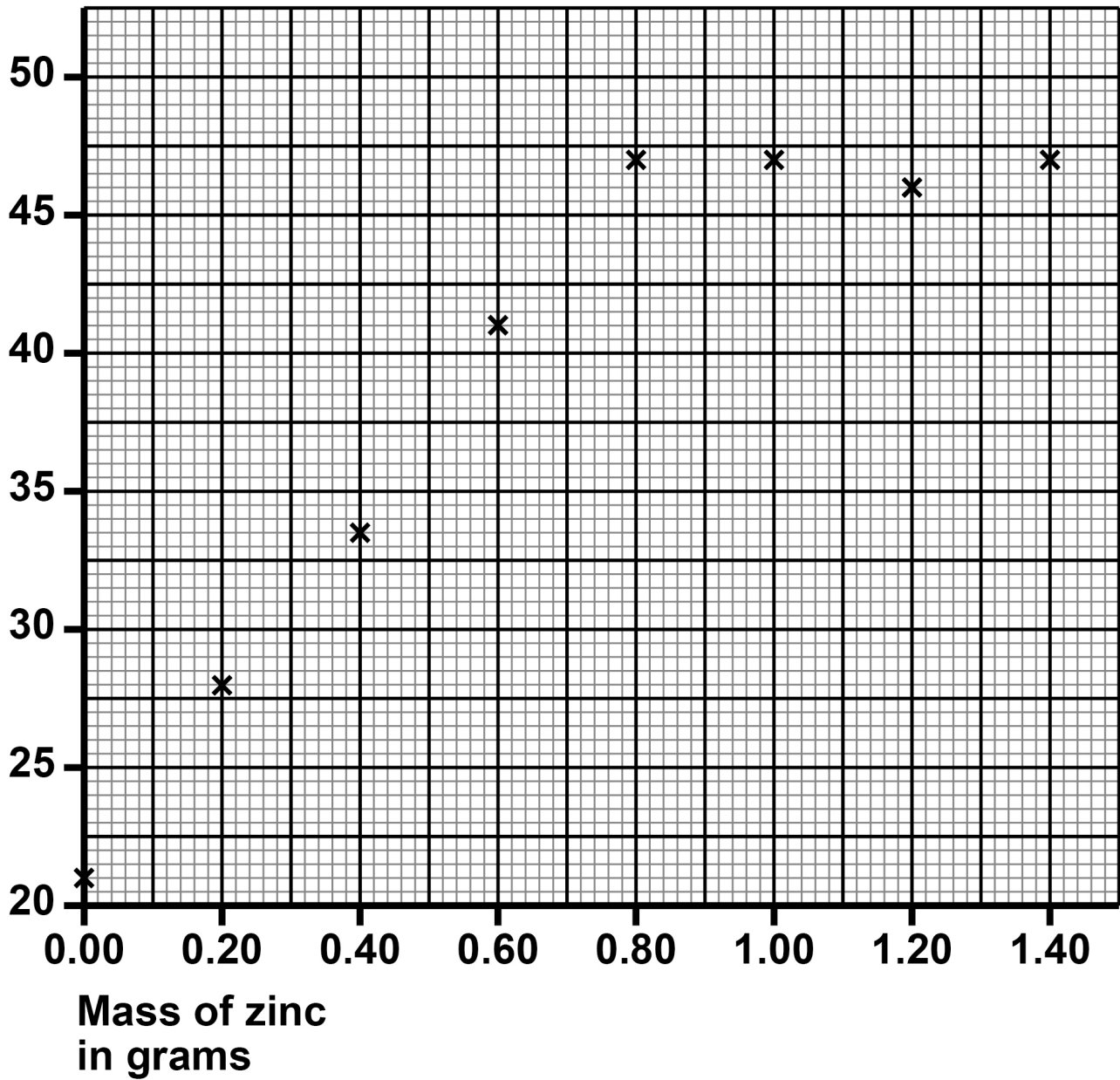
**FIGURE 3, on page 20, shows the results.**

**[Turn over]**



FIGURE 3

Highest  
temperature  
reached  
in °C



04.1

Draw TWO lines of best fit on FIGURE 3.

The lines should cross. [2 marks]

04.2

Explain the results shown in FIGURE 3.

Do NOT refer to anomalous points.

Use data from FIGURE 3. [4 marks]

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[Turn over]



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0	4	.	3
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**Explain why using a polystyrene cup gives more accurate results than using a glass beaker. [2 marks]**

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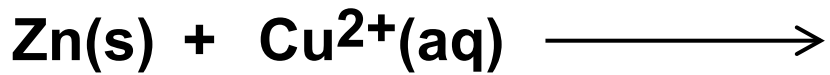
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04.4

Complete the ionic equation for the reaction between zinc and copper sulfate solution.

Include state symbols. [2 marks]



\_\_\_\_\_ ( \_\_\_\_\_ ) + \_\_\_\_\_ ( \_\_\_\_\_ )

[Turn over]



A different student repeated steps 1 to 5 of the method four times using 0.50 g of zinc powder.

TABLE 2 shows the results.

TABLE 2

	TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
HIGHEST TEMPERATURE REACHED IN °C	37.6	37.2	37.8	37.4

0 4 . 5

Calculate the mean highest temperature reached.

Include the uncertainty in your answer. [3 marks]

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Mean highest temperature reached =

\_\_\_\_\_  $\pm$  \_\_\_\_\_ °C

0 4 . 6

The results show random errors.

The student did not make any measuring errors.

Suggest ONE reason for the random errors in this experiment. [1 mark]

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[Turn over]

14



0	5
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**This question is about ionic compounds and electrolysis.**

**Calcium chloride is an ionic compound.**

0	5	.	1
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**Calcium and chlorine react to produce calcium chloride.**

**Describe what happens to calcium atoms and chlorine atoms when the ionic compound calcium chloride is formed. [4 marks]**

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05.2

**Solid calcium chloride CANNOT be electrolysed.**

**Give ONE reason why. [1 mark]**

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**[Turn over]**



05.3

Name the product formed at the negative electrode when aqueous calcium chloride solution is electrolysed. [1 mark]

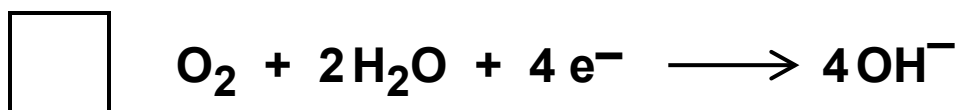
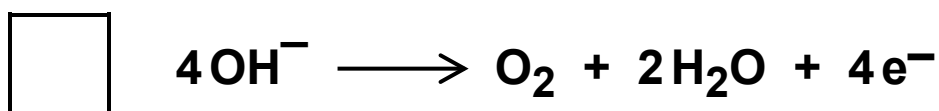
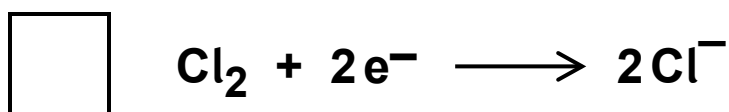
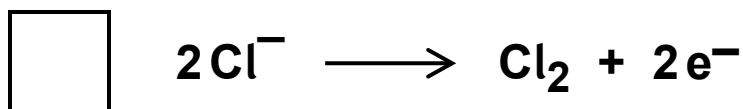
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05.4

What is the half equation for the reaction at the positive electrode when aqueous calcium chloride solution is electrolysed? [1 mark]

Tick (✓) ONE box.

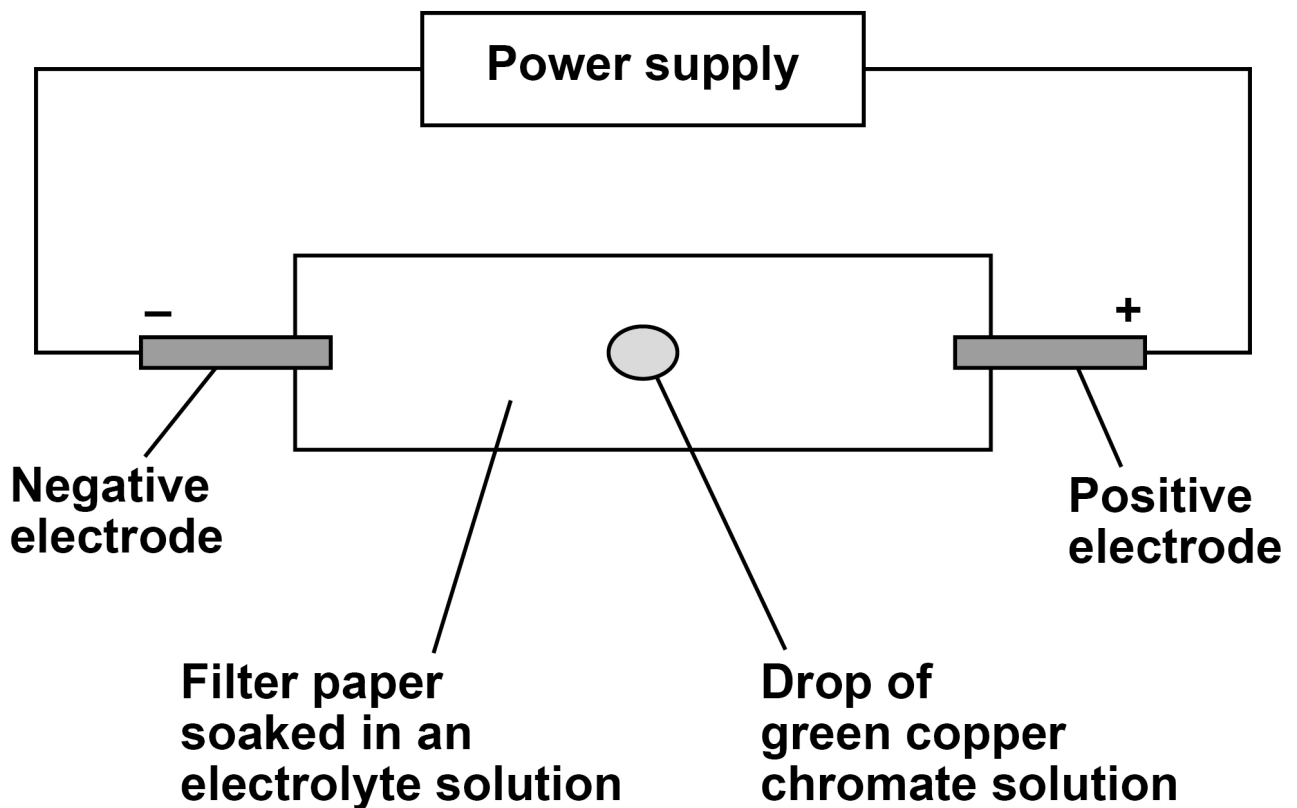


05.5

A student investigated the electrolysis of green copper chromate solution.

FIGURE 4 shows the apparatus.

FIGURE 4

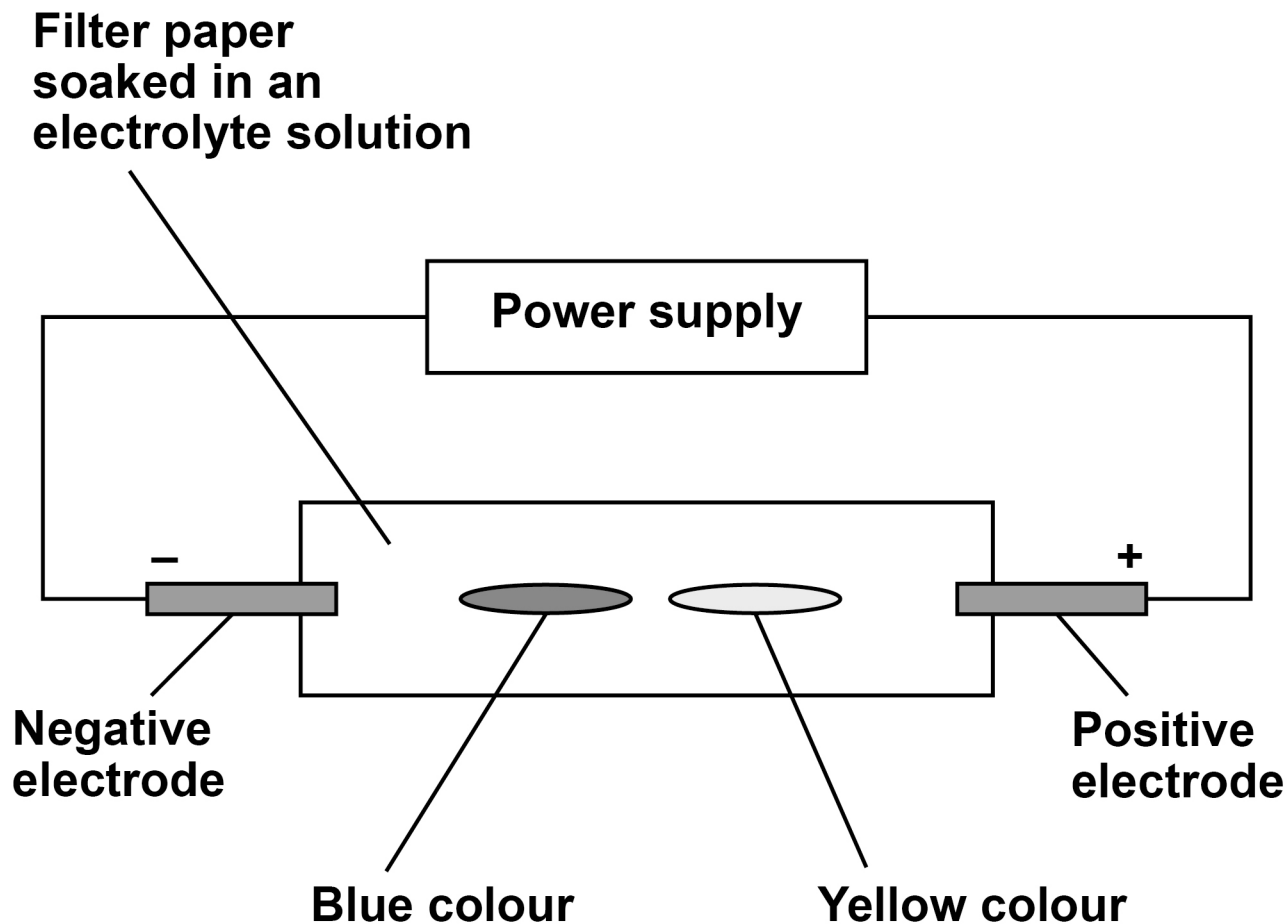


[Turn over]



FIGURE 5 shows the results.

FIGURE 5



Copper chromate solution contains the ions  $\text{Cu}^{2+}$  and  $\text{CrO}_4^{2-}$

Explain the results shown in FIGURE 5. [3 marks]

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**[Turn over]**

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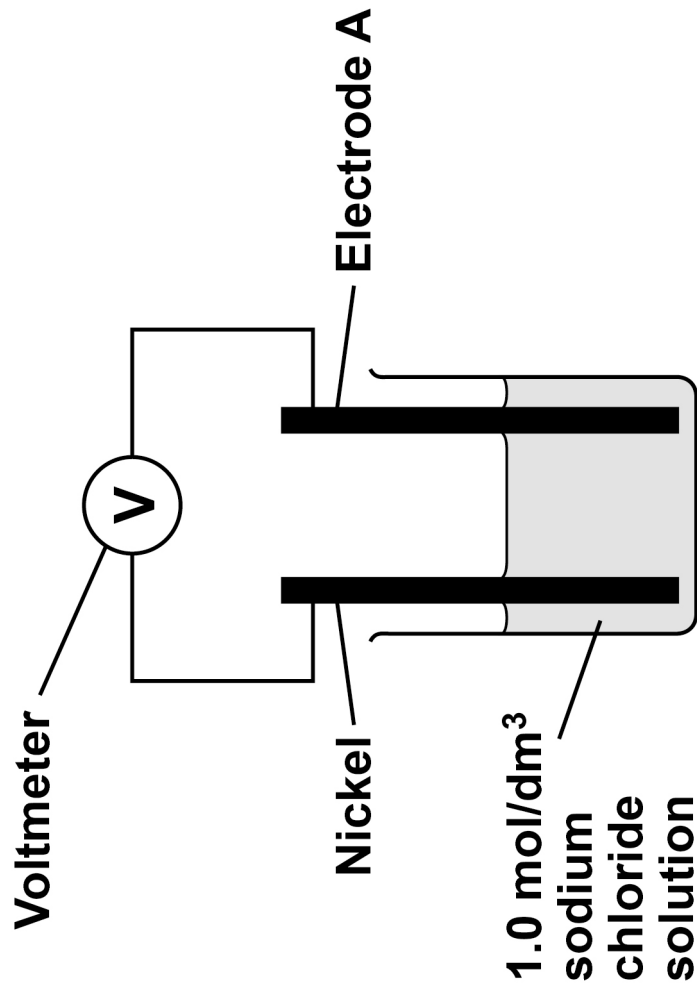


06

A student investigated the voltage produced by different pairs of metal electrodes in a chemical cell.

FIGURE 6 shows the apparatus.

FIGURE 6





**This is the method used.**

- 1. Place a nickel electrode and an electrode made from a different metal (electrode A) in 1.0 mol/dm<sup>3</sup> sodium chloride solution.**
- 2. Measure the voltage produced.**
- 3. Repeat using different metals for electrode A.**

**TABLE 3, on page 34, shows the results.**

**[Turn over]**



3 4

**TABLE 3**

<b>ELECTRODE A</b>	<b>SYMBOL OF METAL</b>	<b>VOLTAGE IN VOLTS</b>
<b>COPPER</b>	<b>Cu</b>	<b>-0.59</b>
<b>MAGNESIUM</b>	<b>Mg</b>	<b>2.12</b>
<b>NICKEL</b>	<b>Ni</b>	<b>0.00</b>
<b>SILVER</b>	<b>Ag</b>	<b>-1.05</b>
<b>ZINC</b>	<b>Zn</b>	<b>0.51</b>



06.1

Write the symbols of the five metals in TABLE 3 in order of reactivity.

Justify your answer. [3 marks]

Most reactive \_\_\_\_\_ Least reactive

Justification \_\_\_\_\_

[Turn over]

## REPEAT OF TABLE 3

ELECTRODE A	SYMBOL OF METAL	VOLTAGE IN VOLTS
COPPER	Cu	-0.59
MAGNESIUM	Mg	2.12
NICKEL	Ni	0.00
SILVER	Ag	-1.05
ZINC	Zn	0.51

06.2

The voltage produced by a chemical cell depends on the concentration of the electrolyte solution.

Plan an experiment to investigate how the voltage produced by a chemical cell varies with the **CONCENTRATION** of the electrolyte solution.

The following substances are available:

- the metal electrodes in TABLE 3
- 1.0 mol/dm<sup>3</sup> sodium chloride solution
- pure water.

[6 marks]





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0	6	.	3
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**Describe how a hydrogen fuel cell produces a potential difference. [2 marks]**

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11



07

This question is about iron.

07.1

Iron is a metal.

Describe how iron conducts thermal energy. [2 marks]

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[Turn over]



0	7	.	2
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**Pure iron is too soft for many uses.**

**Explain why mixing iron with other metals makes alloys which are harder than pure iron. [3 marks]**

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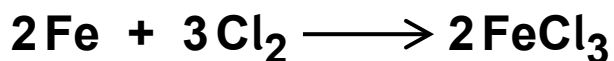
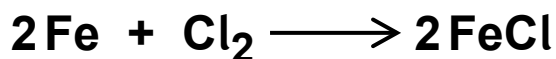
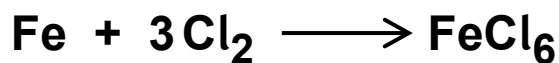
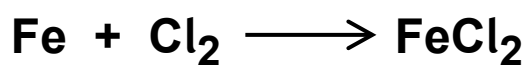


07.3

When iron reacts with chlorine, 0.12 mol of iron reacts with 0.18 mol of chlorine ( $\text{Cl}_2$ ).

Which is the correct equation for the reaction? [1 mark]

Tick (✓) ONE box.



[Turn over]

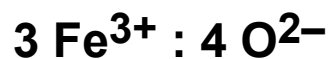
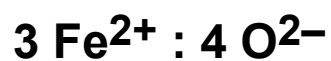


The most common oxides of iron are  $\text{Fe}_2\text{O}_3$  and  $\text{Fe}_3\text{O}_4$

07.4

What is the ratio of the numbers of ions in  $\text{Fe}_3\text{O}_4$ ?  
[1 mark]

Tick (✓) ONE box.

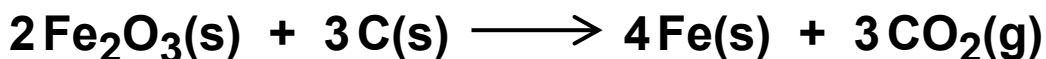




0	7	.	6
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$\text{Fe}_2\text{O}_3$  reacts with carbon to produce carbon dioxide.

The equation for the reaction is:



Calculate the volume of carbon dioxide gas at room temperature and pressure that is produced from 40.0 kg of  $\text{Fe}_2\text{O}_3$  using excess carbon.

Relative formula mass ( $M_r$ ):  $\text{Fe}_2\text{O}_3 = 160$

The volume of 1 mole of any gas at room temperature and pressure is  $24 \text{ dm}^3$ . [5 marks]

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Volume of carbon dioxide = \_\_\_\_\_ dm<sup>3</sup>

[Turn over]

15

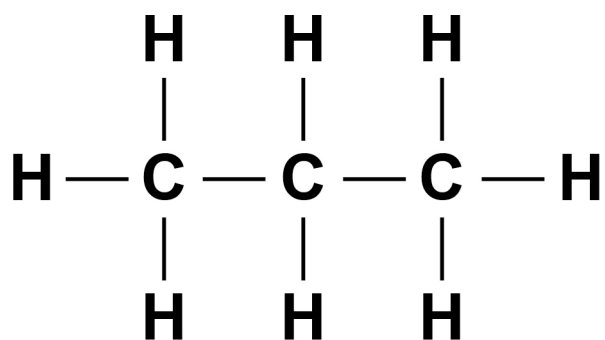


0	8
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This question is about propane ( $C_3H_8$ ).

FIGURE 7 shows the displayed structural formula of propane.

FIGURE 7



0	8	.	1
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Explain why propane has a low boiling point. [3 marks]

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**Propane reacts with oxygen to produce carbon dioxide and water.**

**The reaction is exothermic.**

**08.2**

**FIGURE 8, on pages 48 and 49, shows four reaction profiles.**

**[Turn over]**

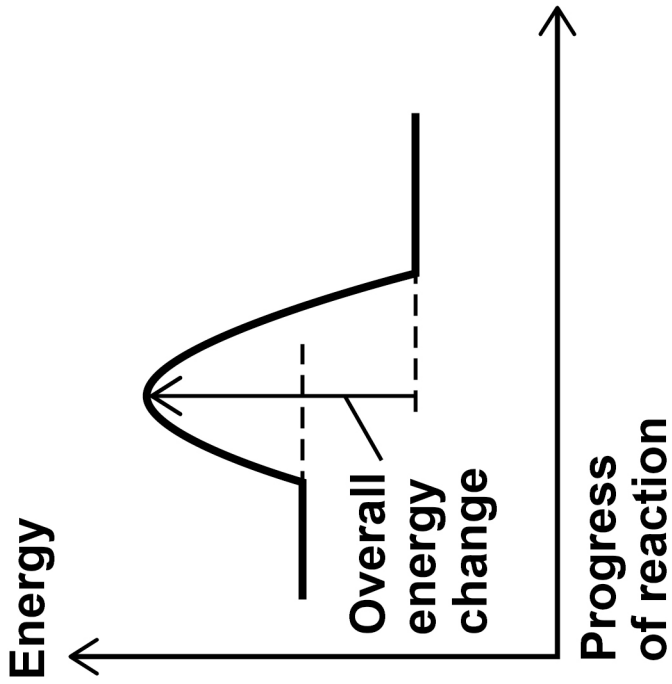




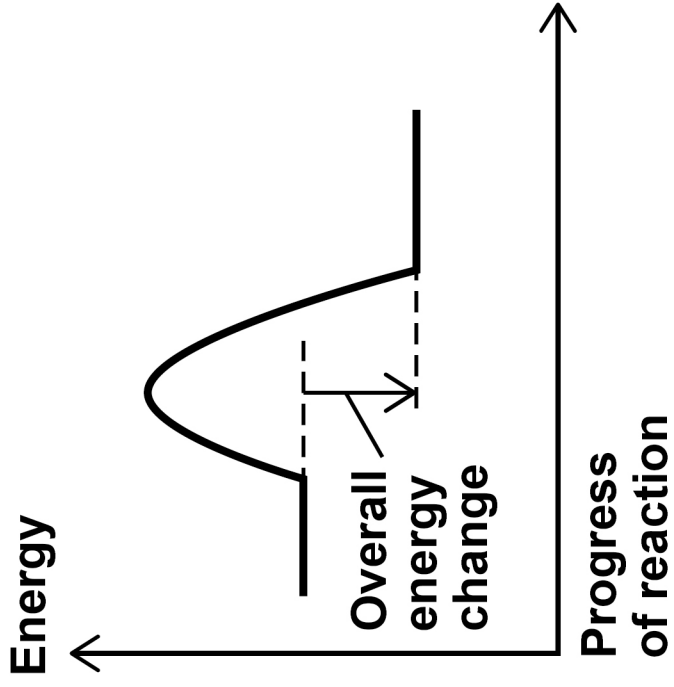
4 8

**FIGURE 8**

**A**



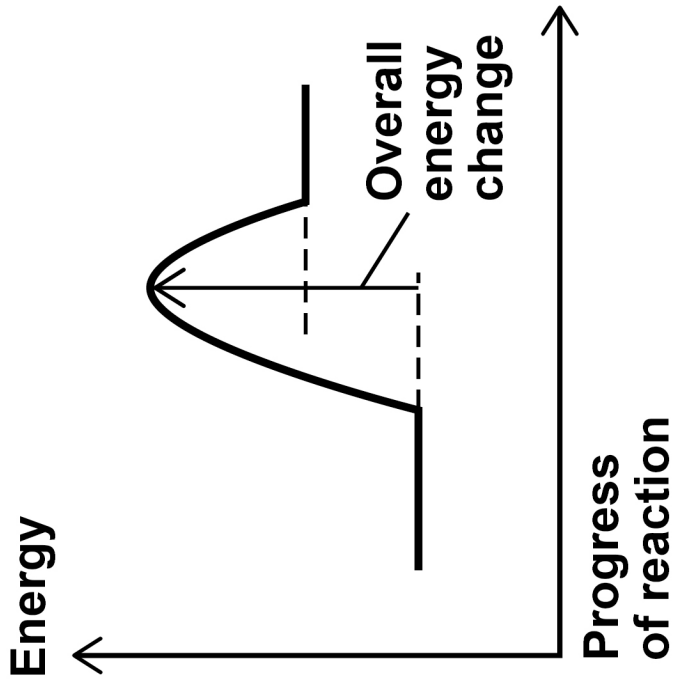
**B**



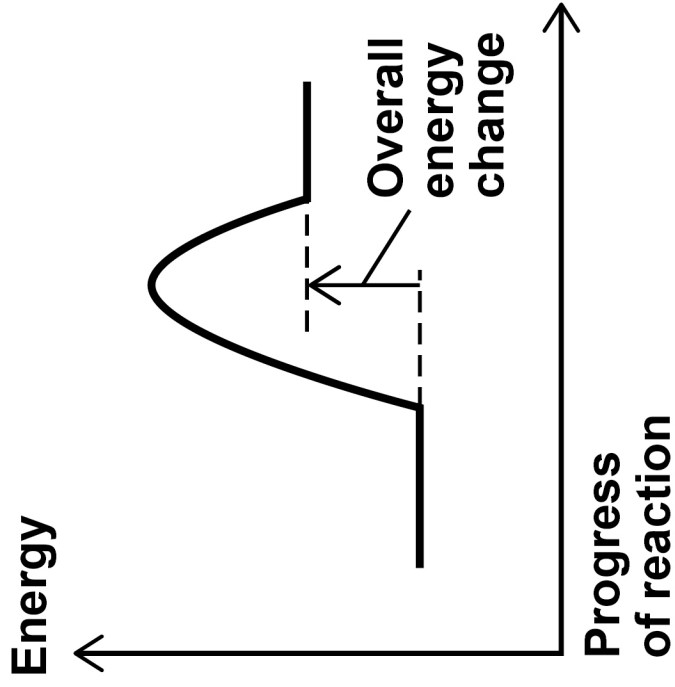


4 9

C



D



[Turn over]

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Using FIGURE 8, on pages 48 and 49, which is the correct reaction profile and labels for the reaction between propane and oxygen? [1 mark]

Tick (✓) ONE box.

A

B

C

D

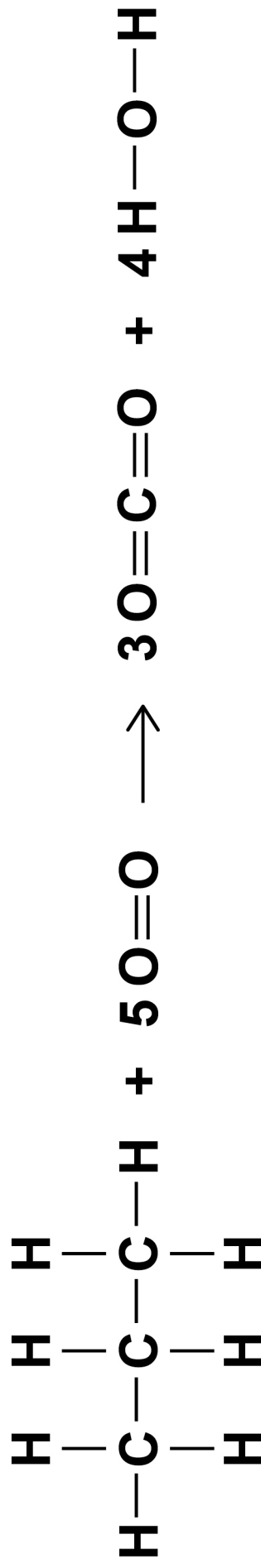
[Turn over]



0 8 . 3

FIGURE 9 shows the displayed formula equation for the reaction between propane and oxygen.

FIGURE 9



The overall energy change of this exothermic reaction is 2219 kJ/mol.

TABLE 4 shows the bond energies of the bonds in the reaction.

TABLE 4

	C—C	C—H	O=O	C=O	O—H
Energy in kJ/mol	347	X	498	805	464



Calculate the bond energy of the C — H bond (X). [5 marks]

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Bond energy of the C — H bond (X) = \_\_\_\_\_ kJ/mol

[Turn over]

0	9
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**This question is about acids and their reactions.**

**Acids can be either weak or strong.**

0	9	.	1
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**What is meant by 'a WEAK acid'? [2 marks]**

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0	9	.	2
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**Explain what happens to the pH of an acid as the acid is diluted with water. [2 marks]**

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**[Turn over]**



0	9	.	3
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A student does a titration to find the volume of acid needed to neutralise an alkali.

The student fills a burette with the acid.

Give **THREE** more steps the student must do before adding the acid to the alkali from the burette.

You should name any equipment used. [3 marks]

1 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3 \_\_\_\_\_

\_\_\_\_\_

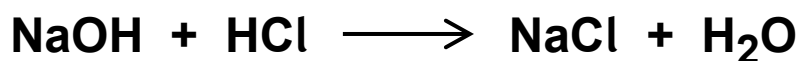
\_\_\_\_\_



0	9	.	4
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The student titrated a solution containing 0.0045 moles of sodium hydroxide with 0.15 mol/dm<sup>3</sup> hydrochloric acid.

The equation for the reaction is:



Calculate the volume of hydrochloric acid in cm<sup>3</sup> needed in the titration. [2 marks]

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

[Turn over]











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For Examiner's Use	
Question	Mark
1	
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3	
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6	
7	
8	
9	
<b>TOTAL</b>	

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