OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL GCSE

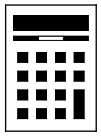
CHEMISTRY

Paper 2

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a pencil and 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.
- You must answer the 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.
- Show all your working.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a scientific calculator where appropriate.
- A Periodic Table is provided as a loose insert.

Answer **all** questions in the spaces provided.

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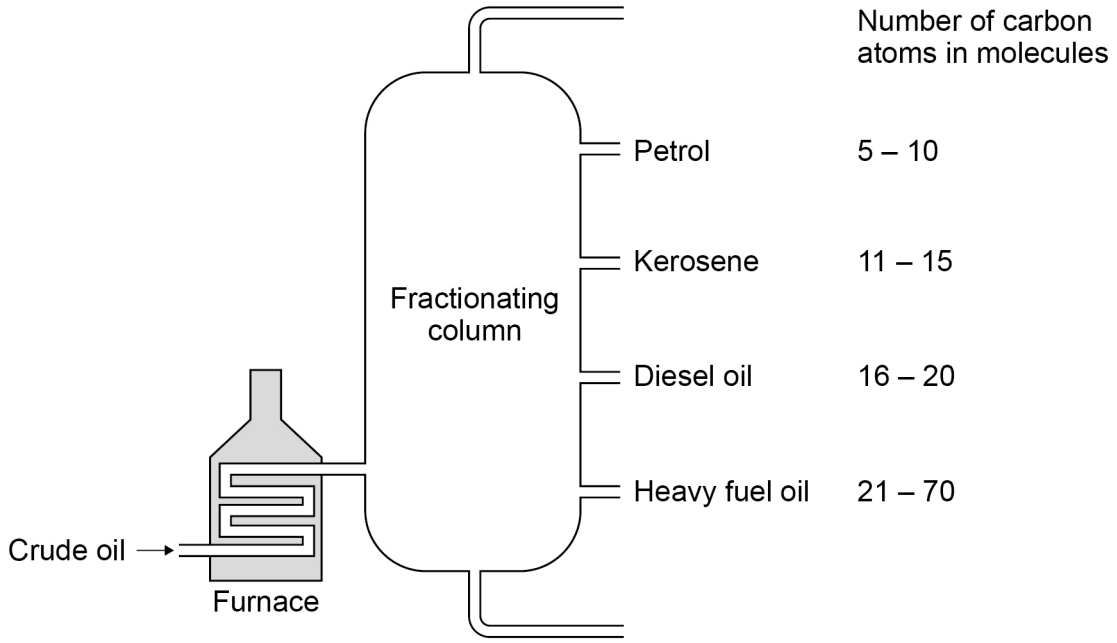
0 1 Crude oil is a mixture of many compounds.

Crude oil is separated into fractions using fractional distillation.

Figure 1 shows a fractionating column.

Figure 1



0 1 . 1 What happens to the crude oil in the furnace in **Figure 1**?

Tick (✓) **one** box.

[1 mark]

Condenses ☐

Evaporates ☐

Freezes ☐

Melts ☐

Do not write outside the box

0 1 . 2 Which fraction in **Figure 1** is the most flammable?

Tick (✓) **one** box.

[1 mark]

Diesel oil ☐

Heavy fuel oil ☐

Kerosene ☐

Petrol ☐

0 1 . 3 Which fraction in **Figure 1** is the most viscous?

Tick (✓) **one** box.

[1 mark]

Diesel oil ☐

Heavy fuel oil ☐

Kerosene ☐

Petrol ☐

0 1 . 4 Some fractions from crude oil are cracked to produce smaller molecules.

Give **one** use of the small molecules produced by cracking.

[1 mark]

_____

_____

Question 1 continues on the next page

Do not write outside the box

Equation 1 shows the reaction when C_7H_{16} is cracked.

Equation 1

$$C_7H_{16} \rightarrow C_5H_{12} + C_2H_4$$

0 1 . 5 What type of reaction is cracking?

Tick (✓) **one** box.

[1 mark]

Combustion ☐

Decomposition ☐

Neutralisation ☐

Oxidation ☐

Do not write outside the box

Table 1 shows some properties of three compounds, **A**, **B** and **C**.

Compounds **A**, **B** and **C** are the three compounds shown in **Equation 1**.

Table 1

Compound	Boiling point in °C	Reaction with bromine water
A	99	no reaction
B	36	no reaction
C	–104	decolourises

0 1 . 6 Explain how the boiling points in **Table 1** show that compound **C** is C_2H_4

[2 marks]

0 1 . 7 What does the reaction with bromine water show about compound **C**?

Use **Table 1**.

[1 mark]

8

Turn over for the next question

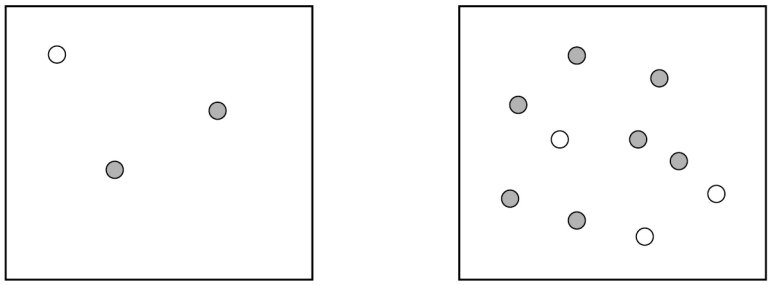
Do not write outside the box

0 2 This question is about rates of reaction.

Some reactions involve gases reacting together.

0 2 . 1 **Figure 2** shows particles of two gases at different pressures.

Figure 2



Low pressure High pressure

Explain why the gases react faster at high pressure than at low pressure.

You should refer to particles and collisions in your answer.

[2 marks]

0 2 . 2 The two gases in **Figure 2** react together to form one product.

600 g of the product is produced in 120 seconds.

Calculate the rate of reaction in g/s

[2 marks]

Rate of reaction = _____ g/s

Do not write outside the box

Catalysts also affect rates of reaction.

A catalyst can be used to speed up the decomposition of hydrogen peroxide.

The equation for the reaction is:

$$2\,H_2O_2\,(aq) \rightarrow 2\,H_2O\,(l) + O_2\,(g)$$

0 2 . 3 Give **one** reason why the catalyst does not appear in the equation for the reaction.

[1 mark]

Question 2 continues on the next page

Do not write outside the box

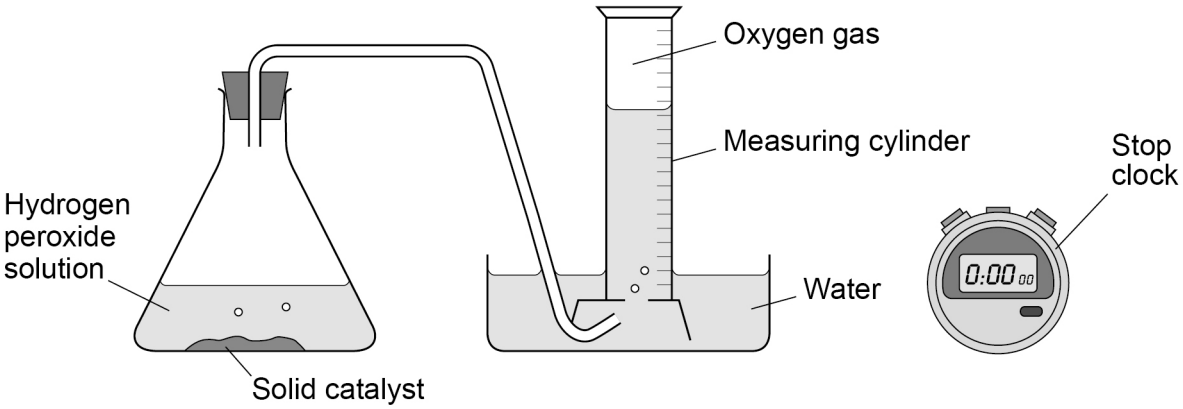
0 2 . 4 A student compares the effect of different catalysts on the rate of decomposition of hydrogen peroxide.

The catalysts are:

- solid iron oxide
- solid manganese oxide.

Figure 3 shows the apparatus used.

Figure 3



Describe a method to compare the effect of the two catalysts on the rate of decomposition of hydrogen peroxide.

Your method should give valid results.

Use the apparatus in **Figure 3**.

[4 marks]

9

Do not write outside the box

0 3 This question is about the periodic table.

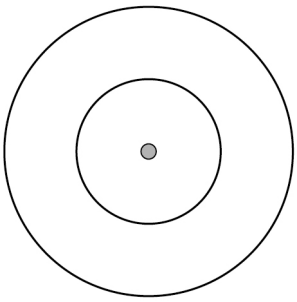
0 3 . 1 An atom of oxygen has 8 electrons.

Complete **Figure 4** to show the electronic structure of oxygen.

Use crosses (x) to represent electrons.

[1 mark]

Figure 4



0 3 . 2 Oxygen has similar chemical properties to other elements in the same group of the periodic table.

Give **one** reason why.

[1 mark]

Question 3 continues on the next page

Do not write outside the box

Table 2 shows some properties of three elements.

Table 2

Element	Melting point in °C	Reaction with water	Formula of oxide
Potassium	63	Reacts with water producing hydrogen	K_2O
Silver	962	No reaction	Ag_2O
Sodium	98	Reacts with water producing hydrogen	Na_2O

Mendeleev produced an early version of the periodic table.

In Mendeleev's table, all three elements in **Table 2** were in the same group.

0 3 . 3 Suggest **one** reason why Mendeleev put all three elements in the same group.

Use **Table 2**.

[1 mark]

0 3 . 4 In the modern periodic table the elements in **Table 2** are in two different groups.

Suggest **two** reasons why.

Use **Table 2**.

[2 marks]

1

2

Do not write outside the box

0 3 . 5 Mendeleev's table did not include helium because helium had not been discovered.

Suggest **one** reason why helium had **not** been discovered.

[1 mark]

0 3 . 6 Aluminium is in Group 3 of the periodic table.

Sulfur is in Group 6 of the periodic table.

What is the formula of aluminium sulfide?

[1 mark]

7

Turn over for the next question

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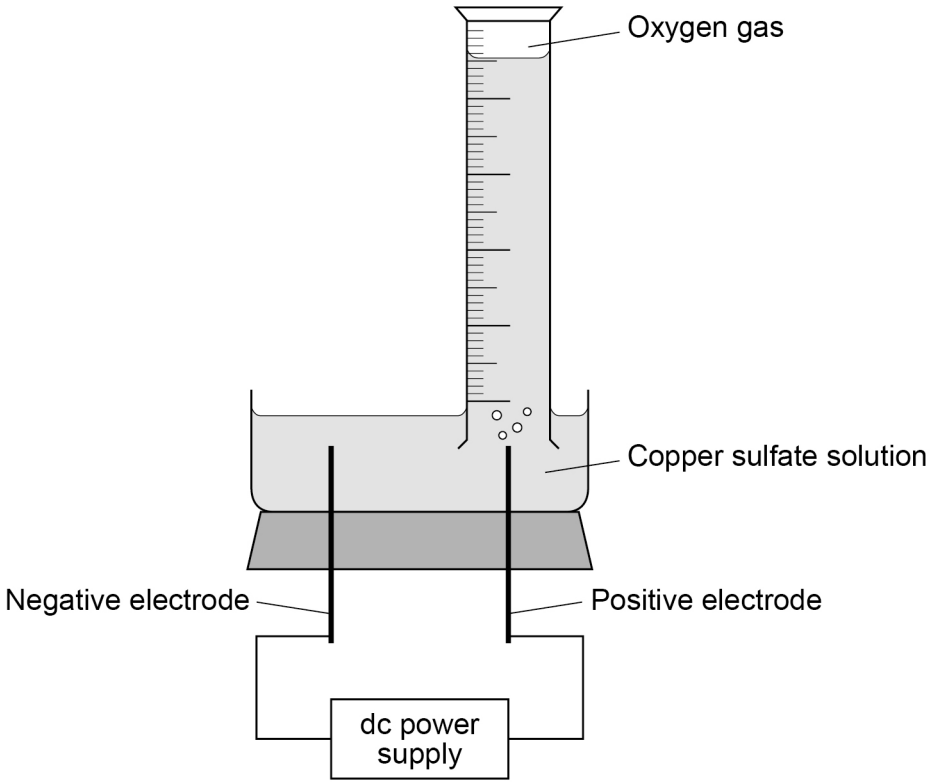
0 4 A student investigated the electrolysis of copper sulfate solution.

Figure 5 shows the apparatus used.

Figure 5



0 4 . 1 What happens to the mass of the negative electrode during the electrolysis of copper sulfate solution?

Tick (✓) **one** box.

Give **one** reason for your answer.

[2 marks]

Decreases ☐

Increases ☐

Stays the same ☐

Reason _____

_____

Question 4 continues on the next page

Turn over ►

The student measured the volume of oxygen gas produced during the experiment.

Table 3 shows the results.

Table 3

Time in minutes	**Volume of oxygen gas in cm^3**
0	0
2	4
4	8
6	12
8	18
10	20

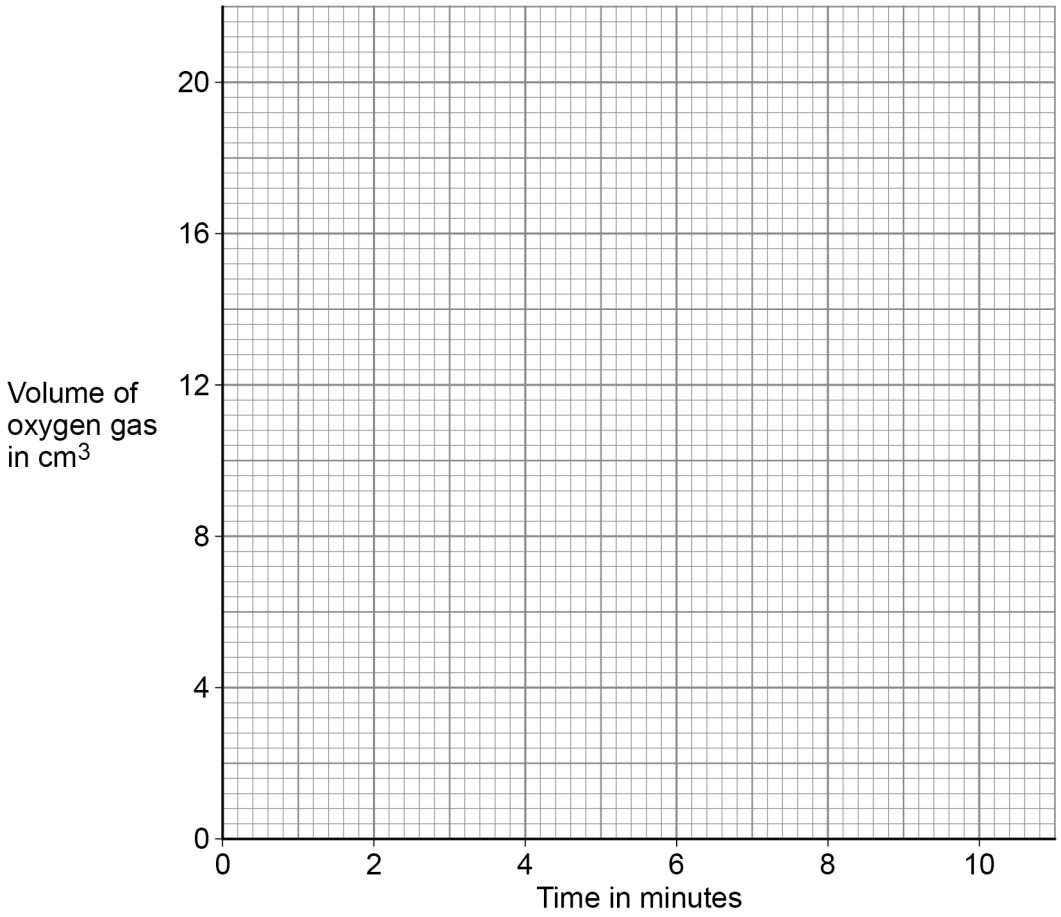
Do not write outside the box

0 4 . 2 Plot the data from **Table 3** on **Figure 6**.

Draw a line of best fit.

[3 marks]

Figure 6



0 4 . 3 Calculate the number of moles of oxygen gas produced after 5 minutes.

The volume of 1 mole of any gas at room temperature and pressure is 24.0 dm^3

Use **Figure 6**.

[4 marks]

Number of moles of oxygen gas = _____ mol

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 The student electrolysed a solution of an unknown salt, **X**.

Table 4 shows the gases produced at the electrodes.

Table 4

Product at negative electrode	Hydrogen
Product at positive electrode	Chlorine

The student concluded that **X** was sodium chloride. Is the student correct?

Explain your answer.

[3 marks]

0 4 . 5 Write the half equation for the production of chlorine at the positive electrode.

[2 marks]

14

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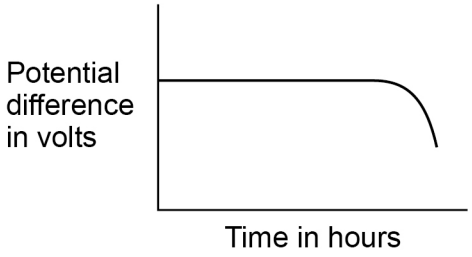
0 5 This question is about cells.

0 5 . 1 **Figure 7** shows how the potential difference of a chemical cell changes with time.

Figure 7



How does **Figure 7** show that the chemical cell will eventually stop working?

[1 mark]

0 5 . 2 Why do chemical cells eventually stop working?

[1 mark]

0 5 . 3 Some electric cars use rechargeable cells as a power source.

Suggest what type of chemical reaction makes a cell rechargeable.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 4 Some cars are powered by a hydrogen fuel cell.

Balance the equation for the reaction in a hydrogen fuel cell.

[1 mark]

$$\_\_\_\_\_ H_2 + O_2 \rightarrow \_\_\_\_\_ H_2O$$

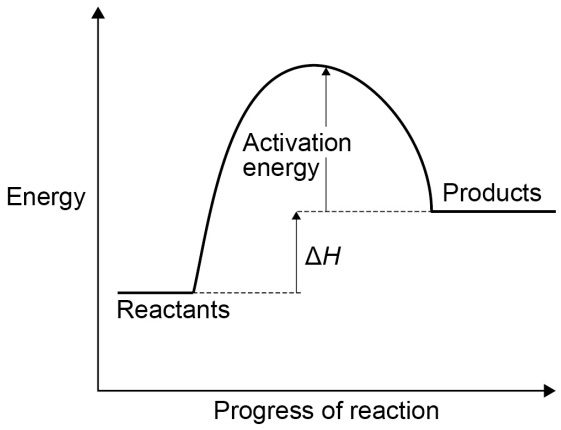
0 5 . 5 The reaction of hydrogen and oxygen in a fuel cell is exothermic.

Which is the correct energy level diagram for this exothermic reaction?

Tick (✓) **one** box.

[1 mark]

A



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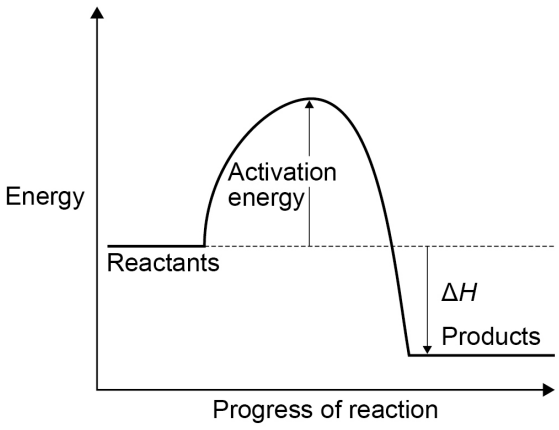
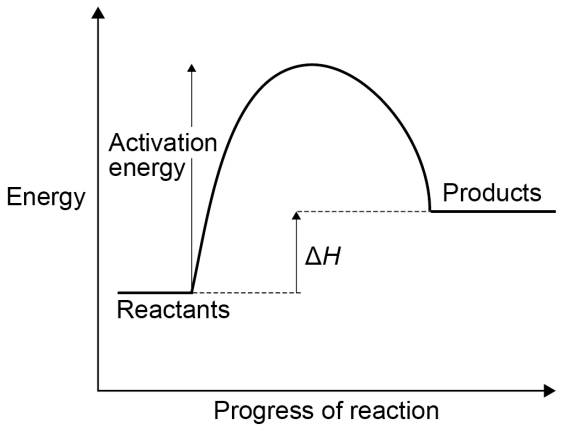
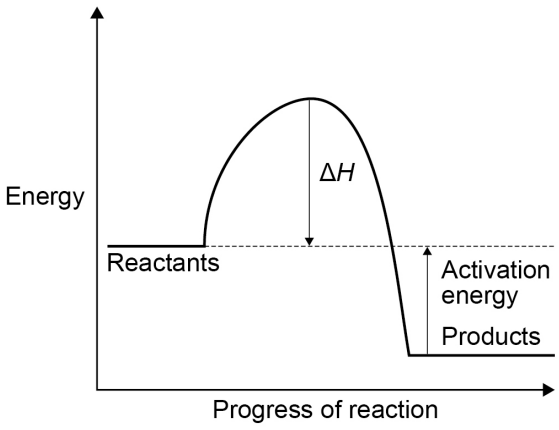


C



D



A ☐ **B** ☐ **C** ☐ **D** ☐

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0 5 . 6 Give **one** advantage and **one** disadvantage of using hydrogen gas as a fuel for cars.

Do **not** refer to cost in your answer.

[2 marks]

Advantage _____

_____

_____

Disadvantage _____

_____

_____

7

Turn over for the next question

Do not write outside the box

0 6 Copper carbonate decomposes when heated.

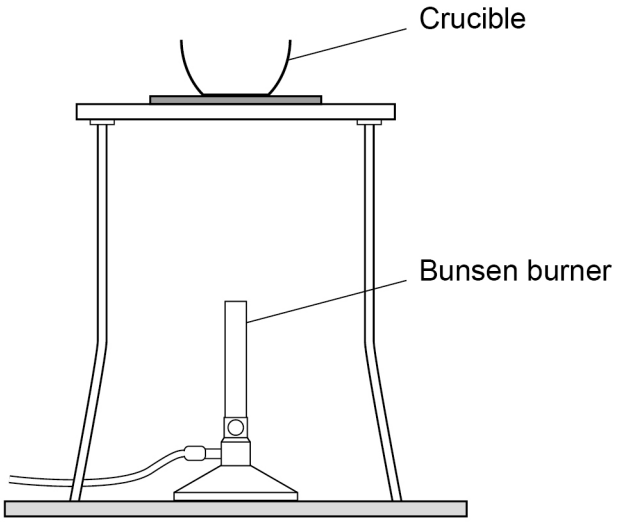
The equation for the reaction is:

$$CuCO_3(s) \rightarrow CuO(s) + CO_2(g)$$

A student investigated the mass of copper oxide produced from a known mass of copper carbonate.

Figure 8 shows the apparatus used.

Figure 8



This is the method used:

1 Measure the mass of a crucible.
2 Add 2.5 g of copper carbonate to the crucible.
3 Heat the crucible strongly for 2 minutes.
4 Allow to cool and measure the mass of the crucible and contents.
5 Repeat steps **3** and **4** one more time.

0 6 . 1 Suggest why the student repeated steps **3** and **4**.

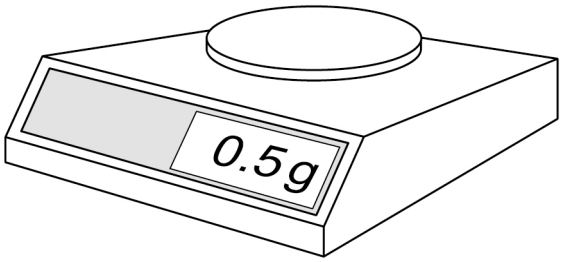
[1 mark]

Do not write outside the box

The student used a balance to measure the mass of the crucible.

Figure 9 shows the reading before the crucible was placed on the balance.

Figure 9



The student said that the reading of 0.5 g caused an error in the investigation.

0 6 . 2 The student said the error could be reduced by making more measurements and calculating a mean.

Why is the student's statement incorrect?

[1 mark]

0 6 . 3 Give **one** way the student could overcome this error.

[1 mark]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 The equation for the reaction is:

$$CuCO_3\,(s) \rightarrow CuO\,(s) + CO_2\,(g)$$

Calculate the maximum mass of copper oxide produced by heating 2.47 g of copper carbonate.

Relative atomic masses (A_r): C = 12 O = 16 Cu = 63.5

[4 marks]

Maximum mass of copper oxide = _____ g

7

Do not write outside the box

0 7 This question is about metals.

0 7 . 1 **Table 5** shows some properties of four substances, **A**, **B**, **C** and **D**.

Table 5

Substance	Melting point in °C	Electrical conductivity when solid	Electrical conductivity when liquid
A	3550	Poor	Poor
B	660	Good	Good
C	150	Poor	Poor
D	801	Poor	Good

Which substance is a metal?

Tick (✓) **one** box.

Give **one** reason for your answer.

[2 marks]

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

_____

Question 7 continues on the next page

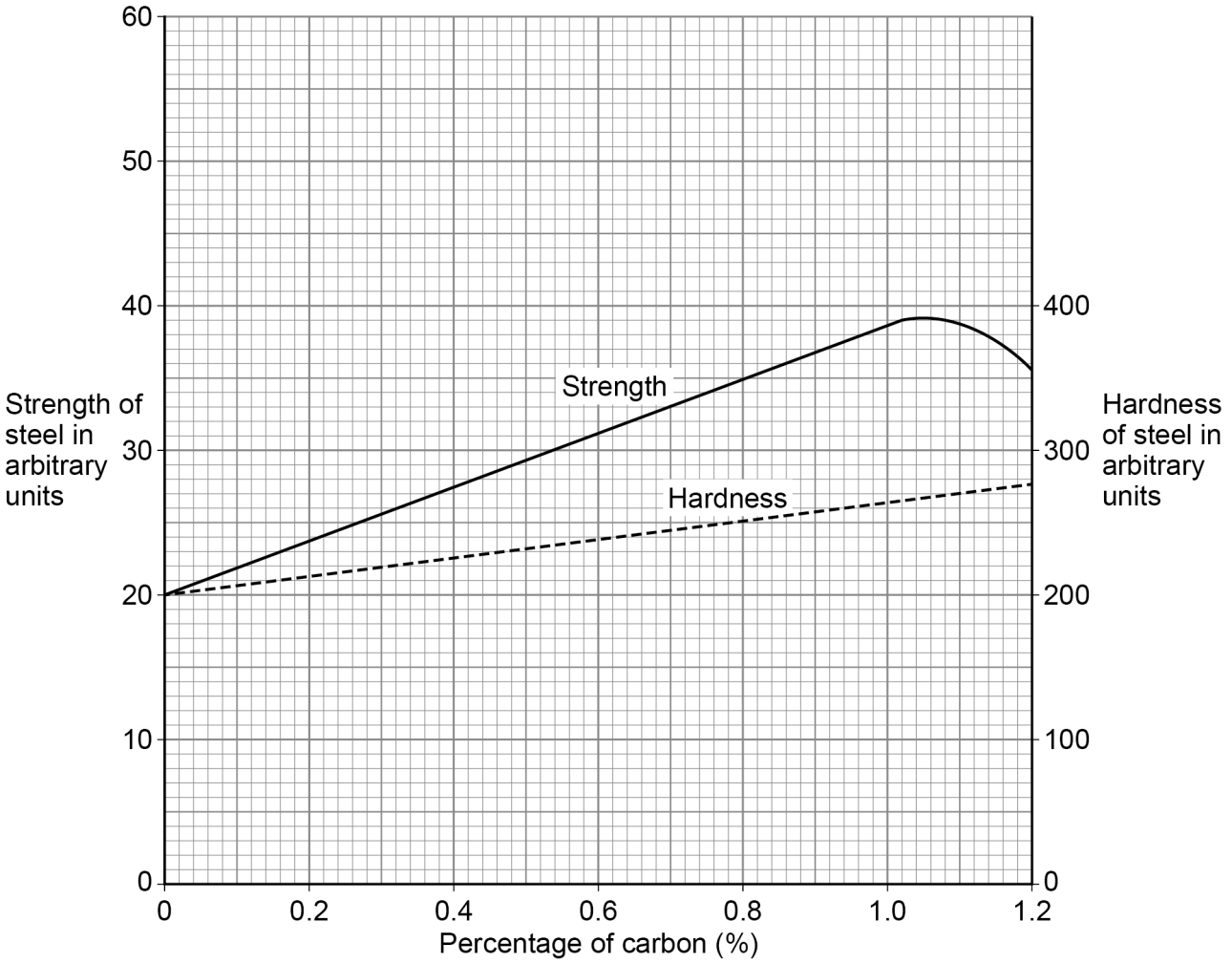
Turn over ►

Do not write outside the box

Steel is a mixture of iron and carbon.

Figure 10 shows how the strength and hardness of steel change with the percentage of carbon in the mixture.

Figure 10



0 7 . 2 Describe how the hardness of steel changes as the percentage of carbon increases.

Use **Figure 10**.

[2 marks]

Do not write outside the box

0 7 . 3 What is the hardness of steel when steel is at its maximum strength?

Use **Figure 10**.

[1 mark]

Hardness = _____ arbitrary units

0 7 . 4 Magnesium is a pure metal.

Describe the structure of magnesium.

You should refer to the arrangement of magnesium atoms in your answer.

[2 marks]

_____

_____

_____

_____

Question 7 continues on the next page

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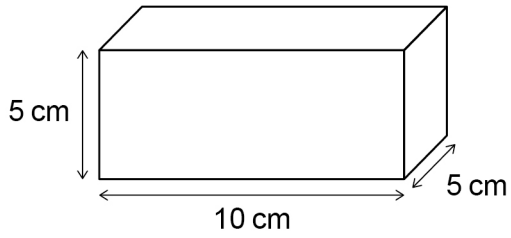
0 7 . 5 **Figure 11** shows a block made of pure iron.

Figure 11



Calculate the number of atoms in the iron block in **Figure 11**.

Use the equation:

$$\text{Density (g/cm}^3\text{)} = \frac{\text{mass (g)}}{\text{volume (cm}^3\text{)}}$$

Density of iron = 7.9 g/cm^3

Relative atomic mass (A_r): Fe = 56

Avogadro's constant = 6.02×10^{23} atoms per mole

[5 marks]

Number of atoms = _____

12

Do not write outside the box

0 8 This question is about acids.

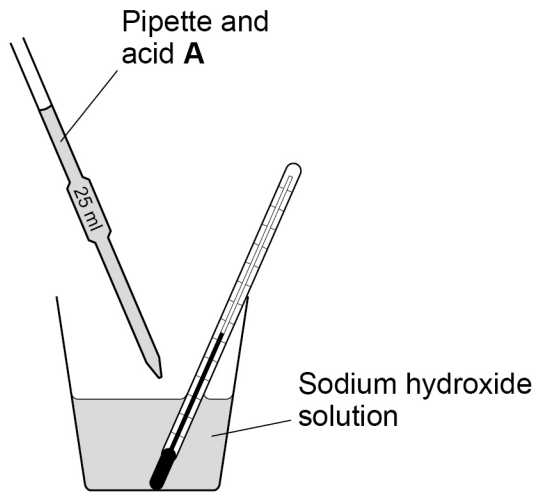
A student compared the temperature increase when acids **A** and **B** were added to sodium hydroxide solution.

This is the method used:

1 Add 25.0 cm^3 of 2.00 mol/dm^3 sodium hydroxide solution to a plastic cup.
2 Measure the temperature of the sodium hydroxide solution.
3 Add 25.0 cm^3 of 2.00 mol/dm^3 acid **A** to the sodium hydroxide solution.
4 Stir the mixture.
5 Measure the highest temperature reached by the mixture.
6 Repeat steps **1**–**5** four times.
7 Repeat steps **1**–**6** with acid **B**.

Figure 12 shows the apparatus used.

Figure 12



0 8 . 1 Give the dependent variable in this investigation.

[1 mark]

0 8 . 2 Give **two** control variables in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

Question 8 continues on the next page

Turn over ►

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Table 6 shows the student's results.

Table 6

	Temperature increase in °C					
	Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 5**	**Mean**
Acid **A**	9.8	9.7	9.8	9.9	9.8	9.8
Acid **B**	6.7	6.2	6.8	6.4	6.9	6.6

0 8 . 3 The student concluded that the results for acid **A** are more precise than the results for acid **B**.

Give the reason for the student's conclusion.

Use **Table 6**.

[1 mark]

0 8 . 4 Calculate the energy released (Q), in joules (J), for the reaction between 25.0 cm^3 of acid **A** and 25.0 cm^3 of sodium hydroxide solution.

Use **Table 6**.

The solutions have a density of 1.0 g/cm^3

Use the equation: $Q = mc\Delta T$

Where:
- Q = energy released in J
- m = total mass of solutions in g
- c = specific heat capacity = 4.2 J/g °C
- ΔT = temperature change in °C

[3 marks]

Energy released (Q) = _____ J

Do not write outside the box

0 8 . 5 The student repeated the method using another acid, **C**.

25.0 cm^3 of 2.00 mol/dm^3 acid **C** was completely neutralised by 25.0 cm^3 of 2.00 mol/dm^3 sodium hydroxide solution.

The student calculated that the energy released by the reaction was 2.60 kJ.

Calculate the enthalpy change (ΔH) for the reaction.

Give your answer in kilojoules per mole of acid **C**.

[3 marks]

Enthalpy change (ΔH) = _____ kJ/mol

0 8 . 6 Give the ionic equation for a neutralisation reaction.

[1 mark]

0 8 . 7 Acid **A** is hydrochloric acid of concentration 2.00 mol/dm^3

Acid **B** is ethanoic acid of concentration 2.00 mol/dm^3

Suggest why the neutralisation of acid **B** produced a smaller temperature increase than the neutralisation of acid **A**.

[2 marks]

13

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0 9 This question is about polymers.

0 9 . 1 **Table 7** shows some information about two polymers:

- poly(ethene)
- a biopolymer called PLA.

Both polymers can be used to make plastic bags.

Table 7

	Polymer	
	Poly(ethene)	**PLA**
Raw material	Crude oil	Corn starch
Strength in arbitrary units	10	37
Biodegradability	Does not decompose	Decomposes in 120 days in industrial composters
Mass of one bag in g	20	25
Mass of CO_2 emitted in kg during manufacture per kg of polymer	6	4.8

Evaluate the environmental impact of poly(ethene) and of PLA when used for plastic bags.

Use **Table 7** and your own knowledge.

[6 marks]

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Question 9 continues on the next page

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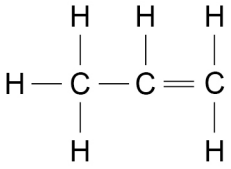
Poly(propene) is produced from propene.

Figure 13 shows the displayed structure of propene.

Figure 13

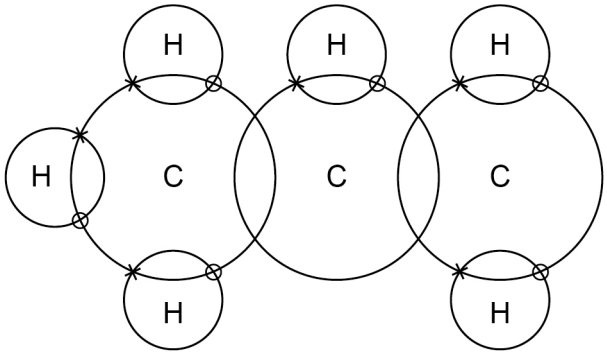


0 9 . 2 Complete **Figure 14** to show the arrangement of the outer shell electrons in propene.

Use dots or crosses to represent the electrons.

[1 mark]

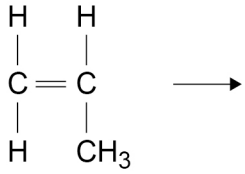
Figure 14



0 9 . 3 Complete the equation to show the formation of poly(propene) from propene.

Balance the equation.

[3 marks]



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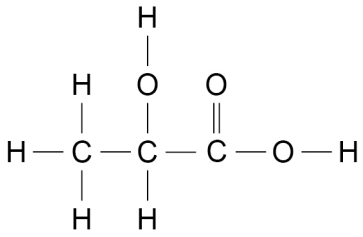
Compound **X** is used to make the biopolymer PLA.

Figure 15 shows the displayed structure of compound **X**.

Figure 15



0 9 . 4 Give the **two** functional groups that compound **X** contains.

[2 marks]

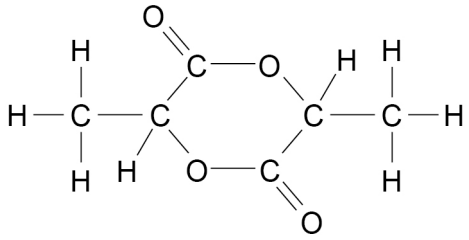
1 _____

2 _____

0 9 . 5 When two molecules of compound **X** react together, two products are formed.

Figure 16 shows the displayed structure of one product.

Figure 16



What is the formula of the other product?

[1 mark]

_____

13

END OF QUESTIONS

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