

Please write clearly in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 2 Chemistry Core

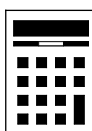
C

Friday 3 November 2023 07:00 GMT Time allowed: 1 hour 45 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.
- 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).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

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 100.
- You are expected to use a scientific calculator where appropriate.
- The periodic table is provided as a loose insert.



N 0 V 2 3 9 2 0 4 C C 0 1

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

0 1

This question is about the elements in Group 0 of the periodic table.

0 1 . 1

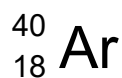
Which Group 0 element has an atomic number of 36?

Use the periodic table.

[1 mark]

0 1 . 2

An atom of argon can be represented as:



How many protons are in this atom of argon?

[1 mark]

Tick (✓) **one** box.

18

☐

22

☐

40

☐

58

☐

0 1 . 3

What is the relative charge of a proton?

[1 mark]

Tick (✓) **one** box.

+1

☐

0

☐

-1

☐

Turn over ►



Table 1 shows the densities of three Group 0 elements.

Table 1

Element	Density in g/dm ³
Argon	1.8
Krypton	3.7
Xenon	5.9

0 1 . 4 A sample of krypton has a volume of 20 dm³.

Calculate the mass of this sample.

Use **Table 1** and the equation:

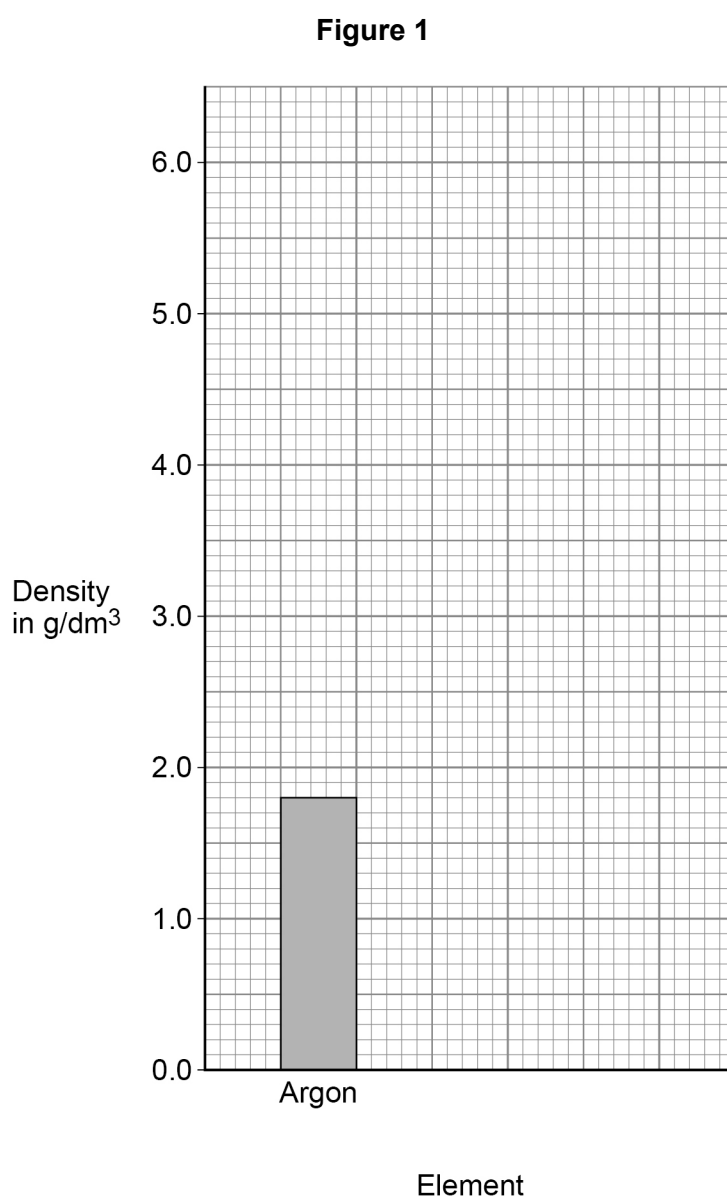
$$\text{Mass of krypton} = \text{density} \times \text{volume}$$

[2 marks]

Mass of krypton = _____ g



0 1 . 5

Figure 1 shows the density of argon.Complete **Figure 1**.

You should:

- plot the rest of the data from **Table 1** as a bar chart
- label each bar.

[2 marks]**Question 1 continues on the next page****Turn over ►**

0 1 . 6 An atom of neon has 10 electrons.

How many electrons are in the outer shell of neon?

[1 mark]

Tick (✓) **one** box.

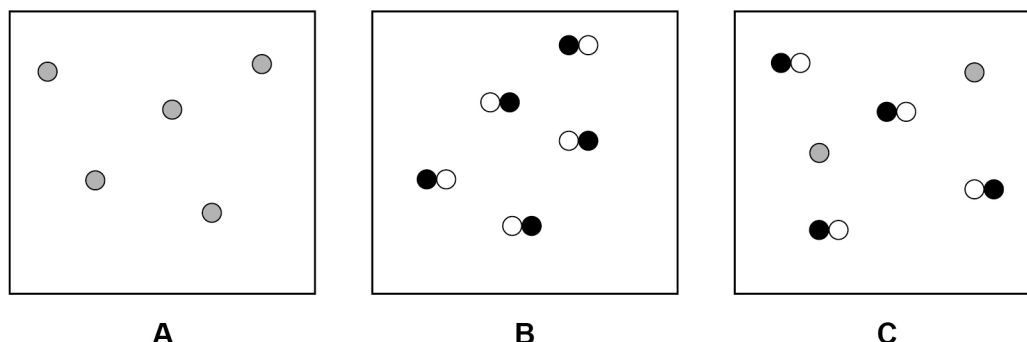
2 ☐

8 ☐

10 ☐

0 1 . 7 The diagrams in **Figure 2** represent the atoms and molecules in different substances.

Figure 2



A

B

C

Which diagram represents a Group 0 element?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

0 1 . 8

Which statement about Group 0 elements is correct?

[1 mark]

Tick (✓) **one** box.

Group 0 elements are reactive metals.

☐

Group 0 elements are reactive non-metals.

☐

Group 0 elements are unreactive metals.

☐

Group 0 elements are unreactive non-metals.

☐

10

Turn over for the next question

Turn over ►



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0 2

This question is about acids, alkalis and bases.

Hydrogen chloride gas consists of simple molecules.

Hydrogen chloride molecules dissolve in water to form hydrochloric acid.

0 2 . 1

What type of bond holds atoms together in molecules?

[1 mark]

Tick (✓) **one** box.

Covalent

☐

Ionic

☐

Metallic

☐**0 2 . 2**

Table 2 shows the melting points of three substances: **A**, **B** and **C**.

Table 2

Substance	Melting point in °C
A	100
B	−114
C	1423

Which substance is hydrogen chloride gas?

[1 mark]

Tick (✓) **one** box.

A

☐

B

☐

C

☐

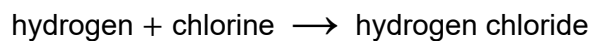
Question 2 continues on the next page

Turn over ►



0 2 . 3 Hydrogen reacts with chlorine to produce hydrogen chloride.

The equation for the reaction is:



In the reaction, 0.2 g of hydrogen reacts with 7.1 g of chlorine.

Calculate the mass of hydrogen chloride produced.

[1 mark]

Mass of hydrogen chloride = _____ g

0 2 . 4 Sodium hydroxide is a base.

Which **two** ions are in **pure** sodium hydroxide?

[2 marks]

Tick (✓) **two** boxes.

Cl⁻

☐

H⁺

☐

Na⁺

☐

O²⁻

☐

OH⁻

☐

0 2 . 5 A student tested three solutions **A**, **B** and **C** with universal indicator.

Table 3 shows the results.

Table 3

Solution	Colour of universal indicator
A	green
B	blue
C	red

The solutions were:

- hydrochloric acid
- sodium chloride solution
- sodium hydroxide solution.

Draw **one** line from each solution to the name of the solution.

[2 marks]

Solution	Name of solution
A	Hydrochloric acid
B	Sodium chloride
C	Sodium hydroxide

Question 2 continues on the next page

Turn over ►



An acid reacts with a base to form a salt.

0 2 . 6 Which word describes the reaction between an acid and a base?

[1 mark]

Tick (✓) **one** box.

Combustion

☐

Fermentation

☐

Neutralisation

☐

Reduction

☐

0 2 . 7 Which acid reacts with a base to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

Hydrochloric acid

☐

Nitric acid

☐

Sulfuric acid

☐

0 2 . 8 Which of the following is a base that reacts with an acid to produce zinc nitrate?

[1 mark]

Tick (✓) **one** box.

zinc

☐

zinc chloride

☐

zinc oxide

☐

0 2 . 9 The base used to produce zinc nitrate is insoluble.

Complete the sentence.

Choose the answer from the box.

[1 mark]

bioleaching

chromatography

crystallisation

filtration

Excess insoluble base can be removed from zinc nitrate solution

using _____ .

11

Turn over for the next question

Turn over ►



0 3

This question is about copper.

0 3 . 1

What is copper metal used for?

[1 mark]Tick (✓) **one** box.

As a fuel

☐

Electrical wiring

☐

Making polymers

☐**0 3 . 2**

Copper can be extracted from low-grade ores by phytomining.

Complete the sentence.

Choose the answer from the box.

[1 mark]**bacteria****carbon****plants****polymers**

To extract copper from low-grade ores, phytomining uses _____.



Phytomining can produce copper sulfate solution.

Copper can be obtained from copper sulfate solution by displacing copper with iron.

0 3 . 3 Copper sulfate has the formula CuSO_4

What is the total number of atoms in the formula of copper sulfate?

[1 mark]

Tick (✓) **one** box.

- | | |
|---|--------------------------|
| 3 | ☐ |
| 4 | ☐ |
| 6 | ☐ |
| 7 | ☐ |

0 3 . 4 Complete the word equation for the displacement reaction between iron and copper sulfate.

[2 marks]

iron + copper sulfate $\rightarrow$ _____ + _____

0 3 . 5 Why does iron displace copper from copper sulfate solution?

[1 mark]

Question 3 continues on the next page

Turn over ►



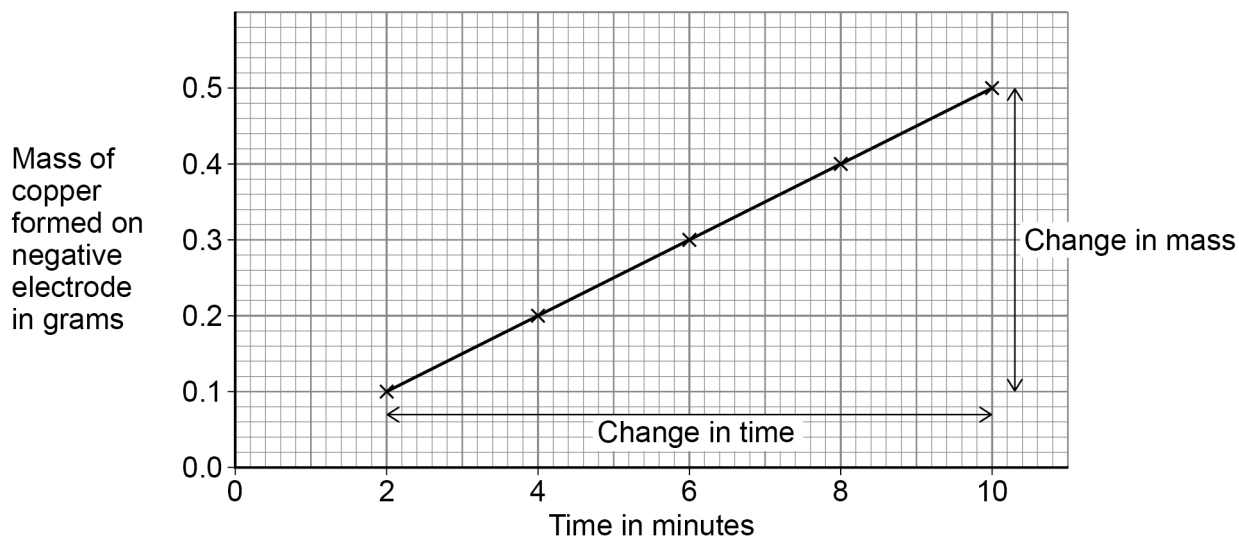
A different method of obtaining copper from copper sulfate solution is by using electrolysis.

A student investigated the electrolysis of copper sulfate solution.

The student determined the mass of copper formed on the negative electrode during the investigation.

Figure 3 show the results.

Figure 3



0 3 . 6

Determine the rate of change in mass of copper formed on the negative electrode.

Use **Figure 3** and the equation:

$$\text{Rate of change in mass} = \frac{\text{change in mass}}{\text{change in time}}$$

You should:

- calculate the change in mass shown in **Figure 3**
- calculate the change in times shown in **Figure 3**
- calculate the rate of change in mass.

[4 marks]

Change in mass _____ g

Change in time _____ minutes

Rate of change in mass = _____ g/minute



0 3 . 7 The negative electrode had a mass of:

- 20.5 g at the start of the experiment
- 20.8 g at time **X**.

Determine time **X**.

You should:

- calculate the mass of copper formed on the negative electrode at time **X**
- use **Figure 3** to find time **X**.

[2 marks]

Mass of copper formed = _____ g

Time **X** = _____ minutes

0 3 . 8 Why does copper sulfate solution conduct electricity?

[1 mark]

Tick (✓) **one** box.

Atoms move to the electrodes

☐

Ions move to the electrodes

☐

Molecules move to the electrodes

☐

0 3 . 9 Give **one** reason why copper should be recycled.

[1 mark]



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0	4
---	---

This question is about alkanes.

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

Methane has the formula CH_4

Calculate the relative formula mass (M_r) of methane.

Relative atomic masses (A_r): C = 12 H = 1

[2 marks]

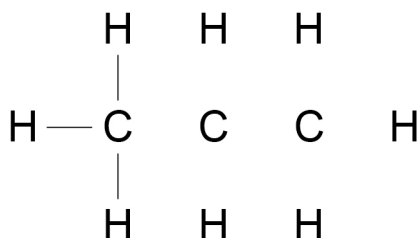
Relative formula mass = _____

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

Propane has the formula C_3H_8

Complete the displayed structure of propane.

[1 mark]



Question 4 continues on the next page

Turn over ►

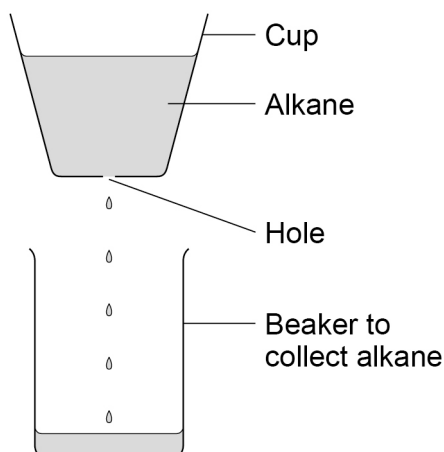


A student investigated the effect of temperature on the viscosity of a liquid alkane.

The student measured the rate of flow of the alkane through a hole in a cup.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Measure 50 cm³ of the alkane.
2. Measure the temperature of the alkane.
3. Pour the alkane into the cup.
4. Record the time taken for all of the alkane to flow through the hole.
5. Repeat steps 1 to 4 with the alkane at different temperatures.

0 4 . 3 Which piece of equipment should be used to measure 50 cm³ of the alkane?

[1 mark]

Tick (✓) **one** box.

Beaker

☐

Measuring cylinder

☐

Ruler

☐

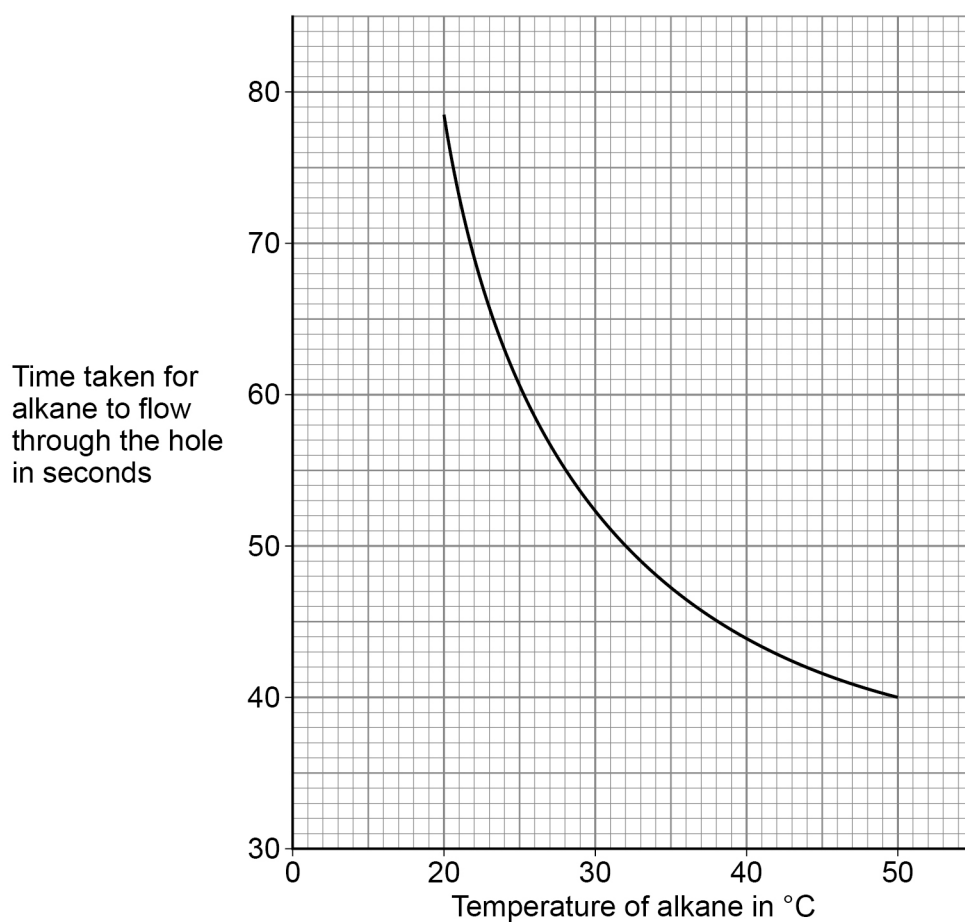
Test tube

☐


0 4 . 4

Give **one** control variable the student should keep the same in the investigation.**[1 mark]**

0 4 . 5

Figure 5 shows the results.**Figure 5**

Describe how the time taken for the alkane to flow through the hole changes when the temperature changes.

[2 marks]

Turn over ►

Alkanes can be used as fuels.

Burning fuels can lead to environmental issues.

0 4 . 6 What are the **two** products of the **complete** combustion of methane (CH_4)?

[2 marks]

Tick (✓) **two** boxes.

Carbon

☐

Carbon dioxide

☐

Hydrogen

☐

Nitrogen

☐

Water

☐

0 4 . 7 Which substance causes acid rain?

[1 mark]

Tick (✓) **one** box.

Carbon monoxide

☐

Nitrogen

☐

Oxygen

☐

Sulfur dioxide

☐

0 4 . 8

Global dimming is caused by solid particles in the air.

What is the main element in the solid particles that cause global dimming?

[1 mark]

Tick (✓) **one** box.

Carbon

☐

Nitrogen

☐

Oxygen

☐

Sulfur

☐

11

Turn over for the next question

Turn over ►



0 5

This question is about crude oil and substances obtained from crude oil.

0 5 . 1

Which process is used to separate crude oil?

[1 mark]Tick (✓) **one** box.

Chromatography

☐

Crystallisation

☐

Filtration

☐

Fractional distillation

☐**0 5 . 2**

A 120 g sample of crude oil contains 15 g of fuel oil.

Calculate the percentage of fuel oil in the sample of crude oil.

[2 marks]

Percentage of fuel oil = _____ %



The hydrocarbons in fuel oil can be cracked to produce more useful hydrocarbons.

Table 4 shows the hydrocarbons present in a sample of fuel oil before cracking and after cracking.

Table 4

Hydrocarbons present before the sample was cracked	Hydrocarbons present after the sample was cracked
$C_{13}H_{28}$ $C_{14}H_{30}$	C_2H_4 C_3H_6 C_6H_{14} C_7H_{16}

0 5 . 3 Which conditions are used for cracking hydrocarbons?

[1 mark]

Tick (✓) **one** answer.

Mix the hydrocarbons with steam at a high temperature

☐

Mix the hydrocarbons with water at a low pressure

☐

Mix the hydrocarbons with yeast at 38 °C

☐

0 5 . 4 What happens to the size of the molecules when hydrocarbons are cracked?

Use **Table 4**.

[1 mark]

0 5 . 5 Which hydrocarbon in **Table 4** has the lowest boiling point?

[1 mark]

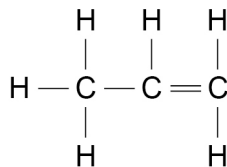
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Propene is a hydrocarbon produced by the cracking process.

Figure 6 shows the displayed structure of propene.

Figure 6



0 5 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

alcohol	alkane	alkene	ester
---------	--------	--------	-------

Propene is an _____.

0 5 . 7 The propene formed by the cracking process can be used to make a polymer.

Name the polymer produced from propene.

[1 mark]



0 5 . 8

What name is given to the small molecules that join together to produce polymers?

[1 mark]

Tick (✓) **one** box.

Alkanes

☐

Catalysts

☐

Monomers

☐

0 5 . 9

What name is used to describe a polymer that **does not** melt when heated?

[1 mark]

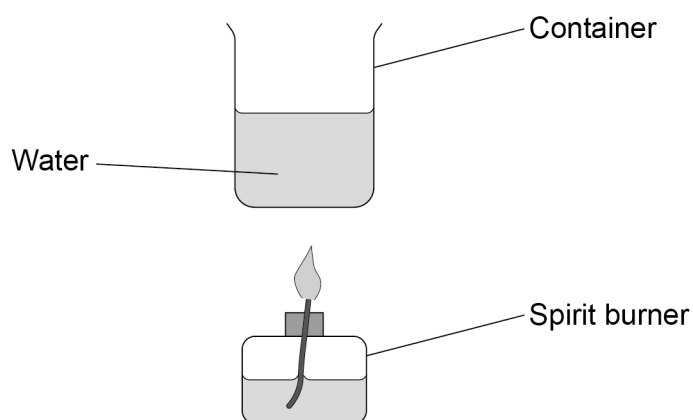
Question 5 continues on the next page

Turn over ►



0 5 . 1 0 Figure 7 shows water being heated by a spirit burner.

Figure 7



Some properties of a polymer are:

- melting point of 150 °C
- slightly soluble in water
- flammable.

Give **three** reasons why this polymer is **not** a suitable material for the container in Figure 7.

[3 marks]

1 _____

2 _____

3 _____



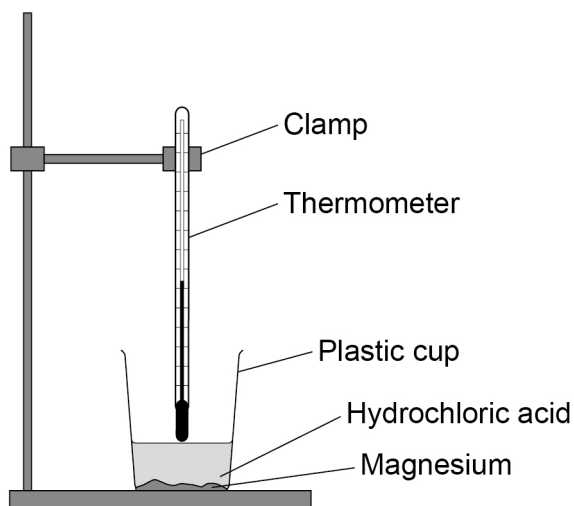
0 6

This question is about energy changes.

A student investigated the temperature change when magnesium was reacted with hydrochloric acid.

Figure 8 shows the apparatus.

Figure 8

**0 6 . 1**

Using the apparatus in **Figure 8** the temperature changed from 20.1 °C to 20.6 °C.

Complete the sentence.

Choose the answer from the box.

[1 mark]

endothermic exothermic reversible

The reaction between magnesium and hydrochloric acid is _____.

0 6 . 2

The student did **not** position the thermometer correctly in **Figure 8**.

Suggest how the thermometer should be positioned.

[1 mark]

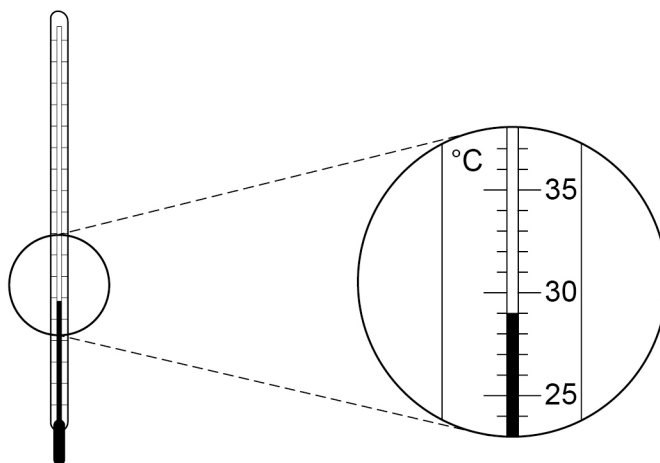
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A different student set up the apparatus correctly.

0 6 . 3 **Figure 9** shows a thermometer reading at one point in the investigation.

Figure 9



What is the temperature reading on the thermometer?

[1 mark]

_____ °C

0 6 . 4 The student recorded the temperature change without stirring the reactants.

The student then repeated the experiment and stirred the reactants.

Stirring the reactants gave a larger temperature change.

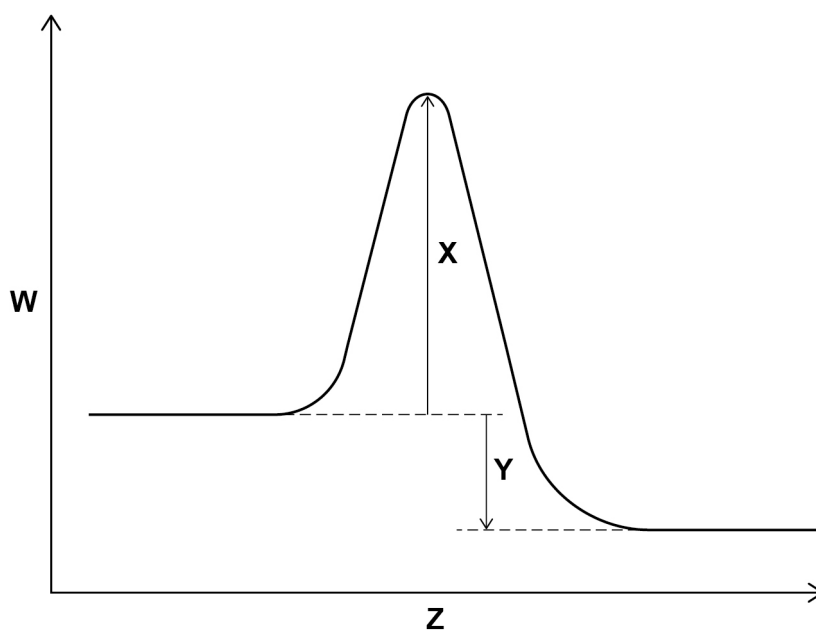
Suggest why.

[1 mark]



Figure 10 shows an energy level diagram for the reaction between magnesium and hydrochloric acid.

Figure 10



0 6 . 5 Which label in **Figure 10** represents the activation energy?

[1 mark]

Tick (✓) **one** box.

w ☐

x ☐

y ☐

z ☐

0 6 . 6 Which label in **Figure 10** represents the progress of the reaction?

[1 mark]

Tick (✓) **one** box.

w ☐

x ☐

y ☐

z ☐

Question 6 continues on the next page

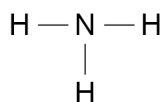
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Ammonia reacts with oxygen to produce nitrogen and water.

0 6 . 7 Figure 11 shows the displayed structure of ammonia.

Figure 11



The energy needed to break 1 mole of N — H bonds is 391 kJ.

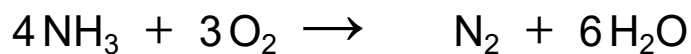
Calculate the total energy needed to break all the bonds in a mole of ammonia.

[2 marks]

Total energy = _____ kJ

0 6 . 8 Balance the equation for the reaction between ammonia and oxygen.

[1 mark]



0 6 . 9 The energy needed to break all the bonds in the reactants = 6186 kJ/mol.

The energy released when all the bonds are formed in the products = 7458 kJ/mol.

Calculate the overall energy change for the reaction in kJ/mol.

[2 marks]

Overall energy change = _____ kJ/mol

11



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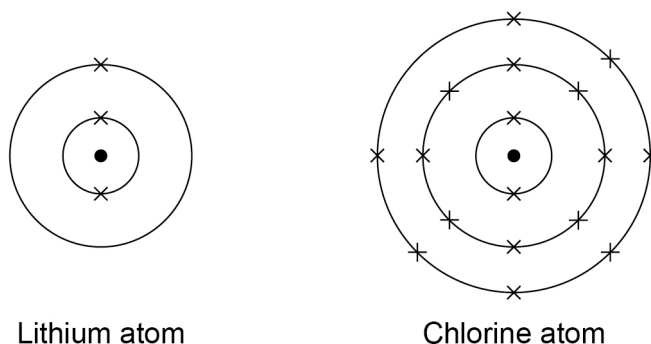
0 7

This question is about lithium compounds.

0 7 . 1

What colour flame would lithium chloride give in a flame test?

[1 mark]

0 7 . 2**Figure 12** shows the electronic structures of a lithium atom and of a chlorine atom.**Figure 12**

Describe what happens when a lithium atom reacts with a chlorine atom to produce lithium chloride.

You should refer to electrons in your answer.

[4 marks]



07.3

Barium chloride solution and hydrochloric acid were added to lithium sulfate solution.

What colour precipitate was observed?

[1 mark]

Tick (✓) **one** box.

Blue

☐

Cream

☐

White

☐

Yellow

☐

07.4

The formula of lithium sulfate is Li_2SO_4

Calculate the percentage by mass of lithium in lithium sulfate.

Give your answer to 3 significant figures.

Relative atomic mass (A_r): $\text{Li} = 7$

Relative formula mass (M_r): $\text{Li}_2\text{SO}_4 = 110$

[3 marks]

Percentage by mass (3 significant figures) = _____ %

9

Turn over ►



0 8

This question is about the reaction of calcium carbonate with hydrochloric acid.

Calcium carbonate reacts with hydrochloric acid to produce calcium chloride, water and a gas.

0 8**. 1**

Which gas is produced when calcium carbonate reacts with hydrochloric acid?

[1 mark]

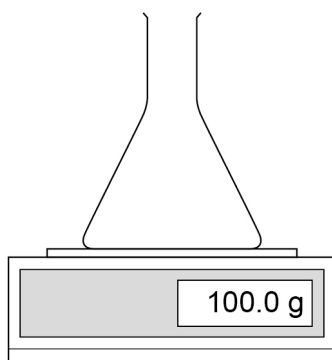
A student investigated the effect of changing the surface area of calcium carbonate pieces on the rate of reaction with hydrochloric acid.

Different-sized calcium carbonate pieces have different surface areas.

The mass of the reaction mixture decreases during the reaction because a gas is produced.

Figure 13 shows the apparatus.

Figure 13



Plan a method to investigate the effect of changing the surface area of calcium carbonate pieces on the rate of reaction with hydrochloric acid.

[6 marks]

[illegible]

Explain the effect of increasing the surface area of calcium carbonate pieces on the rate of reaction with hydrochloric acid.

[2 marks]

Question 8 continues on the next page

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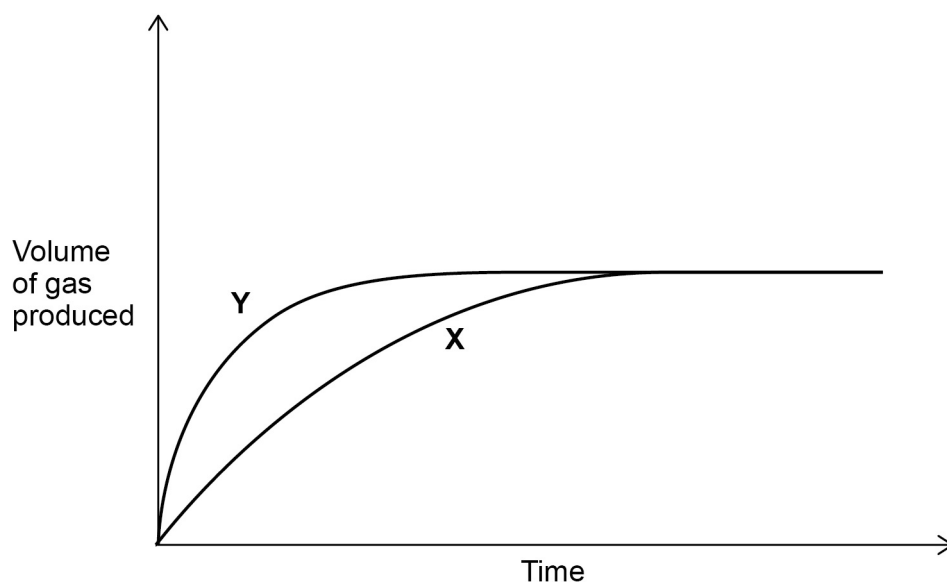


0 8 . 4

A different student investigated the effect of changing temperature on the rate of reaction between calcium carbonate and hydrochloric acid.

Figure 14 shows the results.

Figure 14



Curve **X** shows the results at 25 °C.

Curve **Y** shows the results at a higher temperature.

Explain how curve **Y** shows the rate of reaction is different at a higher temperature.

[2 marks]

11



0 9

This question is about the elements in Group 7 of the periodic table.

0 9 . 1

Which Group 7 element has the lowest melting point?

Use the periodic table.

[1 mark]**0 9 . 2**

Table 5 shows the melting point and the boiling point of bromine.

Table 5

Melting point in °C	–7
Boiling point in °C	59

What is the change of state when bromine is cooled from 100 °C to 50 °C?

[1 mark]

From _____ to _____

Question 9 continues on the next page

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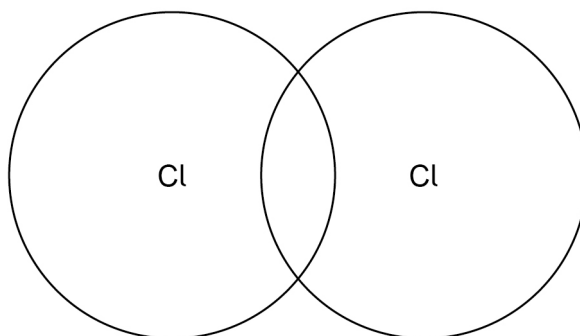
0 9 . 3

Chlorine exists as molecules of Cl_2

A chlorine atom has the electron arrangement 2,8,7

Complete **Figure 15** to show the arrangement of the outer shell electrons in chlorine (Cl_2).

Use dots (•) or crosses (×) to represent the electrons.

[2 marks]**Figure 15**

0 9 . 4

Bromine reacts with metals to form bromide ions.

What is the charge on a bromide ion?

[1 mark]Tick (✓) **one** box.

-2

☐

-1

☐

+1

☐

+2

☐

The reactivity of halogens decreases down the group.

0 9 . 5 A teacher demonstrated the reactivity of the halogens.

The teacher added halogen solutions to potassium halide solutions **X**, **Y** and **Z**.

The potassium halide solutions were:

- potassium bromide solution
- potassium chloride solution
- potassium iodide solution.

Table 6 shows the observations made.

Table 6

Halogen solution	Potassium halide solution		
	X	Y	Z
Chlorine	Changes to brown solution	No change	Changes to orange solution
Bromine	Changes to brown solution	No change	No change
Iodine	No change	No change	No change

Draw **one** line from each potassium halide solution to the correct name of the solution.
[2 marks]

Solution	Name of solution
X	Potassium bromide
Y	Potassium chloride
Z	Potassium iodide

Question 9 continues on the next page

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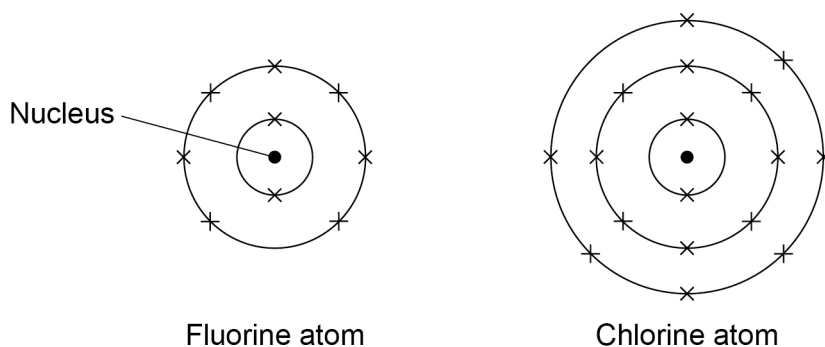


0 9 . 6

Figure 16 shows the electronic structure of a fluorine atom and of a chlorine atom.

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Figure 16



Explain why fluorine is more reactive than chlorine.

Refer to the electrostatic force of attraction between the nucleus and the outer energy level in your answer.

[3 marks]

10

END OF QUESTIONS



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