

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL GCSE COMBINED SCIENCE

Paper 2 Chemistry Core

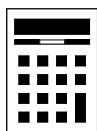
C

Monday 4 November 2024 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.

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.

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



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ANSWER IN THE SPACES PROVIDED**



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

0 1

This question is about atoms, elements and compounds.

0 1 . 1

Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons

neutrons

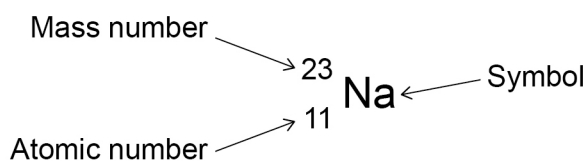
shells

An atom is neutral because there are an equal number of
protons and _____.

0 1 . 2

Figure 1 shows information about a sodium atom.

Figure 1



Draw **one** line from each particle to the number of that particle in this atom.

[2 marks]

Particle	Number of that particle in this atom
	11
Proton	12
Neutron	23
	34

Turn over ►



0 1 . 3 Atoms of the same element can have a different number of neutrons.

Complete the sentence.

Choose the answer from the box.

[1 mark]

alloys

compounds

isotopes

Atoms of the same element with a different number of neutrons
are called _____.

Sodium is a metal in Group 1.

Sodium reacts with chlorine to form sodium chloride.

0 1 . 4 How does a sodium atom change when sodium reacts with chlorine?

[1 mark]

Tick (✓) **one** box.

The sodium atom gains one electron.

☐

The sodium atom loses one electron.

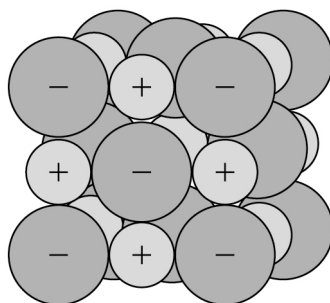
☐

The sodium atom shares one electron.

☐

0 1 . 5 Figure 2 shows the structure of sodium chloride.

Figure 2



What is the structure of sodium chloride?

[1 mark]

Tick (✓) **one** box.

Giant structure made of atoms

☐

Giant structure made of ions

☐

Simple molecule made of atoms

☐

Simple molecule made of ions

☐

0 1 . 6 How does the reactivity of Group 1 metals change going down the group?

[1 mark]

Tick (✓) **one** box.

Decreases

☐

Stays the same

☐

Increases

☐

Question 1 continues on the next page

Turn over ►



Sodium is more reactive than magnesium.

Sodium reacts with magnesium oxide in a displacement reaction.

0 1 . 7 Complete the word equation for the reaction between sodium and magnesium oxide.

[2 marks]

sodium + magnesium oxide $\rightarrow$ _____ + _____

0 1 . 8 The formula of magnesium oxide is MgO

Calculate the relative formula mass (M_r) of magnesium oxide.

Relative atomic masses (A_r): Mg = 24 O = 16

[2 marks]

Relative formula mass (M_r) = _____

11



0 2

This question is about the elements carbon, sulfur and oxygen.

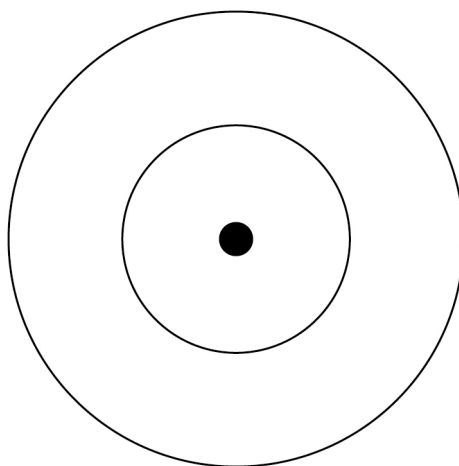
0 2 . 1

A carbon atom has six electrons.

Complete **Figure 3** to show the arrangement of electrons in a carbon atom.

[1 mark]

Figure 3



0 2 . 2

Calculate the number of atoms in 2.0 moles of carbon.

Use the equation:

$$\text{Number of atoms} = \text{number of moles} \times \text{Avogadro's constant}$$

$$\text{Avogadro's constant} = 6.02 \times 10^{23}$$

[2 marks]

Number of atoms =

Question 2 continues on the next page

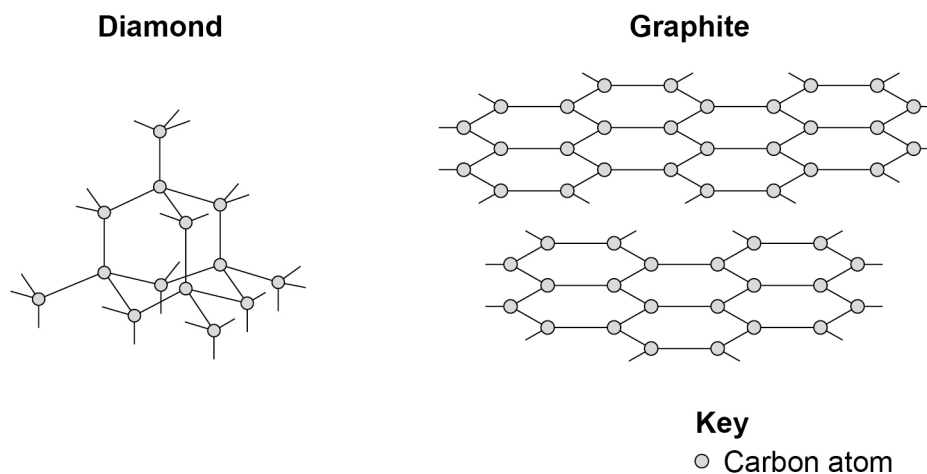
Turn over ►



Diamond and graphite are forms of carbon.

Figure 4 represents the structures of diamond and graphite.

Figure 4



0 2 . 3 Which is a property of diamond?

[1 mark]

Tick (✓) **one** box.

Good conductor of electricity

☐

Low melting point

☐

Very hard

☐

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

Which **two** of the following are reasons why diamond and graphite have different properties?

Use **Figure 4**.

[2 marks]

Tick (✓) **two** boxes.

The carbon atoms are arranged differently in each structure.

☐

The carbon atoms have a different chemical reactivity.

☐

The carbon atoms have a different number of protons.

☐

There are a different number of bonds between the carbon atoms.

☐

There are different types of covalent bonds between the carbon atoms.

☐

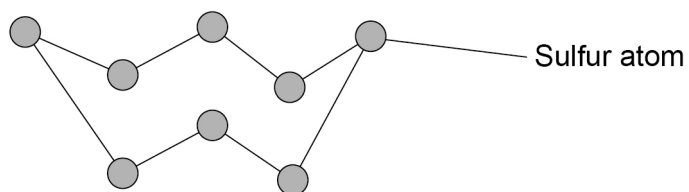
Question 2 continues on the next page

Turn over ►



0 2 . 5 Figure 5 represents a sulfur molecule.

Figure 5



Complete the formula of a sulfur molecule.

[1 mark]

S _____

0 2 . 6 The melting point of sulfur is 115 °C.

The boiling point of sulfur is 445 °C.

Complete the sentence.

Choose the answer from the box.

[1 mark]

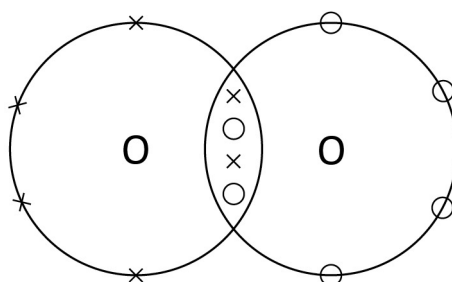
gas	liquid	solid
-----	--------	-------

At 25 °C, sulfur is a _____.



0 2 . 7 Figure 6 represents a molecule of oxygen.

Figure 6



What type of bond exists between oxygen atoms in **Figure 6**?

[1 mark]

Tick (✓) **one** box.

Single covalent bond

☐

Double covalent bond

☐

Triple covalent bond

☐

0 2 . 8 Oxygen and sulfur have similar properties.

Complete the sentence about the periodic table.

Choose the answer from the box.

[1 mark]

group	period	row	series
--------------	---------------	------------	---------------

Oxygen and sulfur have similar properties because the elements are in
the same _____.



0 3

This question is about organic compounds.

0 3 . 1

How many carbon atoms are there in a molecule of methane?

[1 mark]Tick (✓) **one** box.

1

☐

2

☐

3

☐**0 3 . 2**One mole of methane gas has a volume of 24 dm³.

Calculate the volume of 15 moles of methane gas.

[2 marks]

Volume = _____ dm³**0 3 . 3**The general formula of alkanes is C_nH_{2n+2}

Determine the formula of an alkane with 5 carbon atoms.

[1 mark]C₅H _____

0 3 . 4

The properties of alkanes change as the molecules become bigger.

Which is a property change of alkanes as the molecules become bigger?

[1 mark]

Tick (✓) **one** box.

Decrease in boiling point

☐

Decrease in flammability

☐

Decrease in viscosity

☐

0 3 . 5

Bromine water is used to test for alkenes.

Complete the sentence.

Choose the answer from the box.

[2 marks]

blue

colourless

green

orange

white

The colour change when bromine water is added to an alkene is

from _____ to _____ .

Question 3 continues on the next page

Turn over ►



Compound **X** is an organic compound.

0 3 . 6 An empirical formula is the simplest ratio of atoms of each element in the compound.

Compound **X** contains:

- 0.2 moles of C
- 0.4 moles of H
- 0.2 moles of O

Which is the empirical formula of compound **X**?

[1 mark]

Tick (✓) **one** box.

CH₂O

☐

C₂H₄O₂

☐

C₁₀H₂₀O₁₀

☐

C₂₀H₄₀O₂₀

☐

Table 1 shows the pH of compound **X** at different concentrations.

Table 1

Concentration of compound X in mol/dm ³	pH of compound X
0.1	2.88
0.2	2.73
0.3	2.64
0.4	2.58

0 3 . 7 The concentration of compound **X** affects the pH.

Complete the sentence.

[1 mark]

As the concentration of compound **X** increases, the pH _____.

0 3 . 8 What type of substance is compound **X**?

[1 mark]

Tick (✓) **one** box.

Acidic

☐

Neutral

☐

Alkaline

☐

Question 3 continues on the next page

Turn over ►



0 3 . 9 0.5 dm³ of a solution of compound **X** contained 3.0 g of compound **X**.

Calculate the concentration of compound **X** in g/dm³.

Use the equation:

$$\text{Concentration} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

Concentration = _____ g/dm³

12



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0 4

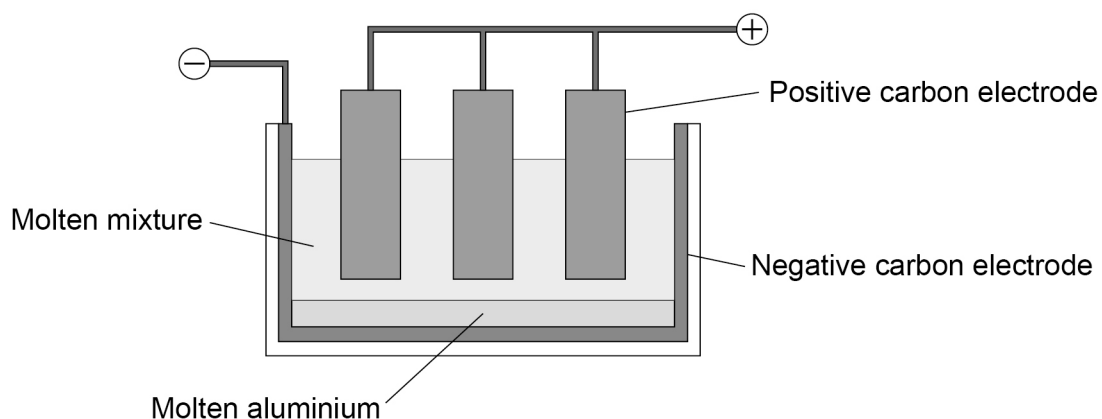
This question is about electrolysis.

0 4

1

Table 2 shows the products of electrolysis of two molten ionic compounds.Complete **Table 2**.**[2 marks]****Table 2**

Molten compound	Product at negative electrode	Product at positive electrode
Copper bromide	Copper	
Lithium iodide		Iodine

Figure 7 shows the apparatus used to electrolyse aluminium oxide.**Figure 7**

The molten mixture contains aluminium oxide and cryolite.

0 4

2

Aluminium ions (Al^{3+}) gain electrons at the negative electrode.

How many electrons does an aluminium ion gain to form an aluminium atom?

[1 mark]



0 4 . 3

The formula of cryolite is Na_3AlF_6

How many elements are there in cryolite?

[1 mark]

0 4 . 4

Why is cryolite used in the electrolysis of aluminium oxide?

[1 mark]

Tick (✓) **one** box.

To increase the energy costs

☐

To increase the purity of the aluminium

☐

To lower the melting point of the mixture

☐

To lower the rate of reaction

☐

Oxygen is produced at the positive carbon electrodes.

The oxygen reacts with the carbon electrodes.

0 4 . 5

Name the gas produced when oxygen reacts with the positive carbon electrodes.

[1 mark]

Question 4 continues on the next page

Turn over ►



0 4 . 6 A 200 kg positive electrode loses 80% of its mass before the electrode is replaced.

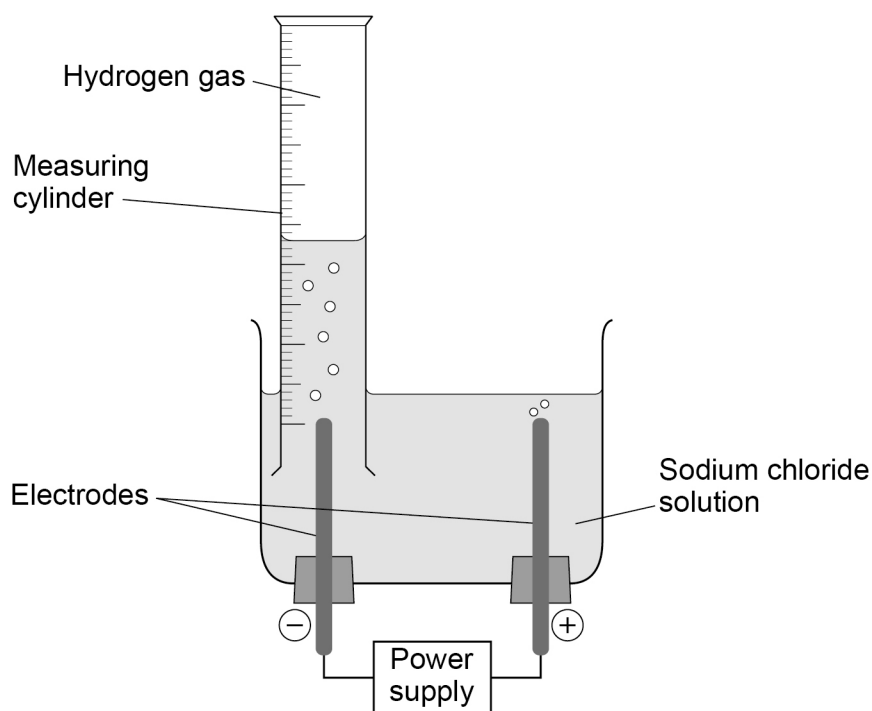
Calculate the mass lost.

[2 marks]

Mass lost = _____ kg

Figure 8 shows the electrolysis of sodium chloride solution.

Figure 8



The electrolysis of sodium chloride solution produces hydrogen gas and chlorine gas.

Sodium hydroxide solution is also produced.

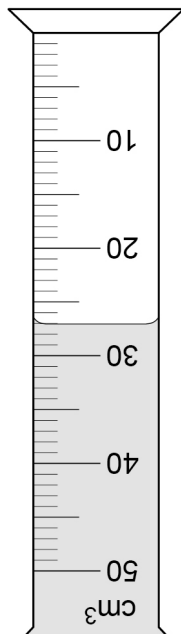


0 4 . 7

The electrolysis in **Figure 8** was done for 3 minutes.

Figure 9 shows the volume of hydrogen gas produced in 3 minutes.

Figure 9



Determine the rate of hydrogen production.

You should:

- Determine the volume of hydrogen gas produced using **Figure 9**.
- Use the equation:

$$\text{Rate of hydrogen production} = \frac{\text{volume of hydrogen gas}}{\text{time in minutes}}$$

[3 marks]

Volume of hydrogen gas = _____ cm³

Rate of hydrogen production = _____ cm³/min

Question 4 continues on the next page

Turn over ►



0 4 . 8

Draw **one** line from each substance to a product made from the substance.

[2 marks]

Substance**Product made from the
substance**

Chlorine

Sodium hydroxide

Fuels

Plastics

Soap

Vinegar

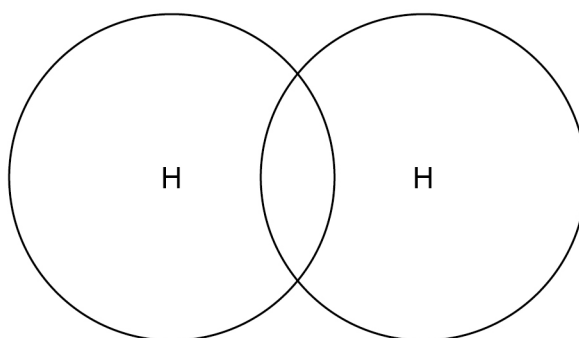
0 4 . 9

A hydrogen atom contains one electron.

Complete **Figure 10** to show the electrons in a molecule of hydrogen.

Use ○ and × to represent the electrons.

[1 mark]

Figure 10

Turn over for the next question

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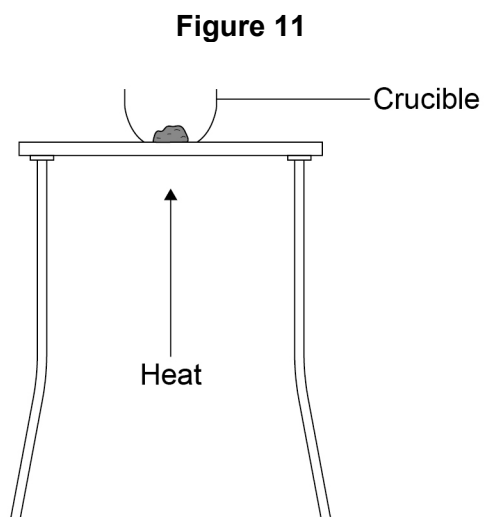


0 5

This question is about metal carbonates.

A student investigated the decomposition of metal carbonates.

Figure 11 shows the apparatus.



The student heated lithium carbonate in a crucible.

The student determined the mass of the crucible and contents every minute for 5 minutes.

Table 3 shows the results.

Table 3

Time in minutes	Mass of crucible and contents in grams
0	25.0
1	23.5
2	22.7
3	22.2
4	22.0
5	22.0

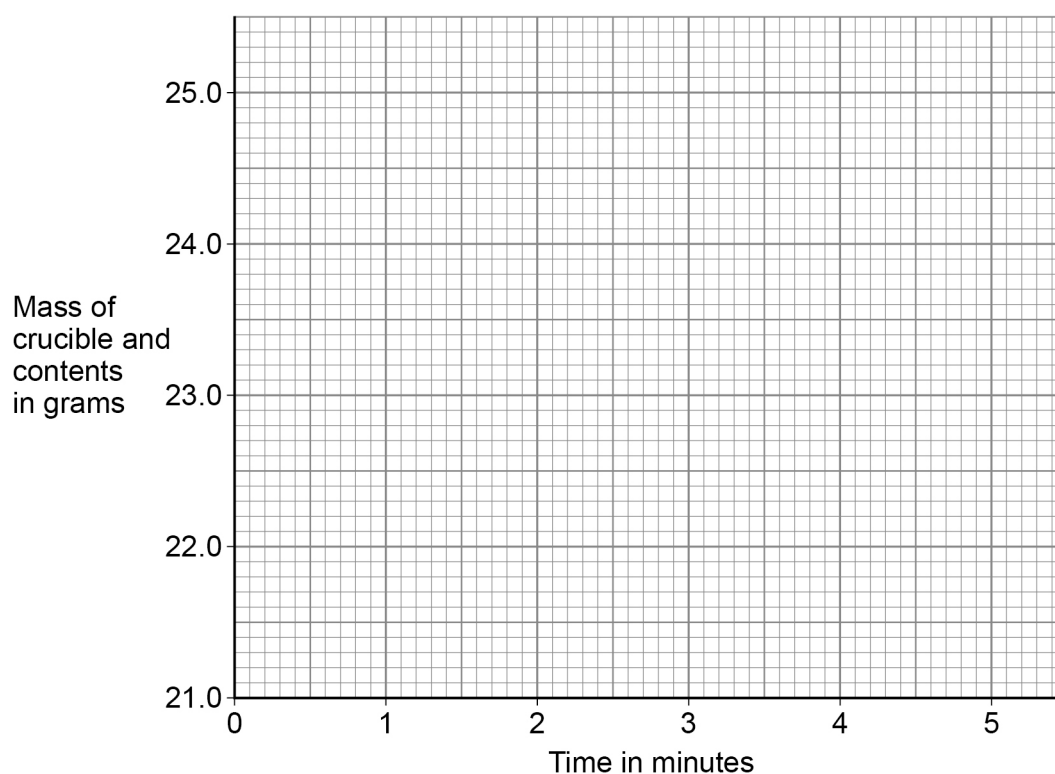
0 5 . 1 Complete **Figure 12**.

You should:

- plot the data from **Table 3**
- draw a line of best fit.

[3 marks]

Figure 12



0 5 . 2 How do the results in **Table 3** show that the reaction has finished?

[1 mark]

Question 5 continues on the next page

Turn over ►



The student did a different investigation.

The student heated four metal carbonates.

This is the method used.

1. Add 5.0 g of magnesium carbonate to a crucible.
2. Measure the mass of the crucible and contents.
3. Heat the crucible and contents for 5 minutes.
4. Allow to cool.
5. Measure the mass of the crucible and contents.
6. Repeat steps 1 to 5 using different carbonates.

Table 4 shows the results.

Table 4

Name of carbonate	Mass of crucible and contents at start in grams	Mass of crucible and contents after 5 minutes in grams	Change in mass in grams
Magnesium carbonate	25.0	22.4	2.6
Potassium carbonate	25.0	25.0	0.0
Sodium carbonate	25.0	25.0	0.0
Zinc carbonate	25.0	23.2	1.8



0 5 . 3 Draw **one** line from each type of variable to the description of the variable.

[2 marks]

Type of variable	Description of variable
	Change in mass
	Mass of metal carbonate
Independent variable	Temperature of Bunsen flame
Dependent variable	Time taken to heat
	Type of metal carbonate

0 5 . 4 Which metal carbonates do **not** decompose?

Give **one** reason for your answer.

Use **Table 4**.

[2 marks]

Metal carbonates _____

Reason _____

Question 5 continues on the next page

Turn over ►



0 5 . 5

The formula of lithium carbonate is Li_2CO_3

Calculate the percentage by mass of lithium in lithium carbonate.

Give your answer to 3 significant figures.

Relative atomic mass (A_r): Li = 7Relative formula mass (M_r): Li_2CO_3 = 74**[4 marks]**

Percentage by mass (3 significant figures) = _____ %

0 5 . 6

Decomposition reactions are endothermic.

Why is a reaction endothermic?

[1 mark]Tick (✓) **one** box.

The energy needed to break bonds is less than the energy released from forming bonds.

☐

The energy needed to break bonds is the same as the energy released from forming bonds.

☐

The energy needed to break bonds is greater than the energy released from forming bonds.

☐

13



Turn over for the next question

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2 9

0 6

This question is about precipitates.

Sodium hydroxide solution reacts with solutions containing copper(II) ions to produce a precipitate of copper hydroxide.

0 6 . 1

What is the state symbol of the copper hydroxide precipitate?

[1 mark]Tick (✓) **one** box.

(aq)

☐

(g)

☐

(l)

☐

(s)

☐**0 6 . 2**

What is the colour of the copper hydroxide precipitate?

[1 mark]Tick (✓) **one** box.

Blue

☐

Brown

☐

Green

☐

Red

☐

A student added sodium hydroxide solution to copper chloride solution in a test tube.

A precipitate of copper hydroxide was produced.

The student separated the precipitate from the solution.

0 6 . 3

Filtration is used to separate a precipitate from a solution.

Draw the apparatus used in filtration.

[2 marks]

0 6 . 4

The student measured the mass of the precipitate obtained.

The student also calculated the mass of the precipitate that should be produced.

Why was less than the calculated mass obtained?

[1 mark]

Tick (✓) **one** box.

Some of the solution in the mixture evaporated.

☐

Some precipitate was left in the test tube.

☐

Too much sodium hydroxide solution was added.

☐

Question 6 continues on the next page

Turn over ►



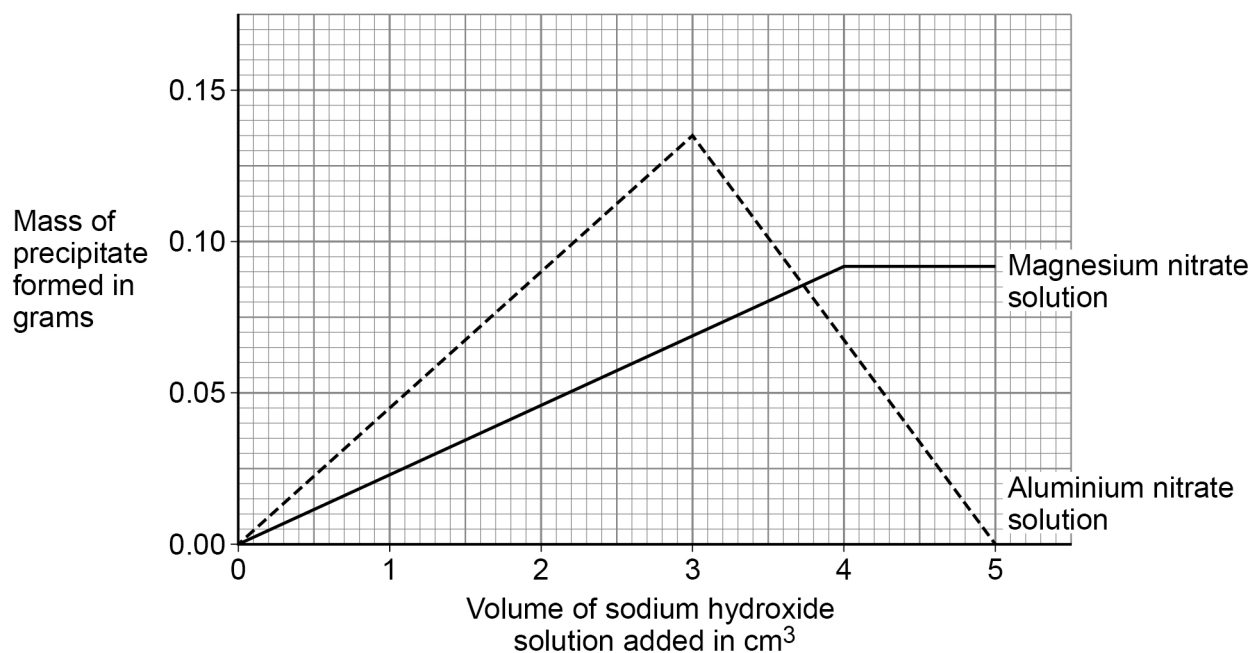
Another student added sodium hydroxide solution to:

- magnesium nitrate solution
- aluminium nitrate solution.

The student determined the mass of precipitate formed after each 1 cm³ volume of sodium hydroxide solution was added.

Figure 13 shows the results.

Figure 13



0 6 . 5

Describe the trend shown by magnesium nitrate solution in **Figure 13**.

[3 marks]



0 6 . 6

The student observed the test tube containing aluminium nitrate solution and sodium hydroxide solution.

What did the student see when more than 3 cm³ of sodium hydroxide solution was added?

Use **Figure 13**.

[1 mark]

Tick (✓) **one** box.

More precipitate forming

☐

No change in the precipitate

☐

The precipitate dissolving

☐

9

Turn over for the next question

Turn over ►



0 7

This question is about pure substances and mixtures.

A scientist tests the purity of a drug used as a medicine.

0 7 . 1

The scientist measures the melting point of a sample of the drug.

The melting point of the pure drug is 135 °C.

The sample of the drug melts between 129–133 °C.

Give **two** reasons why the data shows that the sample is **not** a pure sample of the drug.

[2 marks]

1 _____

2 _____

0 7 . 2

Suggest why it is important to test the purity of drugs before the drug is used as a medicine.

[1 mark]



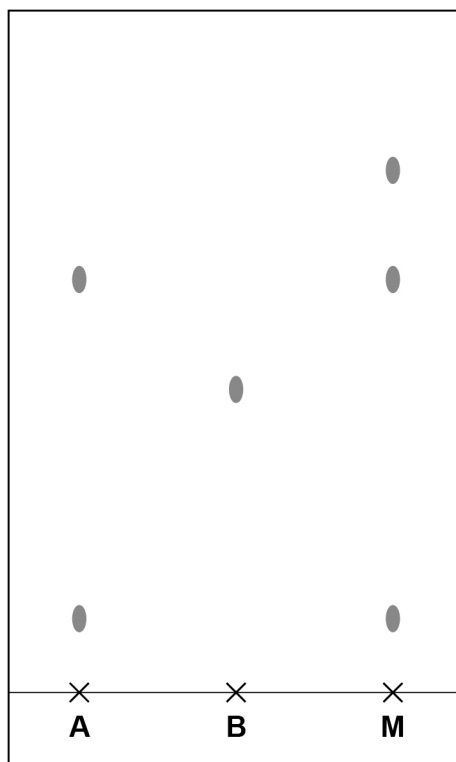
Chromatography is used to analyse mixtures.

0 7 . 3 A student investigated a food colouring **M**.

The student used chromatography to compare food colouring **M** with known colours **A** and **B**.

Figure 14 shows the results.

Figure 14



Give **three** conclusions about food colouring **M**.

[3 marks]

- 1 _____
- 2 _____
- 3 _____

Question 7 continues on the next page

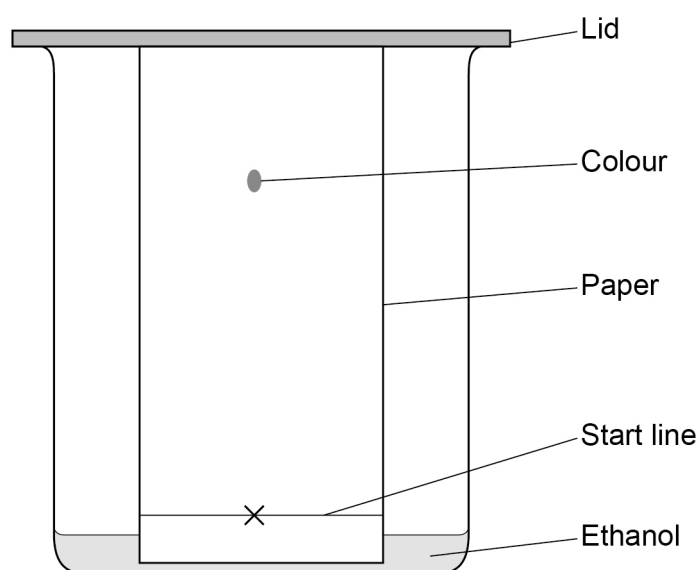
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The student investigated a different food colouring using ethanol as the solvent.

Figure 15 shows the apparatus.

Figure 15



0 7 . 4 Ethanol has a boiling point of 78 °C.

Suggest why the student used a lid when using ethanol as the solvent.

[1 mark]

0 7 . 5 Give **one** reason why the start line is drawn in pencil rather than in ink.

[1 mark]



0 7 . 6 Chromatography involves a mobile phase and a stationary phase.

Draw **one** line from each phase to the correct description of that phase in **Figure 15**.

[2 marks]

Phase	Description of phase
	Colour
	Ethanol
Mobile	Lid
Stationary	Paper
	Start line

10

Turn over for the next question

Turn over ►



0 8

This question is about acids, bases and salts.

0 8 . 1

Sodium hydroxide is an alkali and a base.

Copper oxide is only a base.

Give **one** similarity and **one** difference between an alkali and a base.

[2 marks]

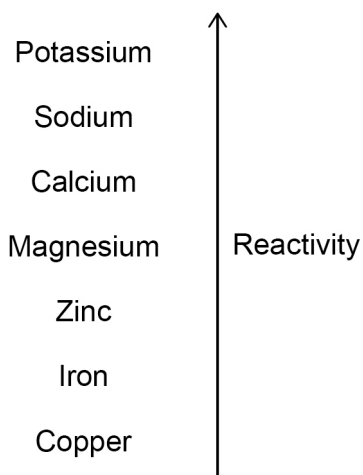
Similarity _____

Difference _____

Some metals can react with dilute acids to make a salt.

Figure 16 shows a reactivity series of metals.

Figure 16



0 8 . 2

Give **one** reason why copper **cannot** be used to make a salt using dilute acid.

[1 mark]



[1 mark]

[6 marks]

Question 8 continues on the next page

Turn over ►



0	8	.	5
---	---	---	---

58 g is the maximum mass of zinc sulfate that dissolves in 100 g of water.

Calculate the minimum mass of water needed to dissolve 14.5 g of zinc sulfate.

[2 marks]

Minimum mass of water = _____ g

12

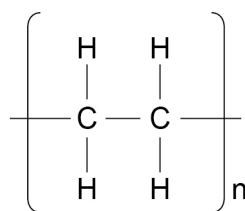


0 9

Nickel can catalyse the decomposition of poly(ethene) waste.

0 9 . 1

The polymer poly(ethene) has the displayed structural formula:

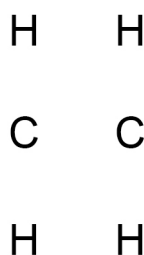


Poly(ethene) is produced from the monomer ethene.

Complete **Figure 17** to show the displayed structural formula of ethene.

[2 marks]

Figure 17



0 9 . 2

Poly(ethene) is a thermosoftening polymer.

Thermosoftening polymers melt when heated.

What type of polymers do **not** melt when heated?

[1 mark]

0 9 . 3

Poly(ethene) is **not** biodegradable.

What is meant by 'biodegradable'?

[1 mark]

Turn over ►



0 9 . 4 Explain how catalysts change the rate of reaction.

You should refer to:

- reaction pathways
- activation energy.

[2 marks]

0 9 . 5 Which is an advantage of using a nickel catalyst to break down poly(ethene)?

[1 mark]

Tick (✓) **one** box.

Less poly(ethene) waste will end up in landfill.

☐

Less poly(ethene) will be used.

☐

The poly(ethene) produced will be stronger.

☐

The poly(ethene) will be produced more quickly.

☐

The nickel used to make the catalyst can be extracted by phytomining.

Phytomining is an alternative to traditional mining.

0 9 . 6

What is used to extract metal compounds in phytomining?

[1 mark]

0 9 . 7

Extraction of nickel by traditional mining has an environmental impact.

Suggest **one** environmental impact of traditional mining.

[1 mark]

9

END OF QUESTIONS



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4 8



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