

GCSE CHEMISTRY

Foundation Tier Paper 1F

F

Specimen 2018

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- the periodic table (enclosed).

Instructions

- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- 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.

Advice

In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature _____

0 1

This question is about different substances and their structures.

0 1**. 1**

Draw **one** line from each statement to the diagram which shows the structure.

[4 marks]**Statement**

The substance is a gas

The substance is a liquid

The substance is ionic

The substance is a solid metal

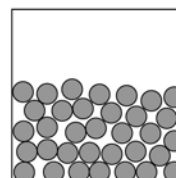
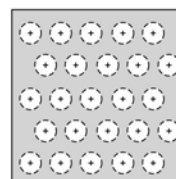
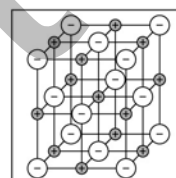
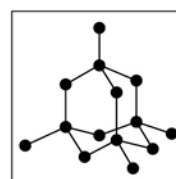
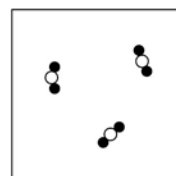
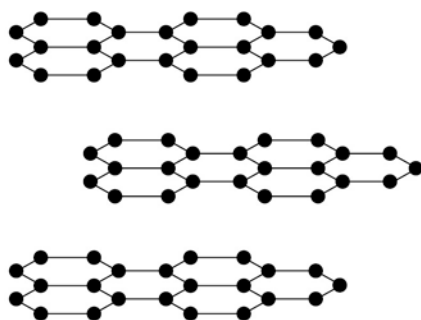
Structure

Figure 1 shows the structure of an element.

Figure 1



0 1 . 2 What is the name of this element?

[1 mark]

Tick **one** box.

Carbon

☐

Chloride

☐

Nitrogen

☐

Xenon

☐

0 1 . 3 Why does this element conduct electricity?

[1 mark]

Tick **one** box.

It has delocalised electrons

☐

It contains hexagonal rings

☐

It has weak forces between the layers

☐

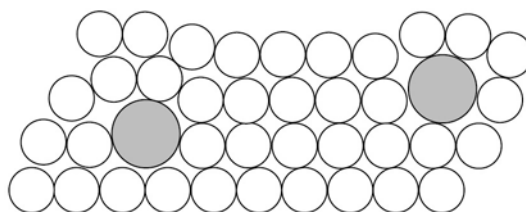
It has ionic bonds

☐

Question 1 continues on the next page

0 1 . 4 Figure 2 shows the structure of an alloy.

Figure 2



Explain why alloys are harder than pure metals.

[2 marks]

0 1 . 5 What type of substance is an alloy?

[1 mark]

Tick **one** box.

Compound

☐

Element

☐

Mixture

☐

Turn over for the next question

Draft

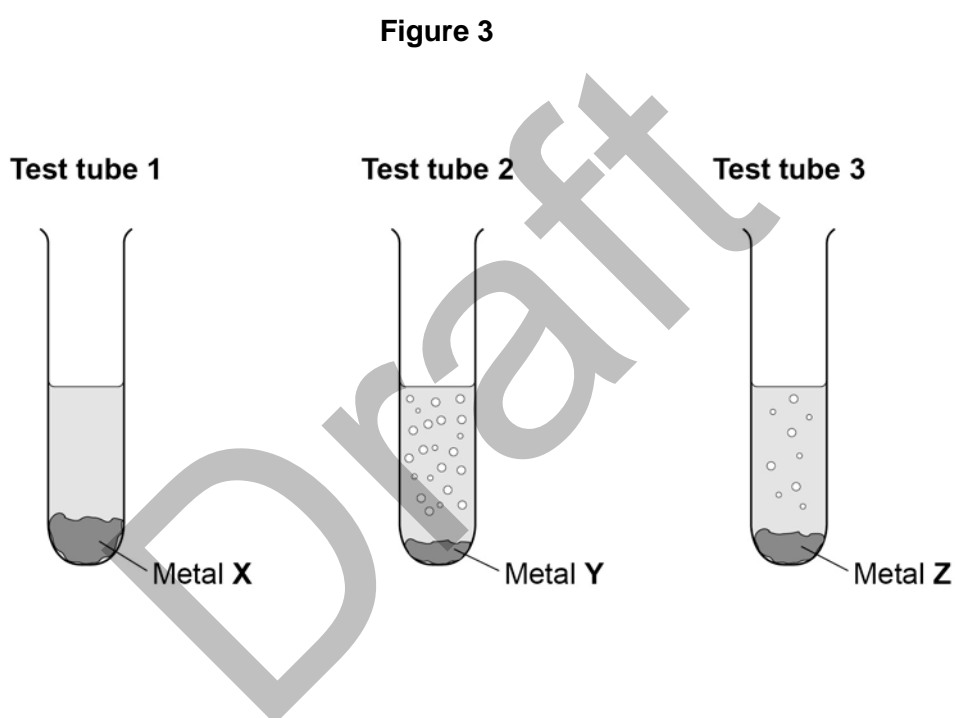
0 2

A student investigated the reactivity of three different metals.

This is the method used.

1. Place 1 g of metal powder in a test tube.
2. Add 10 cm³ of dilute sulfuric acid.
3. Wait one minute and observe.
4. Repeat using the other metals.

Figure 3 shows the test tubes one minute after adding the dilute sulfuric acid to the metal powder.

**0 2****. 1**

What is the independent variable in the investigation?

[1 mark]

Tick **one** box.

Number of bubbles

☐

Time taken

☐

Type of metal

☐

Volume of acid

☐

- 0 2 . 2** The student used measuring instruments to measure some of the variables.

Draw **one** line from each variable to the measuring instrument used to measure the variable.

[3 marks]

Variable	Measuring instrument
Mass of metal powder	Balance
	Measuring cylinder
Time of one minute	Ruler
	Stopclock
Volume of sulfuric acid	Thermometer
	Test tube

- 0 2 . 3** Use the results shown in **Figure 3** to place metals **X**, **Y** and **Z** in order of reactivity.

[1 mark]

Most reactive _____
↕
Least reactive _____

- 0 2 . 4** Suggest **one** reason why the student should **not** use sodium in this investigation.

[1 mark]

Question 2 continues on the next page

0 2 . 5 Sodium reacts with oxygen to produce sodium oxide.

Write the word equation for the reaction.

[1 mark]

0 2 . 6 What is the name for the type of reaction when sodium reacts with oxygen?

[1 mark]

Tick **one** box.

Displacement

☐

Electrolysis

☐

Neutralisation

☐

Oxidation

☐

0 2 . 7 Which metal is found in the Earth as the metal itself?

[1 mark]

Tick **one** box.

Calcium

☐

Gold

☐

Lithium

☐

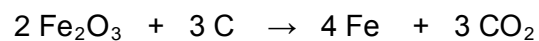
Potassium

☐

0 2 . 8 Iron is found in the Earth as iron oxide (Fe_2O_3).

Iron oxide is reduced to produce iron.

The equation for the reaction is:



Name the element used to reduce iron oxide.

[1 mark]

0 2 . 9 What is meant by reduction?

Tick **one** box.

[1 mark]

Gain of iron

☐

Gain of iron oxide

☐

Loss of iron

☐

Loss of oxygen

☐

Turn over for the next question

0	3
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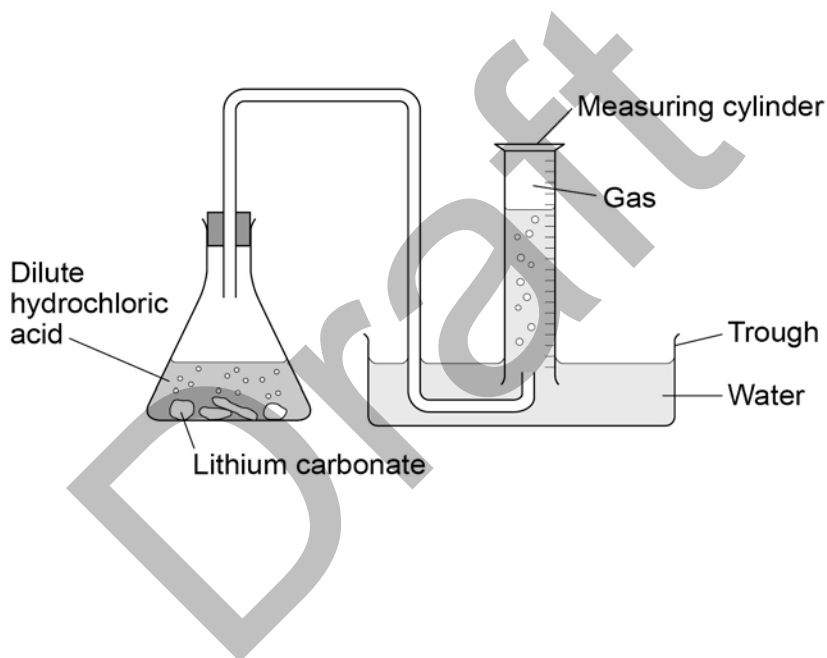
Lithium carbonate reacts with dilute hydrochloric acid.

A group of students investigated the volume of gas produced.

This is the method used.

1. Place a known mass of lithium carbonate in a conical flask.
2. Measure 10 cm³ of dilute hydrochloric acid using a measuring cylinder.
3. Pour the acid into the conical flask.
4. Place the bung in the flask and collect the gas as shown in **Figure 4**.

Figure 4



0	3
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.	1
---	---

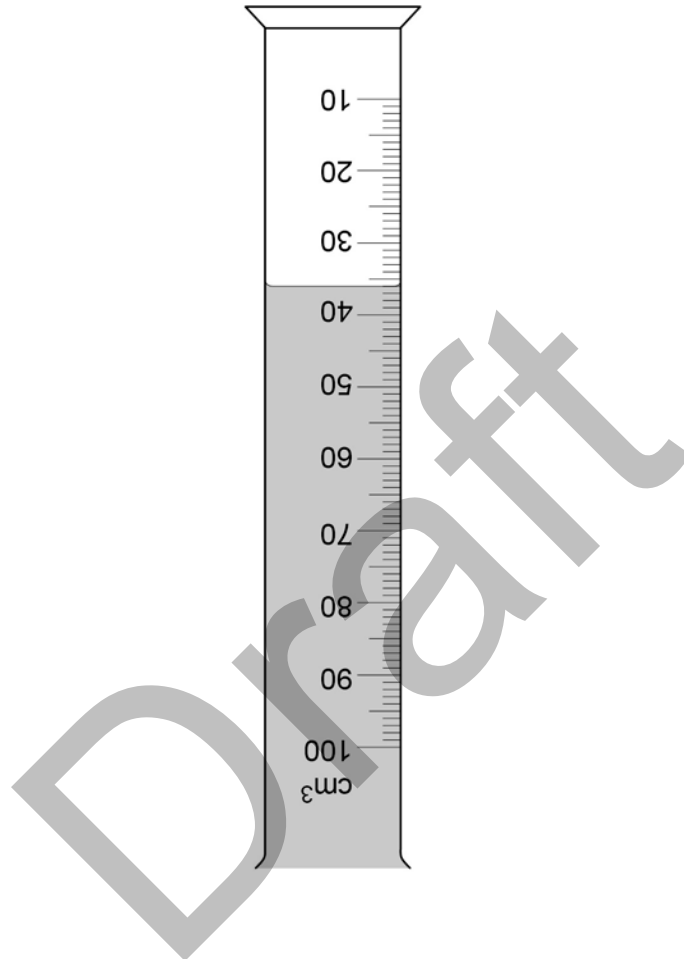
Balance the equation for the reaction.

[1 mark]



0 3 . 2 Figure 5 shows the measuring cylinder.

Figure 5



What volume of gas has been collected?

[1 mark]

Volume = _____ cm³

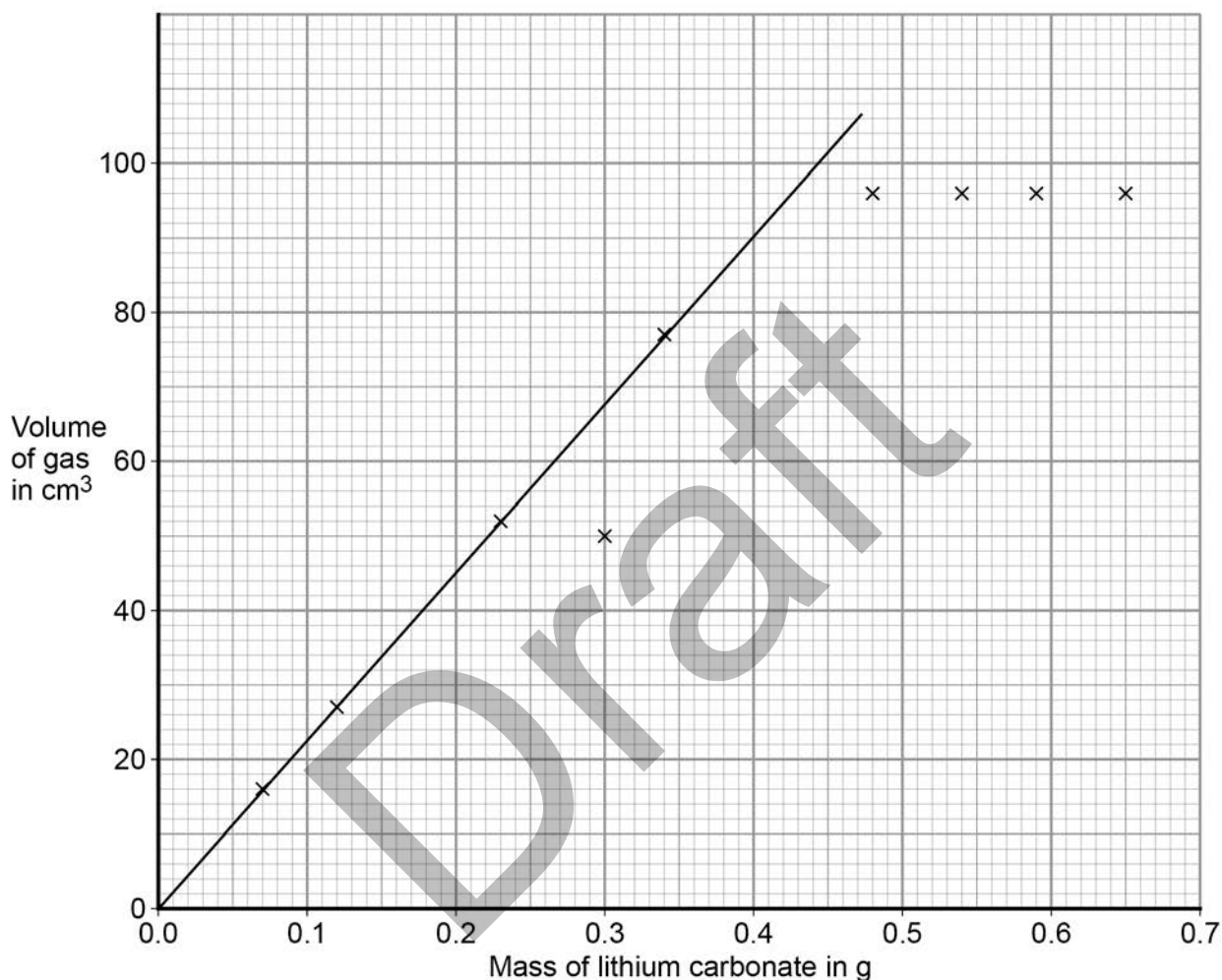
Question 3 continues on the next page

0 3 . 3 On **Figure 6** draw a straight line through the last four points.

Extend your line so that it crosses the line already drawn on the graph.

[2 marks]

Figure 6



0 3 . 4 Use your graph to determine the minimum mass of lithium carbonate that must be added to produce 96 cm³ of gas.

[1 mark]

Mass = _____ g

0 3 . 5 **One** of the points on the graph is anomalous.

Draw a ring around the anomalous point.

[1 mark]

0 3 . 6 What are **two** possible reasons for the anomalous result?

[2 marks]

Tick **two** boxes.

Too much lithium carbonate was added.

☐

The bung was not pushed in firmly enough.

☐

There was too much water in the trough.

☐

The measuring cylinder was not completely over the delivery tube.

☐

The conical flask was too small.

☐

0 3 . 7 Describe the relationship between the volume of gas collected and the mass of lithium carbonate up to 0.4 g.

[2 marks]

Question 3 continues on the next page

Lithium carbonate decomposes when heated.

The equation shows the decomposition of lithium carbonate.

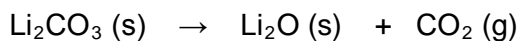
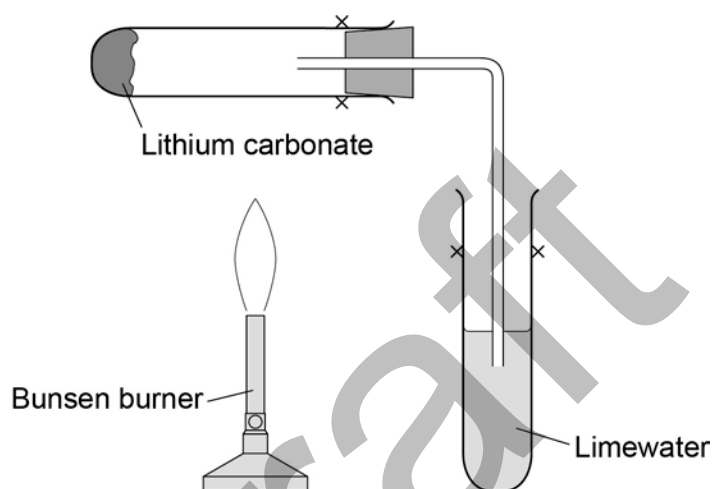


Figure 7 shows the apparatus a student used to decompose lithium carbonate.

Figure 7



0 3 . 8

Why does the limewater bubble?

[1 mark]

0 3 . 9

The student repeated the experiment with potassium carbonate.
The limewater did not bubble.

Suggest why there were no bubbles in the limewater.

[1 mark]

Turn over for the next question

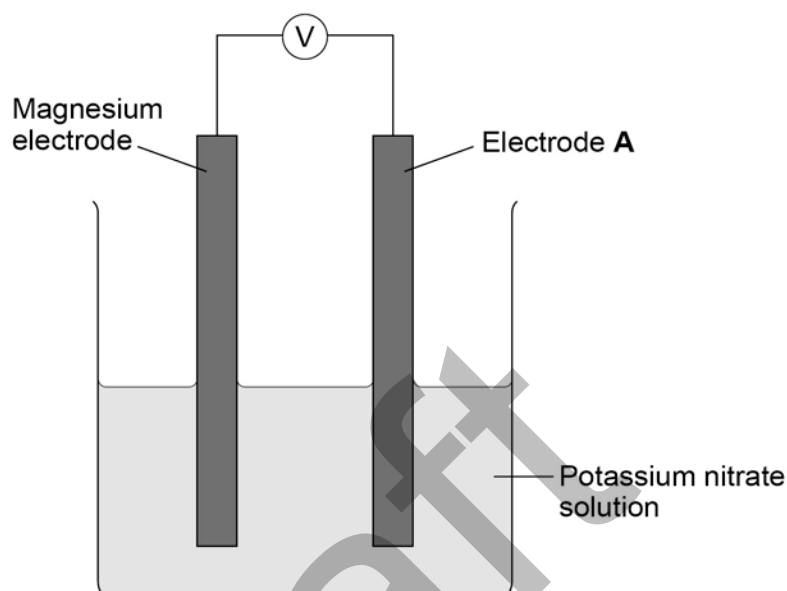
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0 4

A student investigated the reactivity of different metals.

The student used the simple cell shown in **Figure 8**.

Figure 8



The student used four different metals as electrode **A**.

The student measured the voltage from each simple cell three times.

The student's results are shown in **Table 1**.

Table 1

Metal as Electrode A	Voltage in Volts			Mean voltage
	Test 1	Test 2	Test 3	
Iron	2.8	2.6	2.7	
Nickel	2.3	2.4	1.9	2.2
Silver	3.2	0.0	3.2	3.2
Vanadium	1.2	1.0	1.1	1.1

- 0 4 . 1** Give **two** variables the student should control so that the investigation is a fair test.
[2 marks]

1 _____

2 _____

- 0 4 . 2** One of the results for silver is anomalous.

Which result is anomalous?

Suggest **one** reason why this anomalous result was obtained.

[2 marks]

Result _____

Reason _____

- 0 4 . 3** Calculate the mean voltage for iron.

[1 mark]

Mean voltage = _____ V

- 0 4 . 4** Magnesium is more reactive than the other four metals used by the student.

Which metal was the least reactive?

[1 mark]

0 4 . 5 Chromium is between nickel and vanadium in reactivity.

Predict the voltage produced when chromium is used with magnesium in this simple cell.

[1 mark]

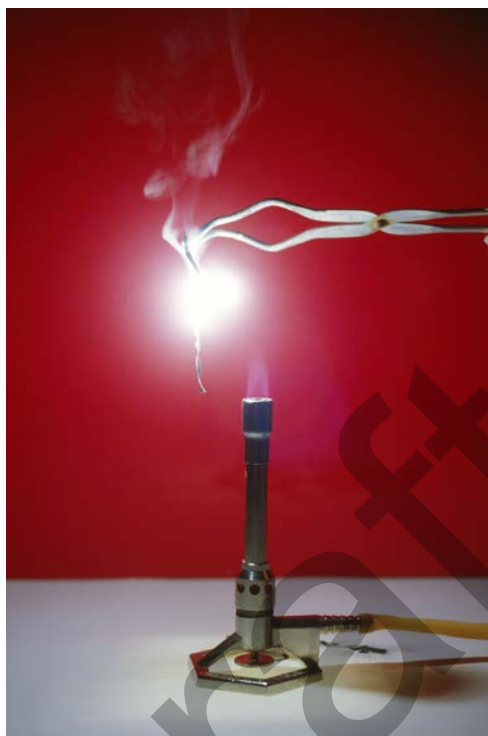
Voltage = _____ V

Draft

0	5
---	---

Figure 9 shows magnesium burning in the air.

Figure 9



0	5
---	---

1

Look at **Figure 9**.

How can you tell that a chemical reaction is taking place?

[1 mark]

0	5
---	---

2

Name the product from the reaction of magnesium in **Figure 9**.

[1 mark]

0 5 . 3 The magnesium needed heating before it would react.

What conclusion can you draw from this?

[1 mark]

Tick **one** box.

The reaction is reversible

☐

The reaction has a high activation energy

☐

The reaction is exothermic

☐

Magnesium has a high melting point

☐

0 5 . 4 A sample of the product from the reaction in **Figure 9** was added to water and shaken.

Universal indicator was added.

The universal indicator turned blue.

What is the pH value of the solution?

[1 mark]

Tick **one** box.

1

☐

4

☐

7

☐

9

☐

0 5 . **5** The magnesium needed heating before it would react.

Why are nanoparticles effective in very small quantities?

[1 mark]

Tick **one** box.

They are elements

☐

They are highly reactive

☐

They have a low melting point

☐

They have a high surface area to volume ratio

☐

0 5 . **6** State **one** advantage of using nanoparticles in sun creams.

[1 mark]

0 5 . **7** State **one** disadvantage of using nanoparticles in sun creams.

[1 mark]

Question 5 continues on the next page

- 0 5 . 8** A coarse particle has a diameter of 1×10^{-6}
A nanoparticle has a diameter of 1×10^{-9}

How much bigger is the coarse particle?

[1 mark]

Tick **one** box.

10 × ☐

100 × ☐

1000 × ☐

10 000 × ☐

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Turn over for the next question

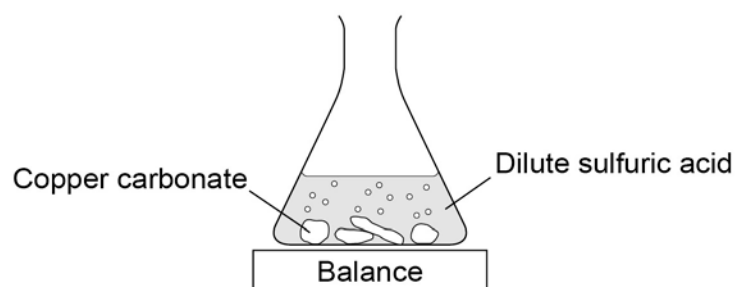
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0 6

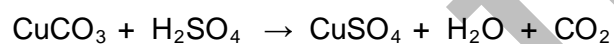
A student investigated the reaction of solid copper carbonate with dilute sulfuric acid.

The student used the apparatus shown in **Figure 10**.

Figure 10



The equation for the reaction is:

**0 6**. **1**

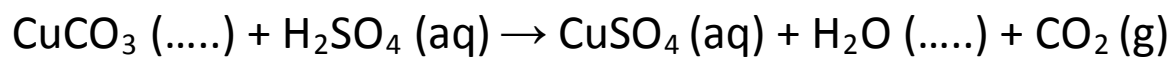
Name the gas produced when copper carbonate reacts with dilute sulfuric acid.

[1 mark]

0 6. **2**

Complete the state symbols in the equation.

[2 marks]



0 6

. 3

Why did the balance reading decrease during the reaction?

[1 mark]

Tick **one** box.

The copper carbonate broke down.

☐

A salt was produced in the reaction.

☐

A gas was lost from the flask.

☐

Water was produced in the reaction.

☐

0 6

. 4

A student used this method to make crystals of copper sulfate.

- 1 Place dilute sulfuric acid in a flask.
- 2 Add excess copper carbonate to the flask.
- 3 Filter the mixture
- 4 Place the filtrate in an evaporating basin and heat for a few minutes.
- 5 Leave the solution to cool.

Give a reason why the student did each of the following:

[4 marks]

Add excess (in step 2)

Filter (in step 3)

Heat (in step 4)

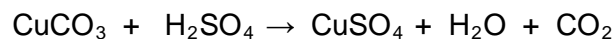
Leave to cool (in step 5)

Question 6 continues on the next page

0 6 . 5 The percentage atom economy for a reaction is calculated using:

$$\frac{\text{Relative formula mass of desired product from equation}}{\text{Sum of relative formula masses of all reactants from equation}} \times 100$$

The equation for the reaction is:



Relative formula masses : $\text{CuCO}_3 = 123.5$; $\text{H}_2\text{SO}_4 = 98$; $\text{CuSO}_4 = 159.5$

Calculate the percentage atom economy for making copper sulfate from copper carbonate.

[3 marks]

Atom economy = _____ %

0 6 . 6 Why is it important for the percentage atom economy of a reaction to be as high as possible?

[1 mark]

0 7

An atom of aluminium has the symbol $^{27}_{13}\text{Al}$.

0 7 . 1

Give the number of protons, neutrons and electrons in this atom of aluminium.

[3 marks]

Number of protons _____

Number of neutrons _____

Number of electrons _____

0 7 . 2

Aluminium is in Group 3 of the periodic table.

Why do the elements in Group 3 have similar chemical properties?

[1 mark]

Question 7 continues on the next page

0 7 . 3 In the periodic table, Group 1 elements and the transition elements are metals.

Compare the chemical and physical properties of transition elements with Group 1 elements.

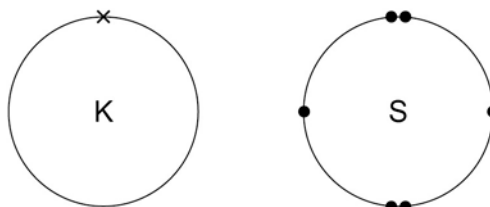
[6 marks]

Handwriting practice lines for the answer. A large diagonal watermark reading "Draft" is overlaid on the lines.

0 8

Figure 11 shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

Figure 11

**0 8****. 1**

Potassium forms an ionic compound with sulfur.

Describe what happens when **two** atoms of potassium react with **one** atom of sulfur.

Give your answer in terms of electron transfer.

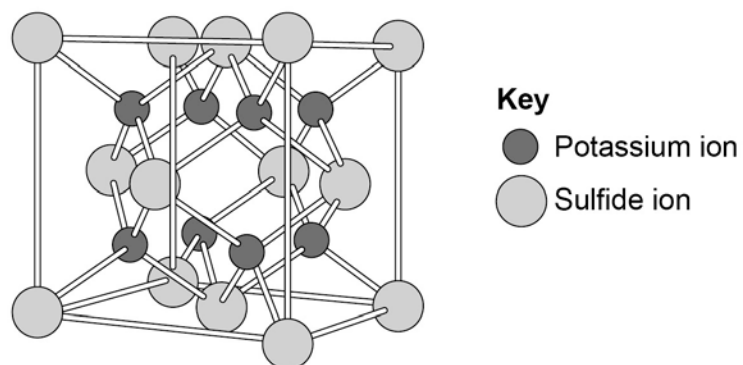
Give the formulae of the ions formed.

[5 marks]

Question 8 continues on the next page

- 0 8 . 2** The structure of potassium sulfide can be represented using the ball and stick model in **Figure 12**.

Figure 12



The ball and stick model is **not** a true representation of the structure of an ionic compound.

Give **one** reason why.

[1 mark]

- 0 8 . 3** The formula of another compound containing potassium and sulfur is KHSO_4

How many atoms are in one particle of KHSO_4 ?

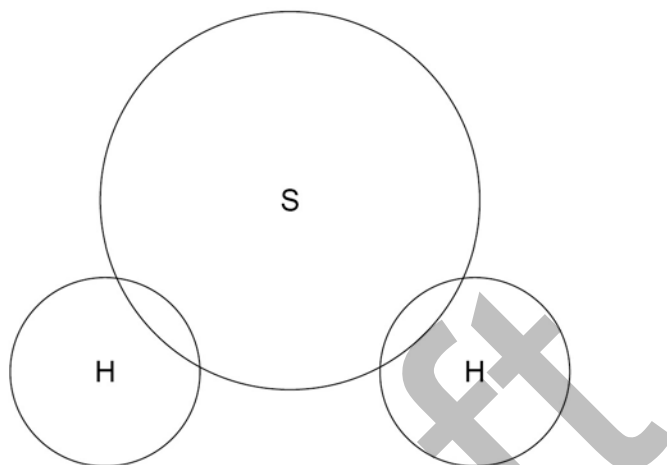
[1 mark]

- 0 8 . 4** Sulfur can also form covalent bonds.

Complete the dot and cross diagram to show the covalent bonding in a molecule of hydrogen sulfide.

Show the outer shell electrons only.

[2 marks]



- 0 8 . 5** Calculate the relative formula mass (M_r) of hydrogen sulfide H_2S

Relative atomic masses (A_r): hydrogen = 1; sulfur = 32

[1 mark]

Question 8 continues on the next page

- 0 8 . 6** Covalent compounds such as hydrogen sulfide have low melting points and do not conduct electricity when molten.

Draw **one** line from each property to the explanation of the property.

[2 marks]

Property	Explanation of property
	Electrons are free to move
Low melting point	There are no charged particles free to move
	Ions are free to move
	Weak intermolecular forces of attraction
Does not conduct electricity when molten	Bonds are weak
	Bonds are strong

- 0 8 . 7 Ionic compounds such as potassium sulfide have high boiling points and conduct electricity when dissolved in water.

Draw **one** line from each property to the explanation of the property.

[2 marks]

Property	Explanation of property
	Electrons are free to move
High boiling point	There are no charged particles free to move
	Ions are free to move
	Weak intermolecular forces of attraction
Conduct electricity when molten	Bonds are weak
	Bonds are strong

Turn over for the next question

0 9

Rock salt is a mixture of sand and salt.

Salt dissolves in water. Sand does not dissolve in water.

Some students separated rock salt.

This is the method used.

1. Place the rock salt in a beaker.
2. Add 100 cm³ of cold water.
3. Allow the sand to settle to the bottom of the beaker.
4. Carefully pour the salty water into an evaporating dish.
5. Heat the contents of the evaporating dish with a Bunsen burner until salt crystals start to form.

0 9 . 1

Suggest **one** improvement to step 2 to make sure all the salt is dissolved in the water.

[1 mark]

0 9 . 2

The salty water in step 4 still contained very small grains of sand.

Suggest **one** improvement to step 4 to remove all the sand.

[1 mark]

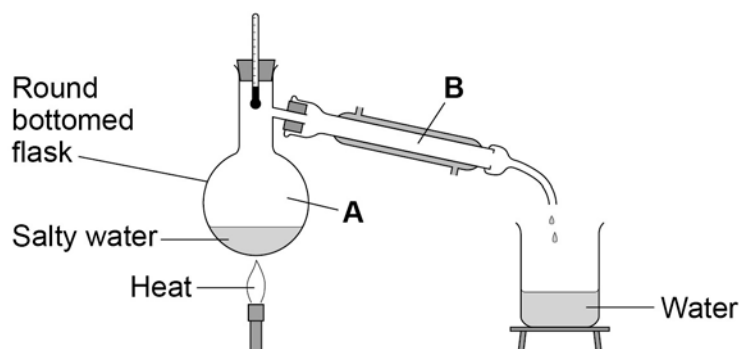
0 9 . 3

Suggest **one** safety precaution the student should take in step 5.

[1 mark]

Another student removed water from salty water using the apparatus in **Figure 13**.

Figure 13



0 9 . 4

What is the name of this technique?

[1 mark]

Tick **one** box.

Chromatography

☐

Crystallisation

☐

Distillation

☐

Spectroscopy

☐

0 9 . 5

What change of state happens at **A**?

[1 mark]

0 9 . 6

What change of state happens at **B**?

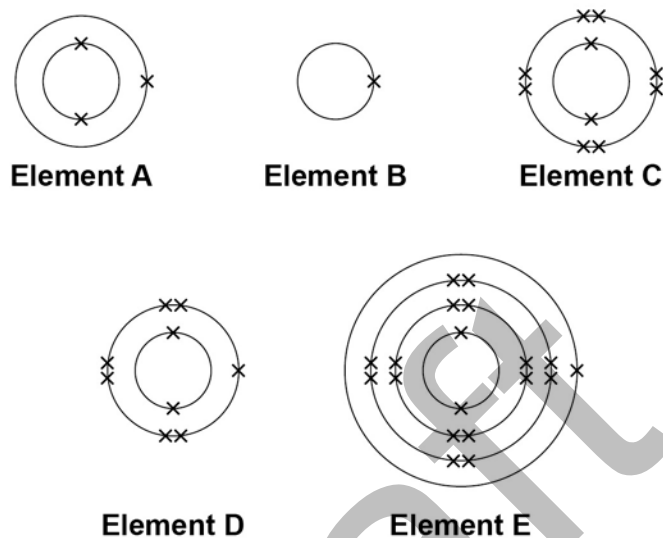
[1 mark]

1 0

The electronic structure of the atoms of five elements are shown in **Figure 14**.

The letters are **not** the symbols of the elements.

Figure 14



Choose the element to answer questions **10.1** to **10.5**. Each answer can be used once, more than once or not at all.

Use the periodic table to help you.

1 0 . 1

Which element is potassium?

[1 mark]

Tick **one** box.

A	B	C	D	E
---	---	---	---	---

1 0 . 2

Which element is a halogen?

[1 mark]

Tick **one** box.

A	B	C	D	E
---	---	---	---	---

- 1 0 . 3 Which element is a metal in the same group of the periodic table as element **A**? [1 mark]

Tick **one** box.

B		C		D		E	
---	--	---	--	---	--	---	--

- 1 0 . 4 Which element exists as single atoms? [1 mark]

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

- 1 0 . 5 Which element has atoms that do **not** have any neutrons in their nucleus? [1 mark]

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

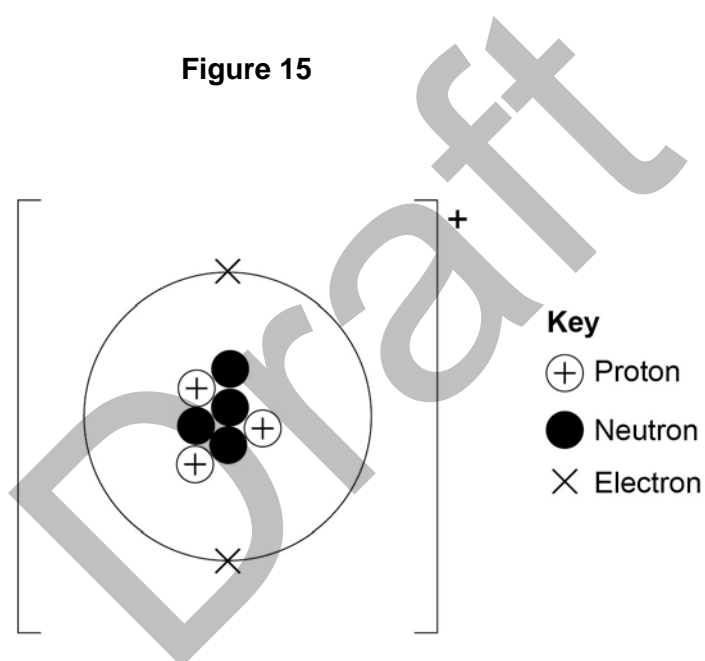
- 1 0 . 6 Explain why element **C** is unreactive. [2 marks]

Question 10 continues on the next page

1 0 . 7 Explain why element **E** can lose its outer shell electron more easily than element **A**.

[2 marks]

1 0 . 8 Figure 15 shows an ion of element **A**.



Explain why the ion in **Figure 15** has a positive charge.

[2 marks]

END OF QUESTIONS

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Figure 9: Bunsen burner © Science Photo Library