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. •
When answering questions 06.3 and 08.3 you need to make sure that your answer:
- is clear, logical, sensibly structured
- fully meets the requirements of the question
- shows that each separate point or step supports the overall answer.

Advice

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

Please write clearly, in block capitals.

Centre number Candidate number

Surname

Forename(s)

Candidate signature

This question is about different substances and their structures.

0 1

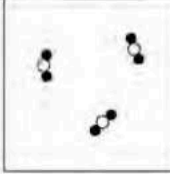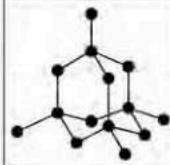**0 1 . 1** Draw one line from each statement to the diagram which shows the structure.
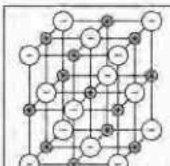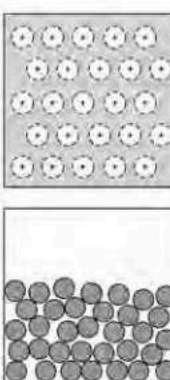[4 marks]

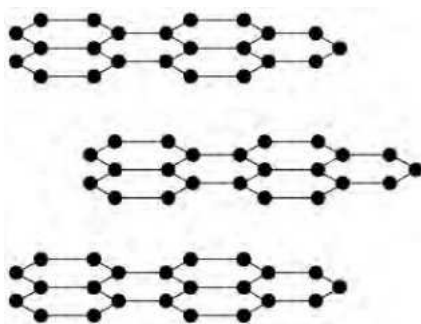| Statement	Structure
The substance is a gas	
The substance is a liquid	
The substance is ionic	
The substance is a solid metal	

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

Turn over ▶

Figure 2 shows the structure of an alloy.

Figure 2
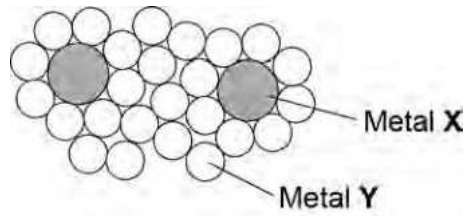
0 1 . 4 Explain why this alloy is harder than the pure metal

[2 marks]

0 1 . 5 What percentage of the atoms in the alloys are atoms of X ?

[2 marks]

0 1 . 6   What type of substance is an alloy?

Tick one box.

[1 mark]

Compound	☐
Element	☐
Mixture	☐

Turn over for the next question

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 metal sulfate.
3. Wait 1 minute and observe.
4. Repeat using the other metals and metal sulfates.

The student placed a tick in Table 1 if there was a reaction and a cross if there was no reaction.

Table 1

	Zinc	Copper	Magnesium
Copper sulfate	☐ x		☐
Magnesium sulfate	x x		x
Zinc sulfate	x x		☐

0 2 . 1 What is the dependent variable in the investigation?

[1 mark]

Tick one box.

Time taken ☐

Type of metal ☐

Volume of metal sulfate ☐

Whether there was a reaction or not ☐

0 2 . 2 Give one observation the student could make that shows there is a reaction between zinc and copper sulfate.

[1 mark]

0 2 . 3   The student used measuring instruments to measure some of the variables.

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

[2 marks]

Variable	Measuring instrument
	Balance
	Measuring cylinder
Mass of metal powder	Ruler
	Burette
Volume of metal sulfate	Thermometer
	Test tube

0 2 . 4   Use the results shown in Table 1 to place zinc, copper and magnesium in order of reactivity.

[1 mark]

Most reactive   _____

↕   _____

Least reactive   _____

0 2 . 5   Suggest one reason why the student should not use sodium in this investigation.
[1 mark]

_____

0 2 . 6   Which metal is found in the Earth as the metal itself?

[1 mark]
Tick box.
one

Calcium   ☐

Gold   ☐

Lithium   ☐

Potassium   ☐

0 2 . 7   Iron is found in the Earth as iron oxide (Fe_2O_3).

Iron oxide is reduced to produce iron.

Balance the equation for the reaction.

[1 mark]

___Fe_2O_3 + ___C → ___Fe + ___ CO_2
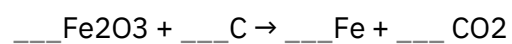
0 2 . 8   Name the element used to reduce iron oxide.

[1 mark]

0 2 . 9   What is meant by reduction?
[1 mark]
Tick one box.

Gain of iron   ☐

Gain of oxide   ☐

Loss of iron   ☐

Loss of oxygen   ☐

Turn over for the next question

0 3 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 a bung in the flask and collect the gas as shown in Figure 3.

Figure 3
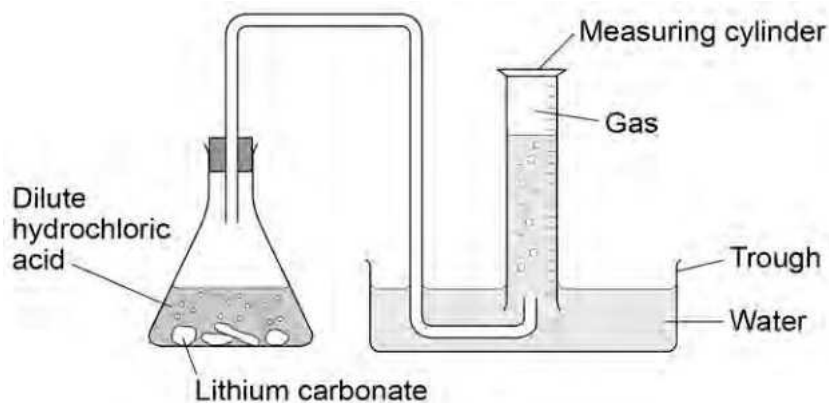
| 0 | 3 | . | 1 | Figure 4 shows the measuring cylinder.

Figure 4

What volume of gas has been collected?
[1 mark]

Volume = _____ cm3

Question 3 continues on the next page

0 3 . 2   Table 2 shows the students' results.

Table 2

Mass of lithium carbonate in g	Volume of gas in cm3
0.0	0
0.1	22
0.2	44
0.3	50
0.4	88
0.5	96
0.6	96
0.7	96

On Figure 5:
• Plot these results on the grid.
• Complete the graph by drawing   two straight lines of best fit.

[4 marks]

Figure 5
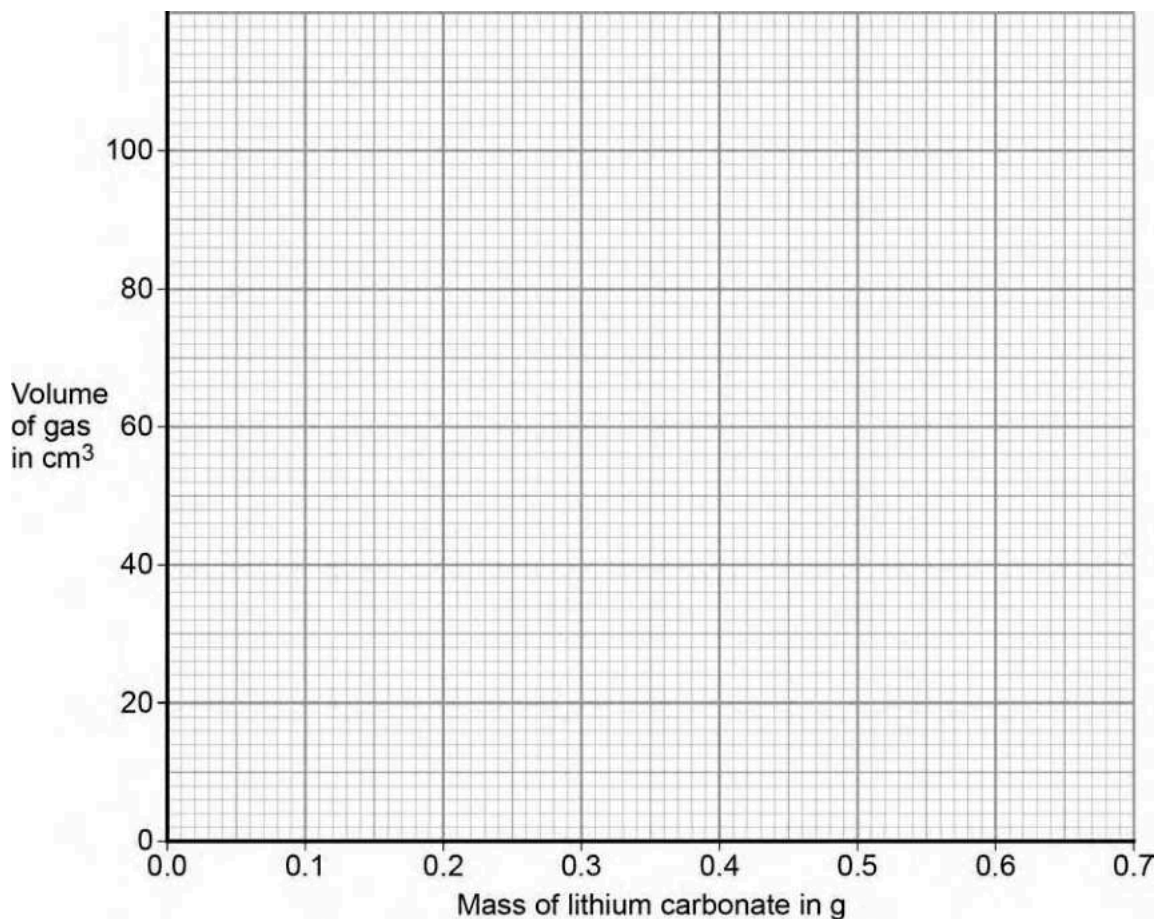
0 3 . 3   What are two possible reasons for the anomalous result?

[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 ☐

The conical flask was too small. ☐

Turn over ▶

0 3 . 4 Describe the pattern the graph shows up to 0.4 g of lithium carbonate added.

[2 marks]

_____

_____

_____

Lithium carbonate decomposes when heated.

The equation shows the decomposition of lithium carbonate.

$Li_2CO_3 (s) \rightarrow Li_2O (s) + CO_2 (g)$
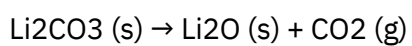
Figure 6 shows the apparatus a student used to decompose lithium carbonate.

Figure 6

Lithium carbonate

Bunsen burner
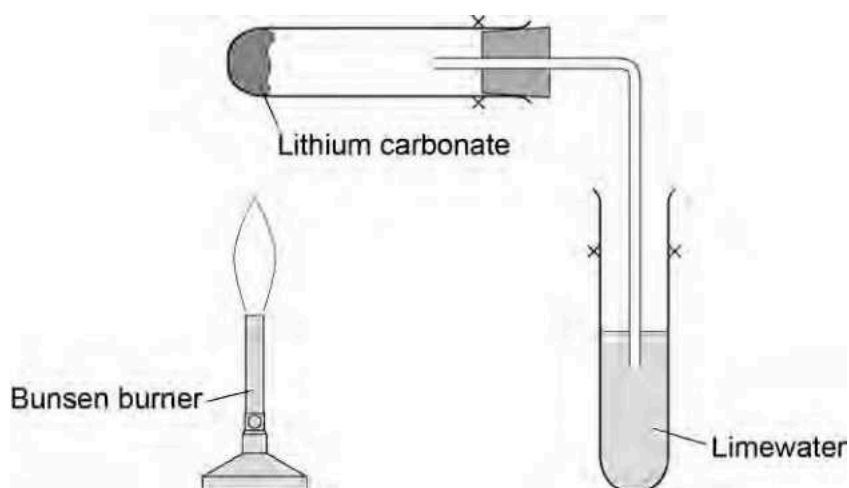
Limewater

0 3 . 5   Why does the limewater bubble?
[1 mark]

0 3 . 6   The student repeated the experiment with potassium carbonate.
The limewater did not bubble.

Suggest why there were bubbles in the limewater.
[1 mark]

Turn over for the next question

0	4

A student investigated the reactivity of different metals.

The student used the apparatus shown in Figure 7.

Figure 7

- Thermometer
- Dilute hydrochloric acid
- Metal powder
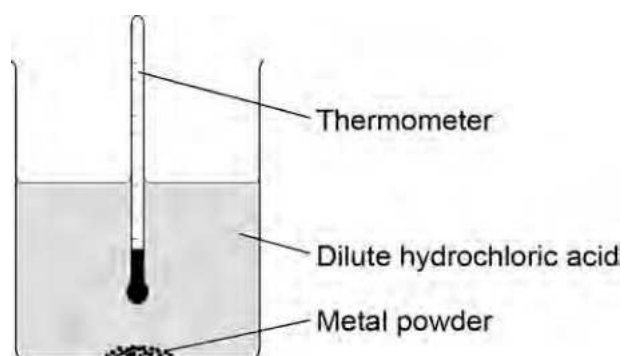
The student used four different metals.

The student measured the temperature rise for each metal three times.

The student's results are shown in Table 3.

Table 3

Metal	Temperature rise in °C Mean temperature rise in °C			
	Test 1	Test 2	Test 3	
Calcium	17.8	16.9	17.5	
Iron	6.2	6.0	6.1	6.1
Magnesium	12.5	4.2	12.3	12.4
Zinc	7.8	8.0	7.6	7.8

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 magnesium 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 temperature rise for calcium.
[1 mark]

Mean temperature rise = _____

_____ $^{\circ}C$

Question 4 continues on the next page

Turn over ▢

0 4 . 4   The temperature rose when the metals were added to sulfuric acid.

Give one other observation that might be made when the metal was added to sulfuric acid.
How would this observation be different for the different metals?

[2 marks]

0 4 . 5   Aluminium is more reactive than iron and zinc but less reactive than calcium and magnesium.

Predict the temperature rise when aluminium is reacted with dilute hydrochloric acid.
[1 mark]

Temperature rise = oC

Turn over for the next question

0 5   Figure 8 shows magnesium burning in air.

Figure 8

0 5 . 1   Look at Figure 8.

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 8 .

[1 mark]

_____

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

What conclusion can you draw from this?

Tick one box.

[1 mark]

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 8   was added to water and shaken.

Universal indicator was added.

The universal indicator turned blue.

What is the pH value of the solution?

Tick one box.

[1 mark]

1	☐
4	☐
7	☐
9	☐

Question 5 continues on the next page

0 5 . 5 Why are nanoparticles effective in very small quantities?

Tick one box. [1 mark]

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 Give one advantage of using nanoparticles in sun creams.

[1 mark]

_____

Give _____

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

[1 mark]

_____

_____

0	5	.	8

A coarse particle has a diameter of 1×10^{-6} m. A nanoparticle has a diameter of 1.6×10^{-9} m.

Calculate how many times bigger the diameter of the coarse particle is than the diameter of the nanoparticle.

[2 marks]

Turn over for the next question

0 6   A student investigated the reaction of copper carbonate with dilute sulfuric acid.

The student used the apparatus shown in Figure 9.

Figure 9
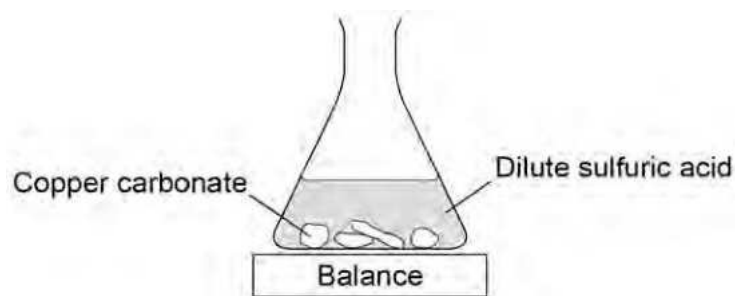
0 6 . 1   Complete the state symbols in the equation.
[2 marks]

$$CuCO_3 (\ldots) + H_2SO_4 (aq) \rightarrow CuSO_4 (aq) + H_2O (\ldots) + CO_2 (g)$$

0 6 . 2   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 . 3 Describe a safe method for making pure crystals of copper sulfate from copper carbonate and dilute sulfuric acid. Use the information in Figure 9 to help you.

In your method you should name all of the apparatus you will use.

[6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Question 6 continues on the next page

| 0 | 6 | . | 4 |

The percentage atom economy for a reaction is calculated using:

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

The equation for the reaction of copper carbonate and sulfuric acid is:

$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$
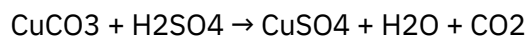
Relative formula masses : $CuCO_3$ = 123.5; H_2SO_4 = 98.0; $CuSO_4$ = 159.5

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

[3 marks]

Atom economy = _____ %

0 6 . 5 Give one reason why is it important for the percentage atom economy of a reaction to be as high as possible.
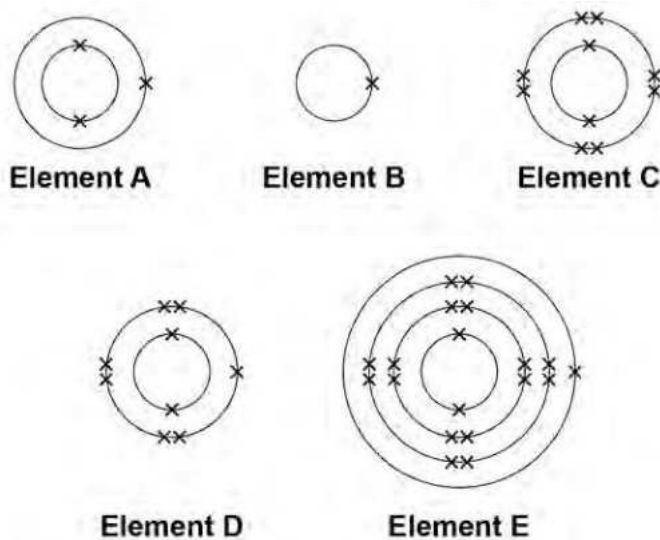
[1 mark]

Turn over for the next question

Turn over ▶

| 0 | 7 | The electronic structure of the atoms of five elements are shown in Figure 10.

The letters are not the symbols of the elements.

Figure 10

Choose the element to answer questions 07.1 to 07.5. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

| 0 | 7 | . | 1 | Which element is hydrogen?

[1 mark]

Tick one box.

A B C ☐   ☐ ☐   ☐ ☐   D ☐   E ☐

| 0 | 7 | . | 2 | Which element is a halogen?

[1 mark]

Tick one box.

A B C ☐   ☐ ☐   ☐ ☐   D ☐   E ☐

| 0 | 7 | . | 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							

| 0 | 7 | . | 4 | Which element exists as single atoms?

[1 mark]

Tick one box.

A	B	C	D							E	

| 0 | 7 | . | 5 | There are two isotopes of element A. Information about the two isotopes is shown in Table 4.

Table 4

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

Use the information in Table 4 to calculate the relative atomic mass of element A. Give your answer to 2 decimal places.

[4 marks]

Relative atomic mass =

| 0 | 8 | An atom of aluminium has the symbol 27 Al

13

| 0 | 8 | . | 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 | 8 | . | 2 | Why is aluminium positioned in Group 3 of the periodic table?

[1 mark]

_____

_____

0 8 . 3 In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in Table 5.

Table 5

|	Transition elements		Group 1 elements	
	Chromium	Iron	Sodium	Caesium
Melting point in°C	1857	1535	98	29
Formula of oxides	CrO Cr_2O_3 CrO_2 CrO_3	FeO Fe_2O_3 Fe_3O_4	Na_2O	Cs_2O

Use your own knowledge and the data in Table 5 to compare the chemical and physical properties of transition elements and Group 1 elements.

[6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Turn over ▶

| 0 | 9 | | 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
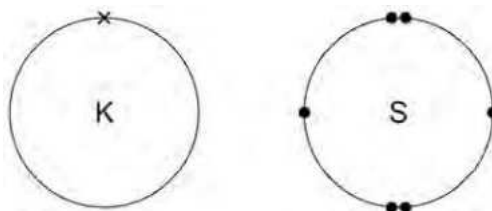
| 0 | 9 | . | 1 | | Potassium forms an ionic compound with sulfur.

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

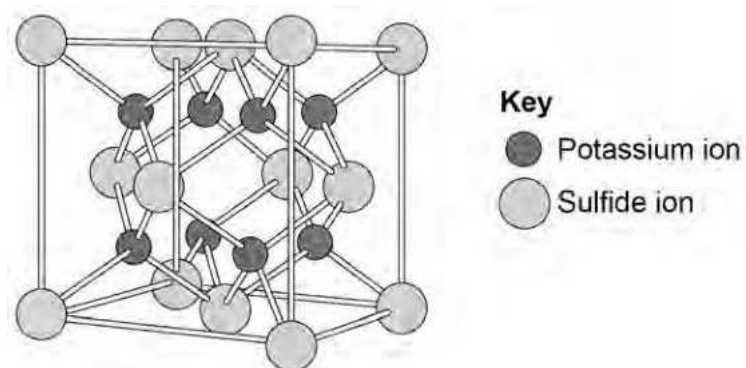Give your answer in terms of electron transfer.

Give the formulae of the ions formed.

[5 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

0 9 . 2 The structure of potassium sulfide can be represented using the ball and stick model in Figure 12

Figure 12

Key
● Potassium ion
○ Sulfide ion

The ball and stick model is not a true representation of the structure of potassium sulfide.

Give one reason why.

[1 mark]

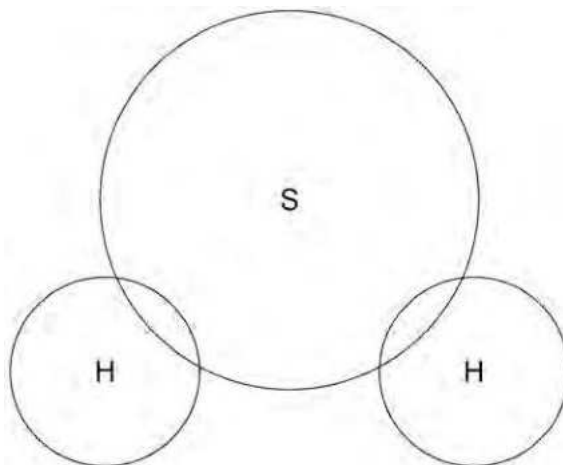Question 9 continues on the next page

Turn over ▶

0 9 . 3 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 9 . 4 Calculate the relative formula mass (*Mr*) of aluminium sulfate Al2(SO4)3

Relative atomic masses (*A* r): oxygen = 16; aluminium = 27; sulfur = 32

[2 marks]

Relative formula mass =

0 9 . 5   Covalent compounds such as hydrogen sulfide have low melting points and donot 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
		There are no charged particles free to move
Low melting point		Ions are free to move
		Weak intermolecular forces of attraction
Does not conduct electricity when molten		Bonds are weak
		Bonds are strong

0 9 . 6   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

High boiling point

Conduct electricity when molten

Explanation of property

Electrons are free to move

There are no charged particles free to move

Ions are free to move

Weak intermolecular forces of attraction

Bonds are weak

Bonds are strong

1 0 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.

1 0 . 1 Suggest one improvement to step 2 to make sure all the salt is dissolved in the water.

[1 mark]

1 0 . 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.
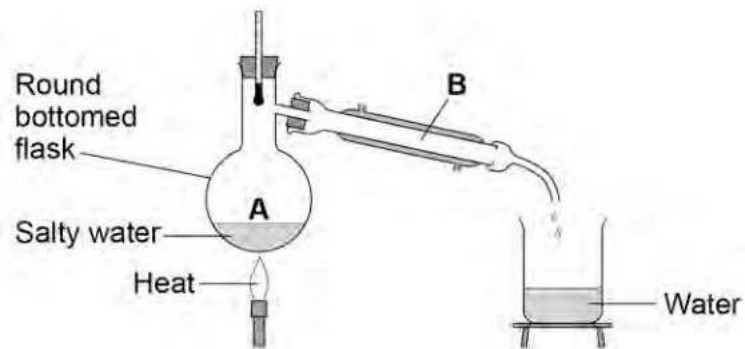
[1 mark]

1 0 . 3 Suggest one safety precaution the students should take in step 5.

[1 mark]

Question 10 continues on the next page

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

Figure 13

1 0 . 4   Describe how this technique works by referring to the processes at A and B.

[2 marks]

_____

_____

_____

_____

1 0 . 5   What is the reading on the thermometer during this process?

[1 mark]

_____ $^{\circ}$C

END OF QUESTIONS

There are no questions printed on this page