SPECIMEN MATERIAL

# GCSE CHEMISTRY

**F**

Foundation Tier Paper 1F

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 _____

**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]**

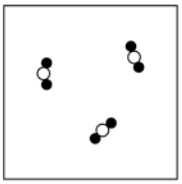
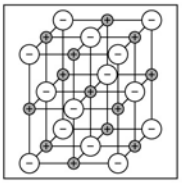
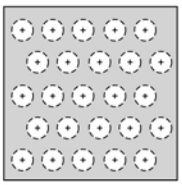
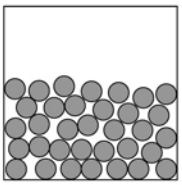
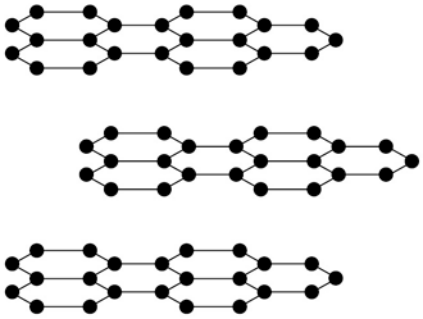
| Statement | Structure |
| --- | --- |
| The substance is a gas |  |
| The substance is a liquid |  |
| The substance is ionic |  |
| The substance is a solid metal |  |
| |  |

**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]**

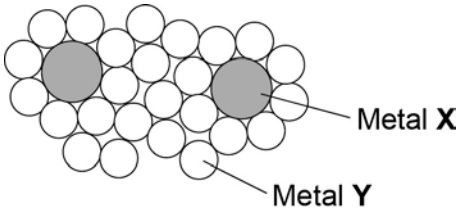
Tick **one** box.

- 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**

**Figure 2** shows the structure of an alloy.

**Figure 2**




**0 1 . 4** Explain why this alloy is harder than the pure metal **Y**.

**[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?

**[1 mark]**

Tick **one** box.

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 $cm^3$ 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.

Draw **one** 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 **one** box.

- 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**

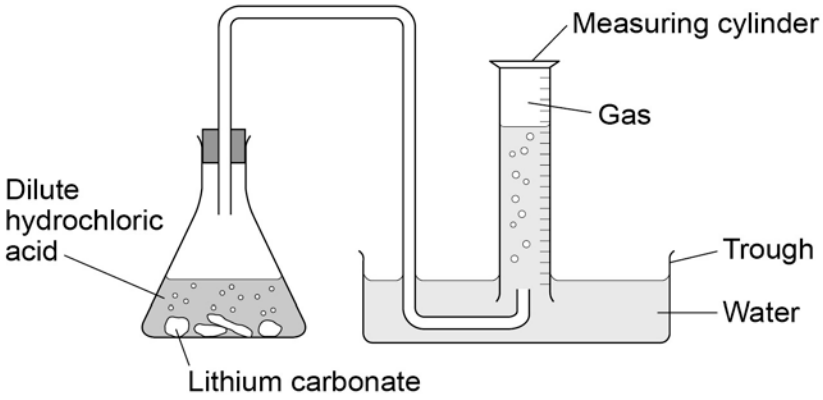
**0 3** Lithium carbonate reacts with dilute hydrochloric acid.

A group of students investigated the volume of gas produced.

This is the method used.

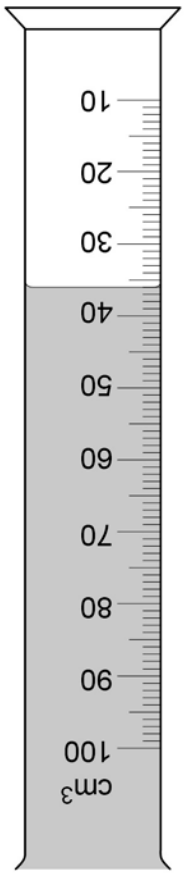
1. Place a known mass of lithium carbonate in a conical flask.
2. Measure 10 $cm^3$ of dilute hydrochloric acid using a measuring cylinder.
3. Pour the acid into the conical flask.
4. Place a bung in the flask and collect the gas as shown in **Figure 3**.

**Figure 3**



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

**Figure 4**




What volume of gas has been collected?

**[1 mark]**

Volume = _____ $cm^3$

**Question 3 continues on the next page**

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

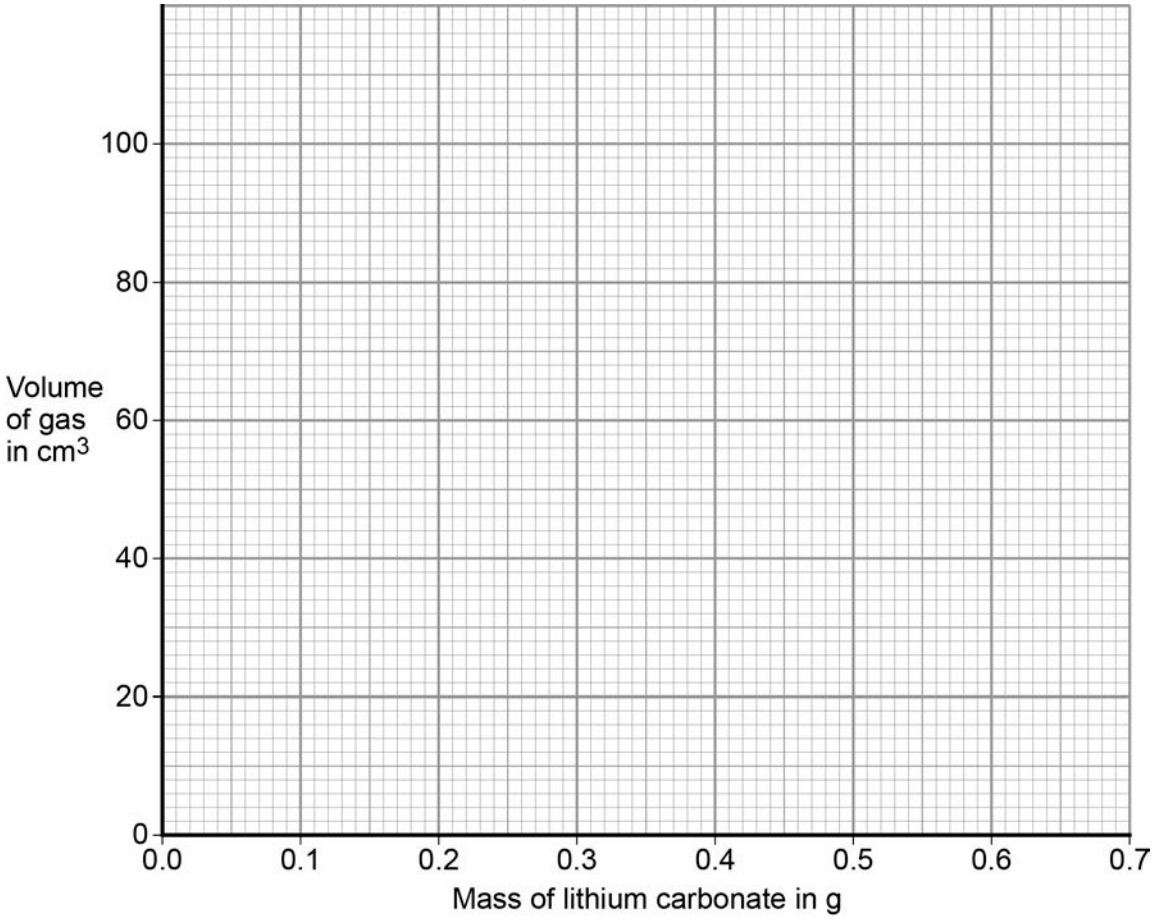
**Table 2**

| Mass of lithium carbonate in g | Volume of gas in $cm^3$ |
|---|---|
| 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. ☐

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

**[2 marks]**

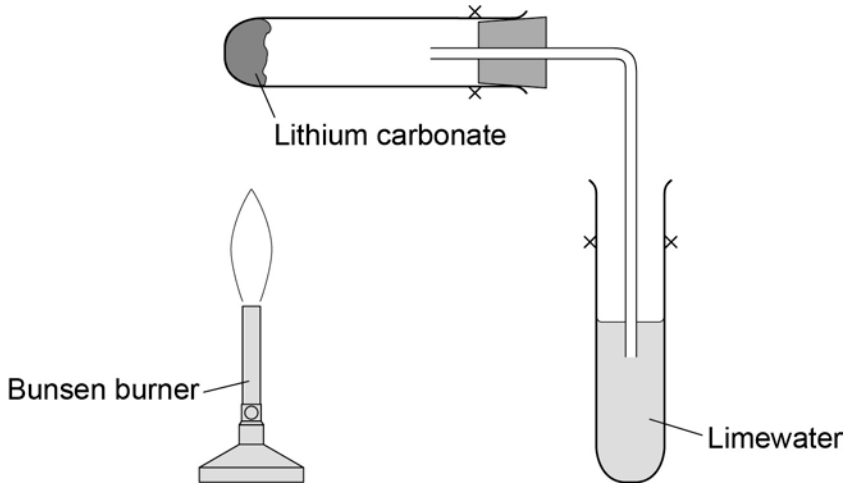
Lithium carbonate decomposes when heated.

The equation shows the decomposition of lithium carbonate.

$Li_2CO_3$ (s) → $Li_2O$ (s) + $CO_2$ (g)

**Figure 6** shows the apparatus a student used to decompose lithium carbonate.

**Figure 6**



**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 **no** bubbles in the limewater.

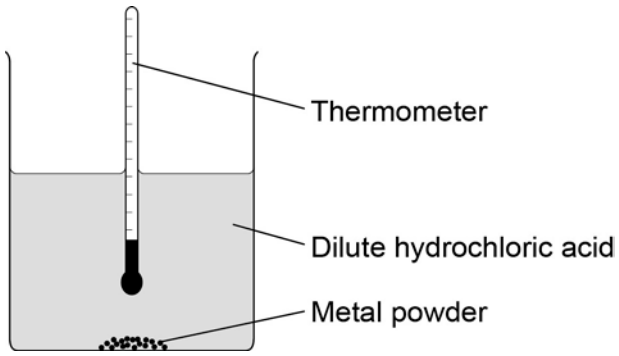
**[1 mark]**

**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**




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 = _____ $^{o}$C

**Question 4 continues on the next page**

**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 = _____ $^{o}C$

**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?

**[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 8** 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 ☐

**Question 5 continues on the next page**

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

**[1 mark]**

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

**[1 mark]**

**0 5 . 8** A coarse particle has a diameter of $1 \times 10^{-6}$ m.
A nanoparticle has a diameter of $1.6 \times 10^{-9}$ m.

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

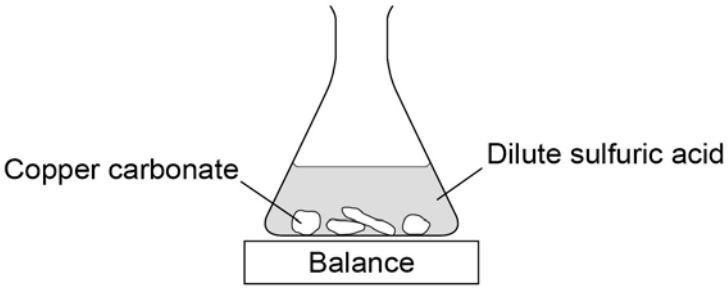
**[2 marks]**

**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]**

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

**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:

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

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.

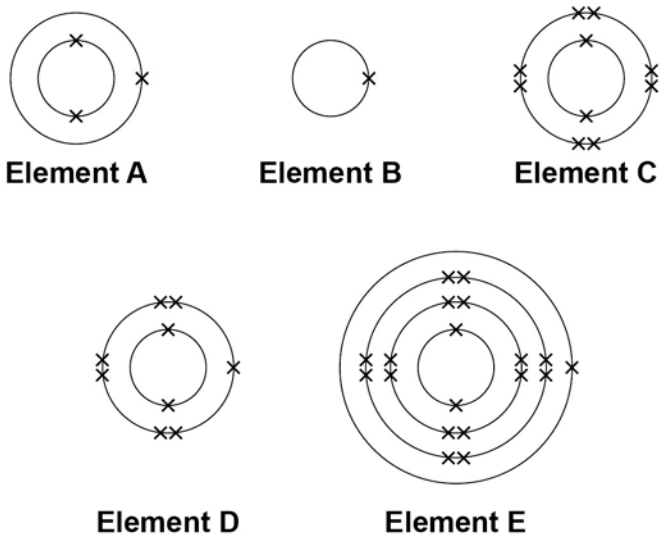
**[1 mark]**

**Turn over for the next question**

**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 $^{27}_{13}Al$

**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**

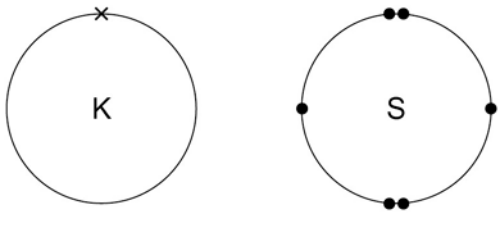
| | **Transition elements** | | **Group 1 elements** | |
|---|---|---|---|---|
| | Chromium | Iron | Sodium | Caesium |
| **Melting point in°C** | 1857 | 1535 | 98 | 29 |
| **Formula of oxides** | CrO<br>$Cr_2O_3$<br>$CrO_2$<br>$CrO_3$ | FeO<br>$Fe_2O_3$<br>$Fe_3O_4$ | $Na_2O$ | $Cs_2O$ |

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]**

**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.

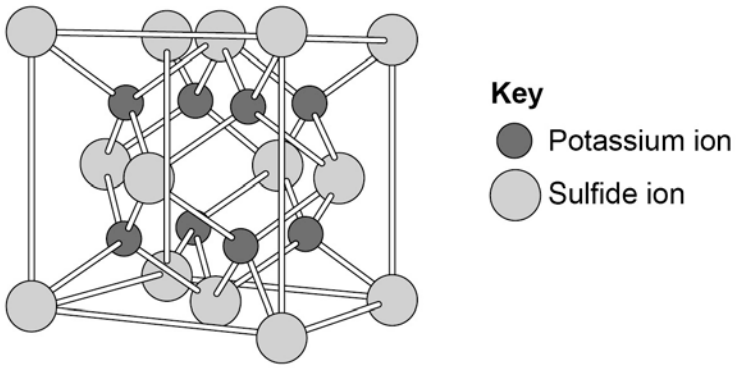
Give your answer in terms of electron transfer.

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**




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

Give **one** reason why.

**[1 mark]**

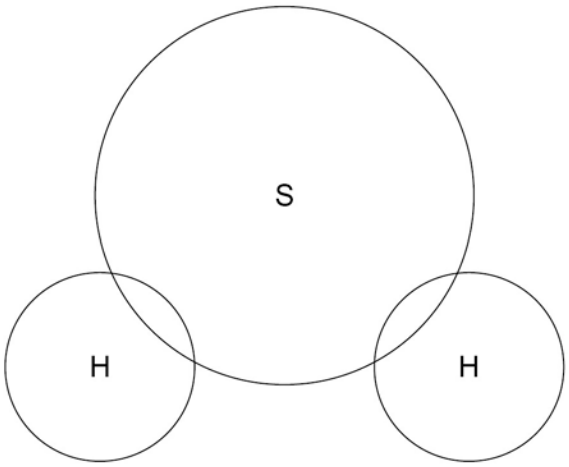
**Question 9 continues on the next page**

**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 ($M_r$) of aluminium sulfate $Al_2(SO_4)_3$

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 do **not** conduct electricity when molten.

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

**[2 marks]**

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

Electrons are free to move

Ions are free to move

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

**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 $cm^3$ 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]**

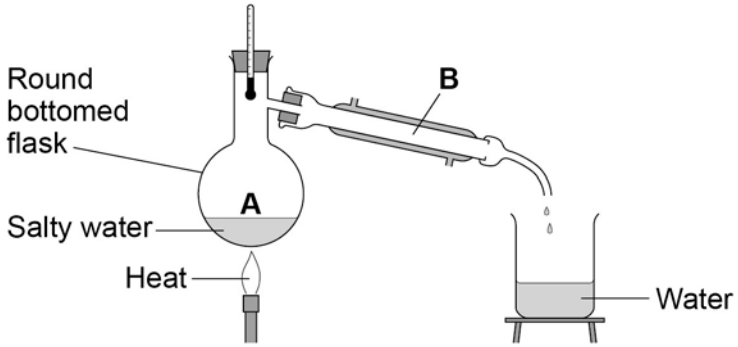
**1 0 . 3** Suggest **one** safety precaution the students should take in step 5.

**[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]**

_____ $^{o}C$

**END OF QUESTIONS**

**There are no questions printed on this page**