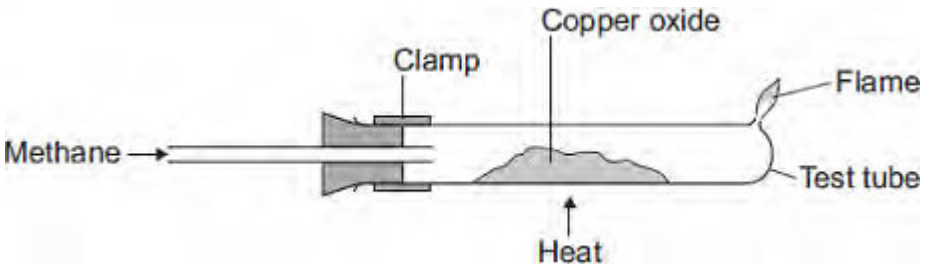
Q1. This apparatus is used for the reaction of copper oxide (CuO) with methane (CH_4).



(a) The symbol equation for this reaction is shown below.

$$4\ CuO(s) + CH_4(g) \longrightarrow 4\ Cu(s) + 2\ H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escape from the test tube.

Use information from the equation to explain why.

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(1)

(b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16, Cu = 64

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Relative formula mass (M_r) = ...

(2)

(ii) Calculate the percentage of copper in copper oxide.

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Percentage of copper = ... %

(2)

(iii) Calculate the maximum mass of copper that could be produced from 4.0 g of copper oxide.

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.....

Mass of copper produced = ... g

(1)

(c) The experiment was done three times.

The mass of copper oxide used and the mass of copper produced were measured each time.

The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper produced in g	3.3	3.5	3.2

(i) Calculate the mean mass of copper produced in these experiments.

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Mean mass of copper produced = ... g

(1)

(ii) Suggest how the results of the experiment could be made more precise.

.....

.....

(1)

(iii) The three experiments gave different results for the amount of copper produced.

This was caused by experimental error.

Suggest two causes of experimental error in these experiments.

1 .....

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2 .....

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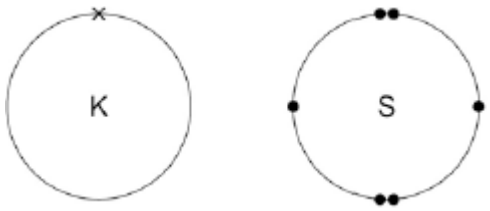
(2)

(Total 10 marks)

Q2.Figure 1 shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

Figure 1



(a) 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.

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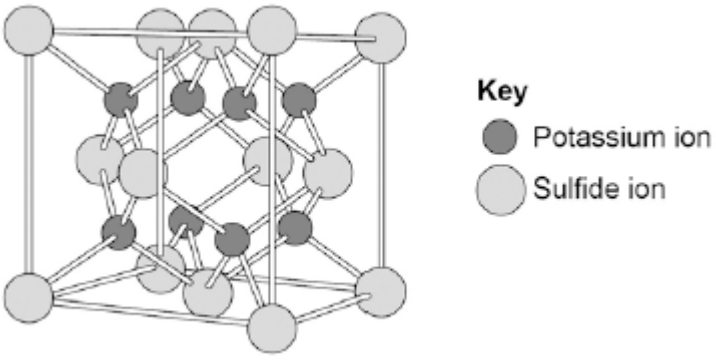
(5)

(b) The structure of potassium sulfide can be represented using the ball and stick model in **Figure 2**.

Figure 2



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

Give **one** reason why.

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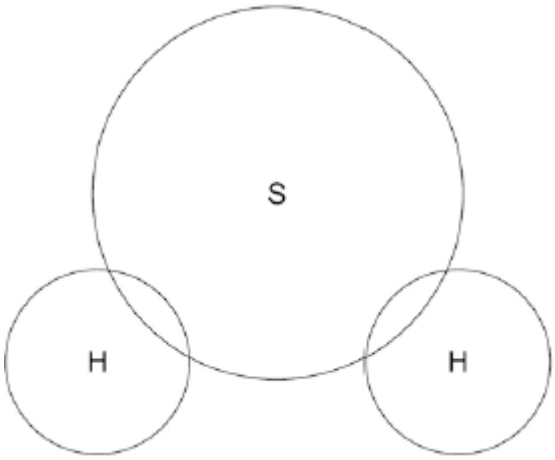
(1)

(c) 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)

(d) 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

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Relative formula mass = ...

(2)

(e) 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.

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

(2)

(f) 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.

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

(2)
(Total 14 marks)

Q3. Some students investigated magnesium oxide.

(a) Magnesium oxide has the formula MgO.

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

Relative atomic masses: O = 16; Mg = 24.

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Relative formula mass = ...

(2)

(ii) Calculate the percentage by mass of magnesium in magnesium oxide.

.....

.....

Percentage by mass of magnesium in magnesium oxide = ...%

(2)

(iii) Calculate the mass of magnesium needed to make 25 g of magnesium oxide.

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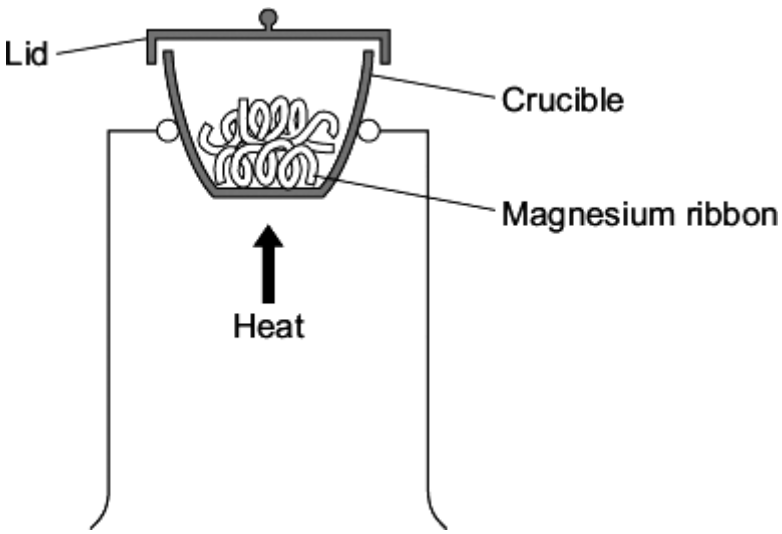
Mass of magnesium = ... g

(1)

(b) The students calculated that if they used 0.12 g of magnesium they should make 0.20 g of magnesium oxide.

They did this experiment to find out if this was correct.



- The students weighed 0.12 g of magnesium ribbon into a crucible.
- They heated the magnesium ribbon.
- They lifted the lid of the crucible slightly from time to time to allow air into the crucible.
- The students tried to avoid lifting the lid too much in case some of the magnesium oxide escaped.
- When all of the magnesium appeared to have reacted, the students weighed the magnesium oxide produced.

The results of the experiment are shown below.

Mass of magnesium used in grams	0.12
Mass of magnesium oxide produced in grams	0.18

(i) The mass of magnesium oxide produced was lower than the students had calculated. They thought that this was caused by experimental error.

Suggest **two** experimental errors that the students had made.

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(2)

(ii) The students only did the experiment once.

Give **two** reasons why they should have repeated the experiment.

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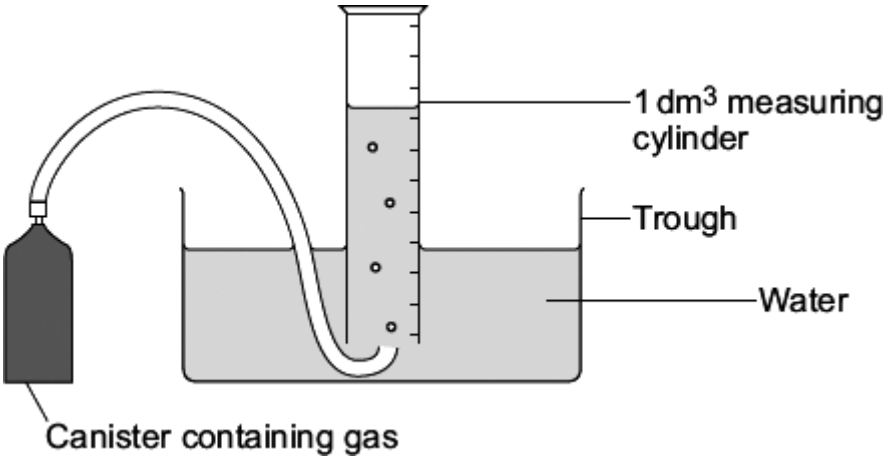
(2)
(Total 9 marks)

Q4. Some students did an experiment to find the relative formula mass (M_r) of a gas.



This is the method they used.

- The mass of the canister of gas was measured using a balance, which weighed to two decimal places.
- The measuring cylinder was filled with 1 dm^3 of the gas from the canister.
- The mass of the canister of gas was measured again.
- The temperature of the laboratory was measured.
- The air pressure in the laboratory was measured.

The students repeated the experiment three times.

(a) The results for one of the experiments are shown in the table below.

Mass of the canister of gas before filling the measuring cylinder	53.07 g
Mass of the canister of gas after filling the measuring cylinder	51.21 g

Calculate the mass of the 1 dm^3 of gas in the measuring cylinder.

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Mass = ... g

(1)

(b) How could the results be made more precise?

.....

.....

(1)

(c) The students used their results to calculate values for the relative formula mass (M_r) of this gas.
The results are shown in the table below.

Experiment	**1**	**2**	**3**	**4**
Relative formula mass (*M*$_r$)	45.4	51.5	46.3	45.8

(i) Calculate the mean value for these results.

.....

Mean = ...

(2)

(ii) The four results are different.
The students thought this was because of experimental error.

Suggest **two** causes of experimental error in this experiment.

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(2)

(iii) It was important for the students to repeat the experiment.
Suggest why.

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(1)

(d) The teacher told the students that the formula of the gas is C_3H_8

Calculate the relative formula mass (M_r) of this gas. You should show your working.

Relative atomic masses: H = 1; C = 12.

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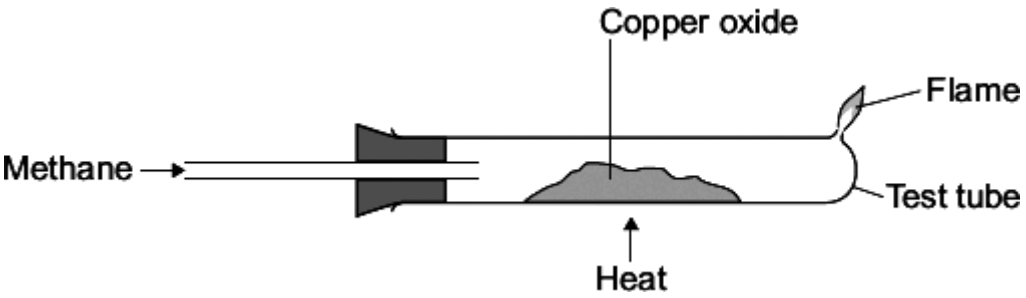
Relative formula mass = ...

(2)
(Total 9 marks)

Q5. An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



(a) The equation for this reaction is shown below.

$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

.....

(1)

(b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

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.....

Relative formula mass (M_r) = ...

(2)

(ii) Calculate the percentage of copper in copper oxide.

.....

.....

.....

Percentage of copper = ... %

(2)

(iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

.....

.....

Mass of copper = ... g

(1)

(c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

(i) Calculate the mean mass of copper made in these experiments.

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Mean mass of copper made = ... g

(1)

(ii) Suggest how the results of these experiments could be made more precise.

.....

.....

(1)

(iii) The three experiments gave slightly different results for the mass of copper made. This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 .....

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2 .....

.....

(2)

(Total 10 marks)

Q6. (a) The table gives information about two isotopes of hydrogen, hydrogen-1 and hydrogen-2.

	Hydrogen-1	**Hydrogen-2**
Atomic number	1	1
Mass number	1	2

An atom of hydrogen-1 is represented as: $^{1}_{1}\mathrm{H}$

Show how an atom of hydrogen-2 is represented.

(1)

(b) (i) Calculate the relative formula mass (M_r) of water, H_2O

Relative atomic masses: H = 1; O = 16.

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Relative formula mass (M_r) = ...

(1)

(ii) Simple molecules like water have low boiling points.

Explain why, in terms of molecules.

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(2)

(c) Molecules of heavy water contain two atoms of hydrogen-2 instead of two atoms of hydrogen-1.

Explain why a molecule of heavy water has more mass than a normal water molecule.
You should refer to the particles in the nucleus of the two different hydrogen atoms in your answer.

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(2)
(Total 6 marks)