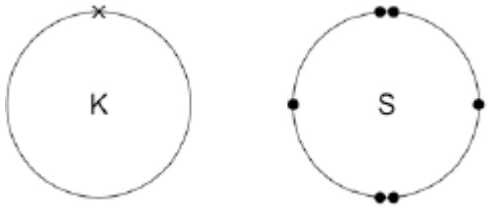
Q1.Figure 1 shows the outer electrons in an atom of the Group 1 element potassium and in an atom of the Group 6 element sulfur.

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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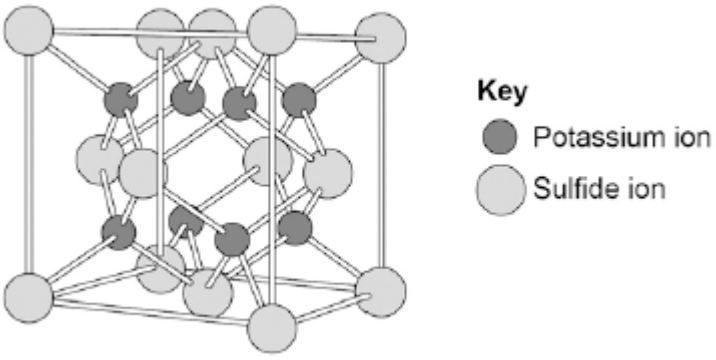
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(5)

(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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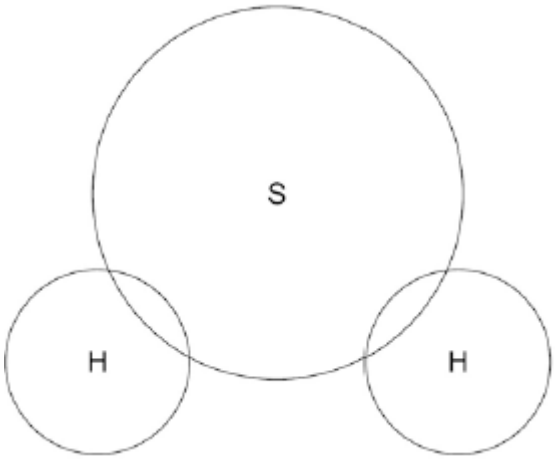
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(1)

(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.

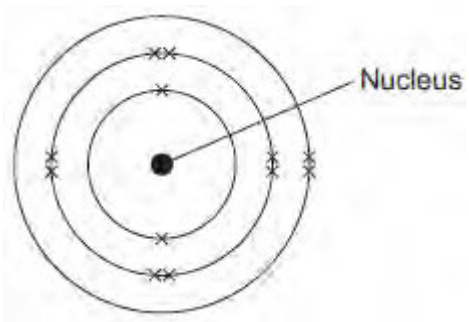
Draw **one** line from each property to the explanation of the property.

Property	**Explanation of property**
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

(2)
(Total 14 marks)

Q2. This question is about magnesium.

(a) (i) The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	**neutrons**	**protons**	**shells**

The nucleus contains protons and .....

The particles with the smallest relative mass that move around the nucleus are called .....

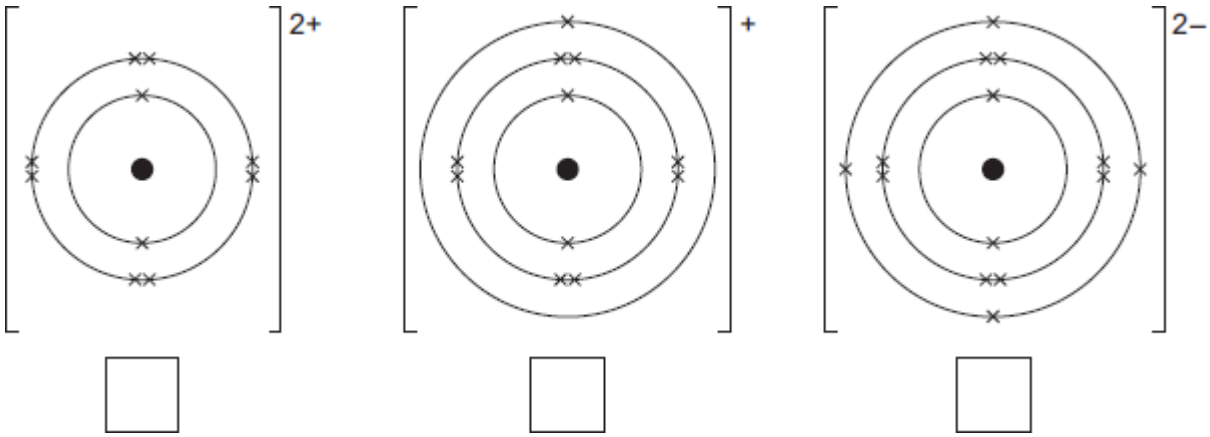
Atoms of magnesium are neutral because they contain the same number of electrons and .....

(3)

(ii) A magnesium atom reacts to produce a magnesium ion.

Which diagram shows a magnesium ion?

Tick (✓) **one** box.



(1)

(b) Magnesium and dilute hydrochloric acid react to produce magnesium chloride solution and hydrogen.

$$Mg(s) + 2\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

(i) State **two** observations that could be made during the reaction.

1 .....

.....

2 .....

.....

(2)

(ii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe a method for making pure crystals of magnesium chloride from magnesium and dilute hydrochloric acid.

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

You do **not** need to mention safety.

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(6)
(Total 12 marks)

Q3. This question is about metals and alloys.

(a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

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(4)

(b) Describe how the structure of an alloy is different from the structure of a pure metal.

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(2)

(c) Alloys are used to make dental braces and coins.

(i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

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(1)

(ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

.....

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(1)

(iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

Aluminium is manufactured by the electrolysis of a molten mixture of cryolite and

.....

(1)

(iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

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(1)

(d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

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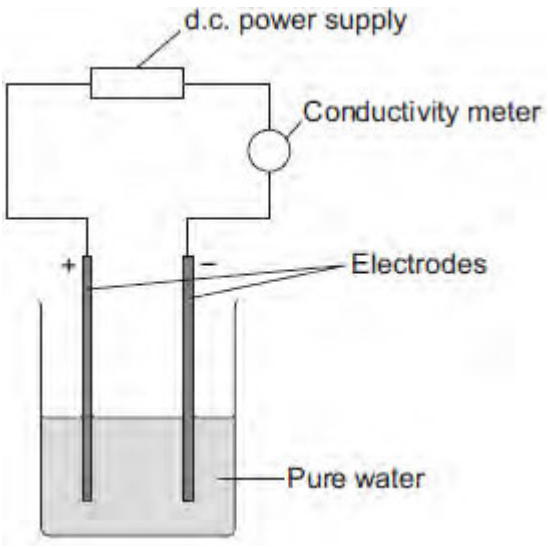
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(1)
(Total 11 marks)

Q4.A student investigated the conductivity of different concentrations of sodium chloride solution.
The student set the apparatus up as shown in **Figure 1**.

Figure 1



The student measured the conductivity of the pure water with a conductivity meter.

The reading on the conductivity meter was zero.

(a) The student:

- added sodium chloride solution one drop at a time
- stirred the solution
- recorded the reading on the conductivity meter.

The student's results are shown in the table below.

Number of drops of sodium chloride solution added	**Relative conductivity of solution**
0	0
1	100
2	120
3	310
4	400
5	510

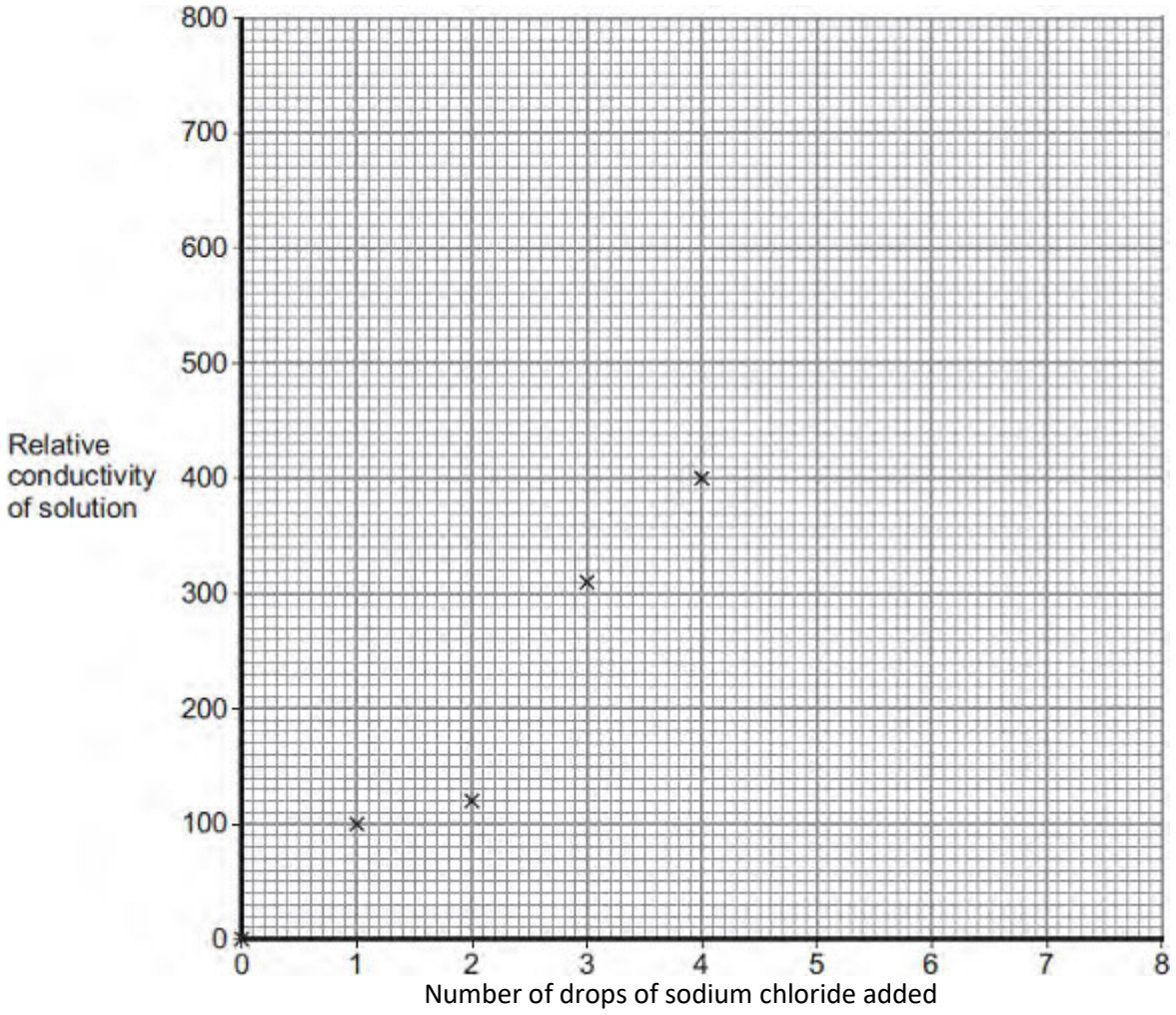
6	590
7	710
8	800

(i) The student plotted the results on the grid shown in **Figure 2**.

Plot the four remaining results.

Draw a line of best fit, ignoring the anomalous result.

Figure 2



(3)

(ii) One of the points is anomalous.

Suggest **one** error that the student may have made to cause the anomalous result.

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(1)

(iii) The student wanted to compare the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable he should keep constant when measuring the conductivity of the two solutions.

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(1)

(b) (i) Explain, in terms of bonding, why pure water does **not** conduct electricity.

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(2)

(ii) Explain why sodium chloride solution conducts electricity.

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(2)

(iii) After he had added sodium chloride solution, the student noticed bubbles of gas at the negative electrode.

Complete the sentence.

The gas produced at the negative electrode is .....

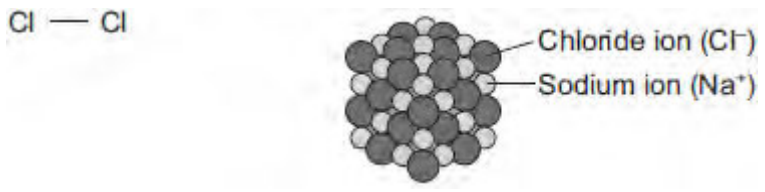
(1)

(Total 10 marks)

Q5.In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

Explain why chlorine (Cl_2) is a gas at room temperature, but sodium chloride (NaCl) is a solid at room temperature.

Chlorine **Sodium chloride**



Include a description of the bonding and structure of chlorine and sodium chloride in your answer.

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Extra space .....

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(Total 6 marks)