

Name:

Date:

C2 - Test 3  
BONDING  
Intermediate

**GCSE**

**CHEMISTRY**

**AQA - Triple Science**

Mark

Grade

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### Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

### Instructions

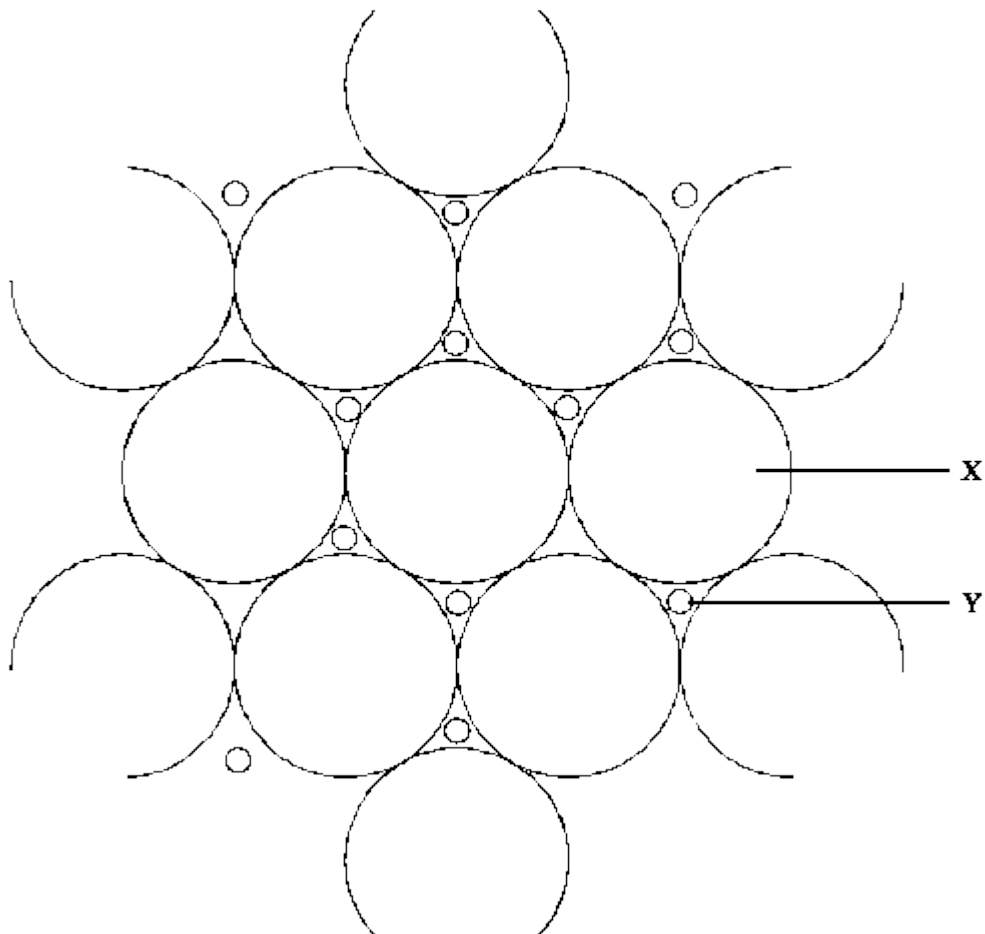
- Answer all questions
- Answer questions in the space provided
- All working must be shown

### Information

- The marks for the questions are shown in brackets

1.

The diagram shows a model of part of the giant lattice of a metal.



(a) Name particles **X** and **Y**.

**X** \_\_\_\_\_

**Y** \_\_\_\_\_

(2)

(b) Explain, in terms of the giant structure above, why is it possible to bend a piece of metal.

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(2)

(Total 4 marks)

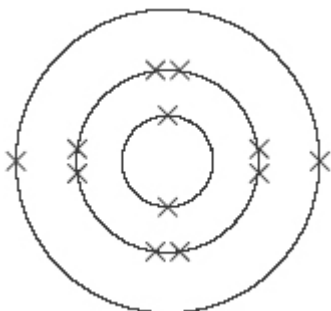
2.

(a) Write a balanced symbol equation for the reaction between magnesium (Mg) and oxygen (O<sub>2</sub>) to form magnesium oxide (MgO).

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(1)

- (b) The diagram shows the electronic structure of a magnesium atom.  
The atomic (proton) number of magnesium is 12.



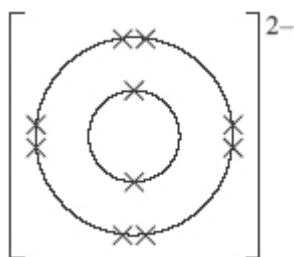
**Magnesium atom**

Draw a similar diagram to show the electronic structure of an oxygen atom.  
The atomic (proton) number of oxygen is 8.

(1)

- (c) Magnesium ions and oxide ions are formed when magnesium reacts with oxygen.

The diagram shows the electronic structure of an oxide ion.



**Oxide ion**

Draw a similar diagram to show the electronic structure of a magnesium ion.

(1)

(d) Magnesium oxide is a white solid with a high melting point.

Explain how the ions are held together in solid magnesium oxide.

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(2)

(e) Indigestion tablets can be made from magnesium oxide. The magnesium oxide neutralises some of the hydrochloric acid in the stomach.

Complete the word equation for the reaction between magnesium oxide and hydrochloric acid.

hydrochloric acid + magnesium oxide → \_\_\_\_\_ + water.

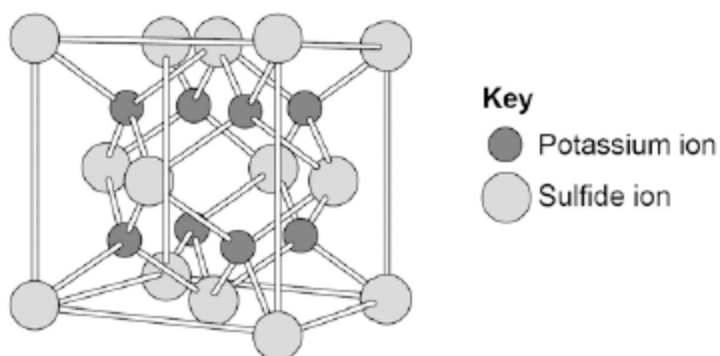
(1)

(Total 6 marks)



- (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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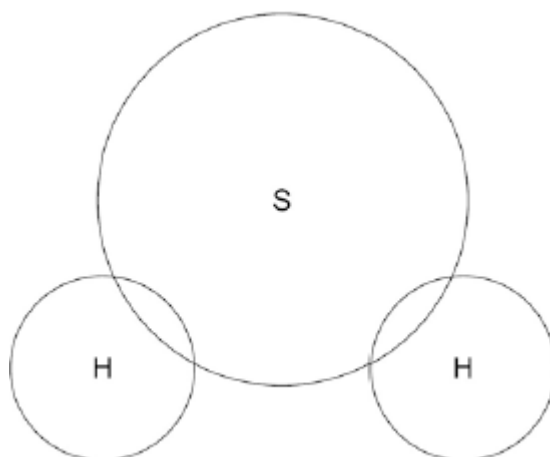
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(1)

- (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  $\text{Al}_2(\text{SO}_4)_3$

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
Low melting point	Electrons are free to move
	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

(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	Electrons are free to move
	There are no charged particles free to move
	Ions are free to move
Conduct electricity when molten	Weak intermolecular forces of attraction
	Bonds are weak
	Bonds are strong

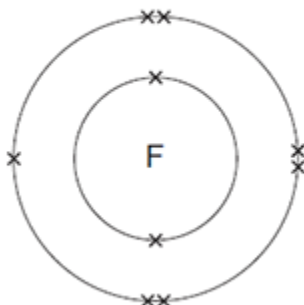
(2)  
(Total 14 marks)

4.

This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

**Figure 1**



(i) In which group of the periodic table is fluorine?

Group \_\_\_\_\_

(1)

(ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

(iii) Use the correct answer from the box to complete the sentence.

<b>alkalis</b>	<b>alloys</b>	<b>isotopes</b>
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Atoms of fluorine with different numbers of neutrons are called \_\_\_\_\_ .

(1)

(b) Sodium reacts with fluorine to produce sodium fluoride.

(i) Complete the word equation for this reaction.

sodium + \_\_\_\_\_ → \_\_\_\_\_

(1)

(ii) Complete the sentence.

Substances in which atoms of two or more different elements are chemically combined are called \_\_\_\_\_ .

(1)

(iii) The relative formula mass ( $M_r$ ) of sodium fluoride is 42.

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

<b>ion</b>	<b>mole</b>	<b>molecule</b>
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The relative formula mass ( $M_r$ ), in grams, of sodium fluoride is one \_\_\_\_\_ of the substance.

(1)

- (iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

**Figure 2**



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

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(4)

(v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✓) **two** boxes.

Dissolve in water

Gas at room temperature

High melting point

Low boiling point

(2)

(Total 13 marks)

5.

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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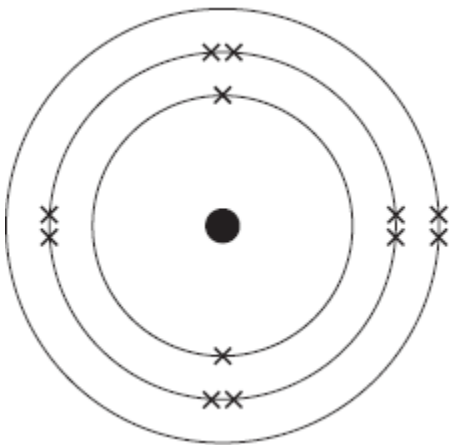
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(1)

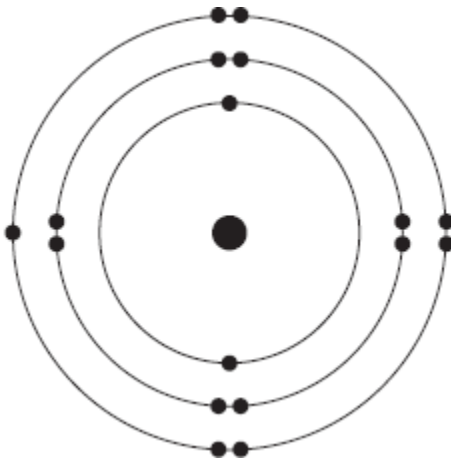
(Total 11 marks)

6.

(a) The diagram shows an atom of magnesium and an atom of chlorine.



Magnesium



Chlorine

Describe, in terms of electrons, how magnesium atoms and chlorine atoms change into ions to produce magnesium chloride ( $\text{MgCl}_2$ ).

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(4)

(b) Calculate the relative formula mass ( $M_r$ ) of magnesium chloride ( $\text{MgCl}_2$ ).

Relative atomic masses ( $A_r$ ): magnesium = 24; chlorine = 35.5

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Relative formula mass ( $M_r$ ) = \_\_\_\_\_

(2)

(Total 6 marks)

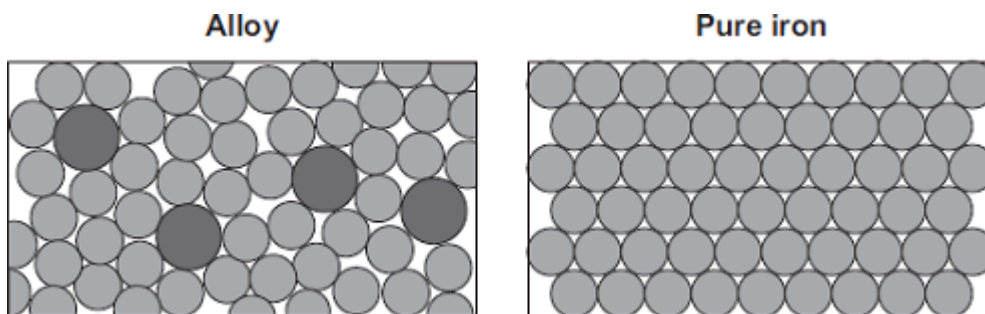
**7.** Oil rigs are used to drill for crude oil.



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(a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.



Use the diagrams to explain why the alloy is harder than pure iron.

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(2)



(b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

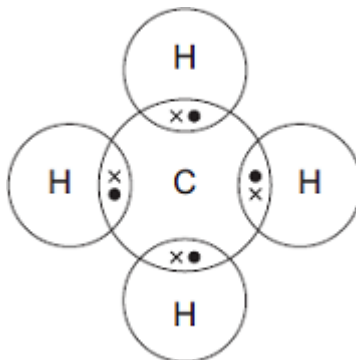
Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2)

(c) Methane gas is often found where crude oil is found.

The diagram shows how atoms bond in methane.

Only the outer electrons are shown.



(i) Draw a ring around the correct answer to complete the sentence.

Methane is

a compound.

an element.

a mixture.

(1)

(ii) Draw a ring around the correct answer to complete each sentence.

The formula of methane is

$C_4H_4$

$C_4H$

$CH_4$

(1)

(iii) Name the type of bond between the carbon and hydrogen atoms in methane.

\_\_\_\_\_

(1)

(d) Explain why methane is a gas at 20°C.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 9 marks)

8.

Calamine lotion is used to treat itching. The main ingredients are two metal oxides.



(a) One of the metal oxides has a relative formula mass ( $M_r$ ) of 81.

The formula of this metal oxide is MO.

(M is **not** the correct symbol for the metal.)

The relative atomic mass ( $A_r$ ) of oxygen is 16.

(i) Calculate the relative atomic mass ( $A_r$ ) of metal M.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Relative atomic mass ( $A_r$ ) = \_\_\_\_\_

(2)

- (ii) Use your answer to part (a)(i) and the periodic table on the Data Sheet to name metal M.

The name of metal M is \_\_\_\_\_ .

(1)

- (b) The other metal oxide is iron(III) oxide.

This contains iron(III) ions ( $\text{Fe}^{3+}$ ) and oxide ions ( $\text{O}^{2-}$ ).

- (i) Explain in terms of electrons how an iron atom (Fe) can change into an iron(III) ion ( $\text{Fe}^{3+}$ ).

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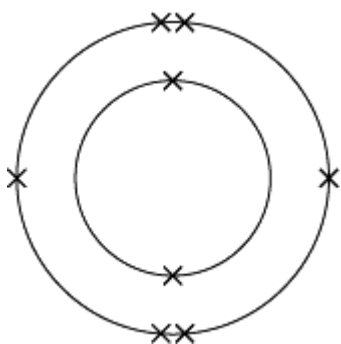
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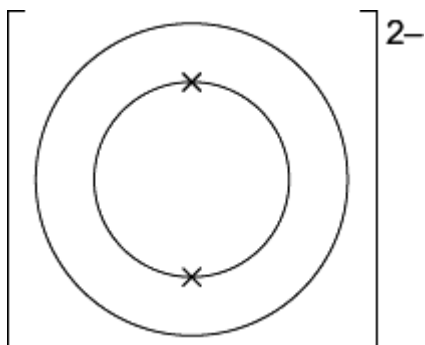
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(2)

- (ii) The diagram below represents the electronic structure of an oxygen atom (O).



Complete the diagram below to show the electronic structure of an oxide ion ( $\text{O}^{2-}$ ).



(1)

(Total 6 marks)