



## New Document 1

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

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Time: **36 minutes**

Marks: **36 marks**

Comments:

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**Q1.**

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.

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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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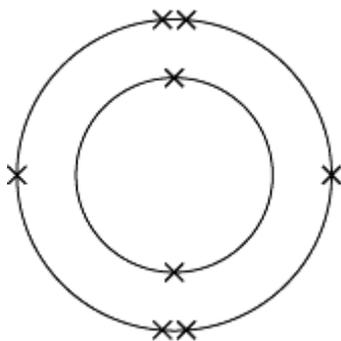
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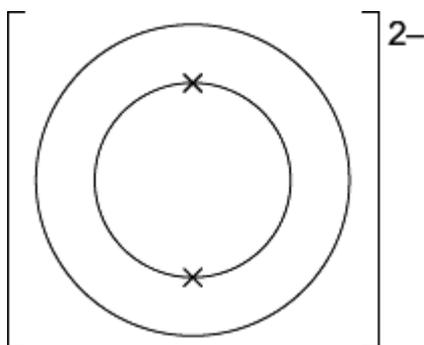
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(2)

(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 ( $O^{2-}$ ).



(1)

(Total 6 marks)

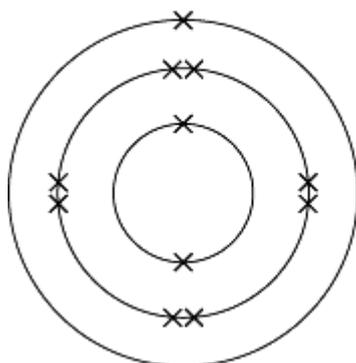
## Q2.

Sodium chloride is a raw material.

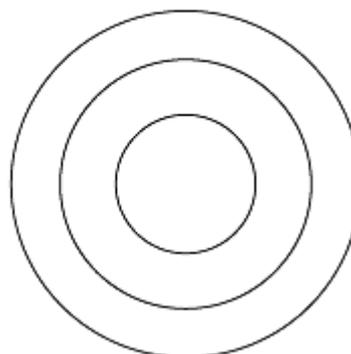
(a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

**Sodium atom**



**Chlorine atom**



(1)

(b) When sodium and chlorine react to form sodium chloride they form sodium ions ( $Na^+$ ) and chloride ions ( $Cl^-$ ).

How does a sodium atom change into a sodium ion?

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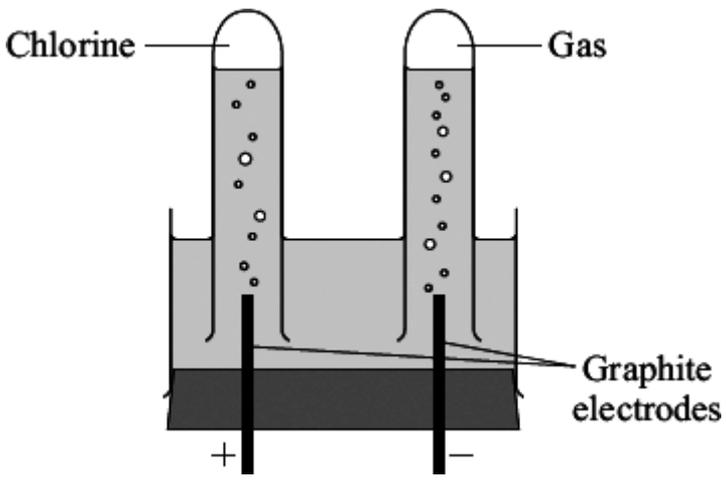
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(2)

(c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions ( $\text{Na}^+$ ), chloride ions ( $\text{Cl}^-$ ), hydrogen ions ( $\text{H}^+$ ) and hydroxide ions ( $\text{OH}^-$ ).

(i) Why do chloride ions move to the positive electrode?

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(1)

(ii) Name the gas formed at the negative electrode.

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(1)

(d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

Local people have been protesting outside a paper factory. They say:  
'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'

The company replied:  
'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

(i) Why are some local people worried about the use of chlorine compounds?

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(1)

- (ii) Why might other local people want the company to continue to use chlorine compounds?

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(1)

- (iii) It is decided to have an inquiry.  
Why should this be done by independent scientists?

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(1)

(Total 8 marks)

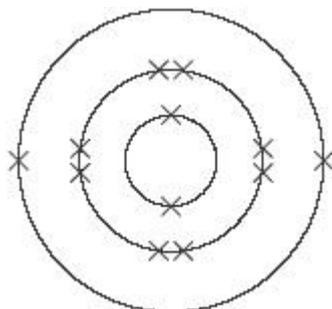
**Q3.**

- (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.



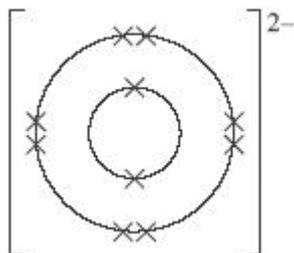
**Magnesium atom**

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.

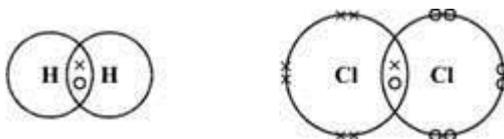
(1)

(Total 6 marks)

#### Q4.

Hydrogen chloride (HCl) can be made by the reaction of hydrogen (H<sub>2</sub>) with chlorine (Cl<sub>2</sub>).

- (a) The diagrams represent molecules of hydrogen and chlorine.



Draw a similar diagram to represent a molecule of hydrogen chloride (HCl). You need show only the outer energy level (shell) electrons.

(1)

- (b) The word equation for the reaction of hydrogen with chlorine is shown below.



Write a balanced symbol equation for this reaction.

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(2)

- (c) Hydrogen chloride gas reacts with magnesium to form the ionic compound called magnesium chloride. Use the table of ions on the Data Sheet to help you to write the formula of magnesium chloride.

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(1)

- (d) Why does magnesium chloride have a much higher melting point than hydrogen chloride?

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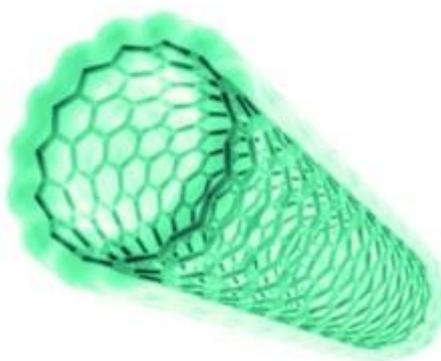
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(2)

(Total 6 marks)

### Q5.

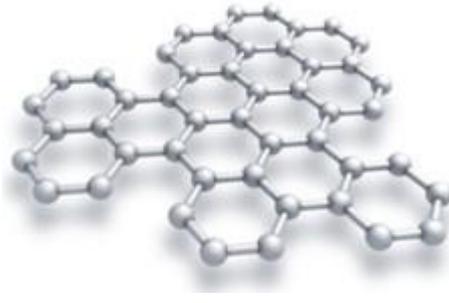
Carbon atoms are used to make nanotubes.



© Denis Nikolenko/Hemera/Thinkstock

Carbon atoms in a nanotube are bonded like a single layer of graphite.

The figure below shows the structure of a single layer of graphite.



© Evgeny Sergeev/iStock/Thinkstock

- (a) Suggest why carbon nanotubes are used as lubricants.

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(2)

- (b) Explain why graphite can conduct electricity.

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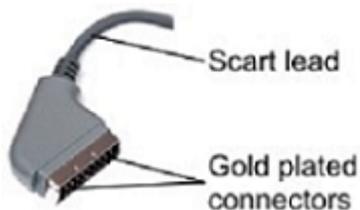
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(2)

(Total 4 marks)

### Q6.

High quality connectors are used to connect a satellite box to a television. The connectors should conduct electricity very well and should not corrode.



By Alphathon (Own work) [CC-BY-SA-3.0 or GFDL], via Wikimedia Commons

The connectors on this scart lead are coated with gold.

- (a) Gold is a typical metal.
- (i) Describe the structure and bonding of gold.

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**(3)**

(ii) Why is gold a good conductor of electricity?

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**(1)**

(b) The surface of some metals, such as iron, corrode when exposed to the air.

Suggest why this reduces the electrical conductivity of the metal.

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**(2)**

**(Total 6 marks)**

## Mark schemes

### Q1.

(a) (i) 65

*correct answer with or without working = 2 marks*  
*if answer incorrect*  
*evidence of (81 - 16) for 1 mark*  
*ignore units*

2

(ii) zinc

*accept error carried forward from (a)(i)*  
*allow correct symbol*  
*answer given should be element / metal closest to their answer*  
*do **not** allow compounds*

1

(b) (i) • it loses electrons  
*sharing / covalency = max 1 mark*

1

• three electrons

1

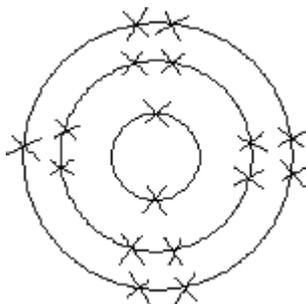
(ii) 8 electrons shown in second shell.

*accept dots / crosses / mixture of dots and crosses / e*  
*electrons do not need to be paired*  
*do **not** allow extra electrons in first shell*

1

[6]

### Q2.



(a)

*accept dots / crosses / e*  
*must be drawn on diagram*  
*electrons do not need to be paired*  
*ignore brackets or + or -charges*  
*ignore 2,8,7*

1

(b) (one) electron

*recognition that electrons are involved*

1

lost / given away / transferred from sodium / transferred to chlorine owtte  
*must be linked to electrons*  
*accept loses electron(s) for 2 marks*  
*NB loses 2 or more electrons gains 1 mark*  
*reference to sharing / covalent max 1 mark*  
*ignore charges on ions formed*

1

(c) (i) any **one** from:

- ions / atoms / they are / it is negatively charged / anions  
*accept they are negative*
- opposite (charges) attract  
*accept they are attracted or it is oppositely charged*  
*ignore opposite forces attract*

1

(ii) hydrogen

*accept H<sub>2</sub>*  
*ignore H or H<sup>+</sup>*

1

(d) (i) poisons released into environment (owtte)

*accept any sensible idea of harm / harmful / poisons /  
poisonous / pollution / damaging*  
*do **not** accept answers such as global warming / ozone layer  
etc.*  
*ignore safety unless qualified*

1

(ii) any **one** sensible idea eg

- loss of work / unemployment  
*eg shops / house prices etc.*
- or**  
company goes out of business
- any adverse effect on local economy (owtte)
- any adverse effect on paper production / cost of paper / cost of water  
(treatment)  
*allow less expensive to use chlorine or converse*
- chlorine (compounds) have been used (for many years) without  
causing harm owtte
- only a tiny amount of chlorine is released so it would not cause harm  
*ignore uses of chlorine to treat drinking water unless  
qualified*

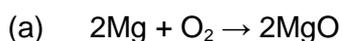
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(iii) ideas related to bias

*accept more reliable or valid or fair*  
*ignore more accurate / fair test*

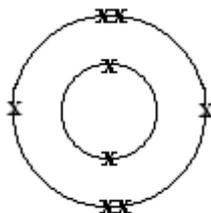
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## Q3.

*accept correct multiples / fractions*

1

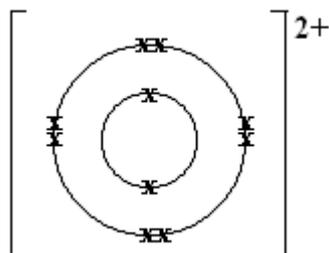
(b)



*electrons do not need to be paired*  
*accept dots / circles / e instead of crosses*  
 do **not** allow 2.6 without diagram

1

(c)



*electrons do not need to be paired*  
*allow without bracket s/ must have the charge*  
*accept dots / circles / e instead of crosses*  
*ignore extra empty outer shells*  
*ignore nucleus*  
 do **not** allow  $[2.8]^{2+}$  without diagram

1

(d) oppositely charged (ions / atoms)

*allow positive and negative(ions / atoms)*

1

(they) attract

*must be in correct context*  
*accept held by electrostatic forces*  
*ignore ionic bonding*  
**maximum 1** if they refer to intermolecular forces / attractions  
 / covalent bonds

1

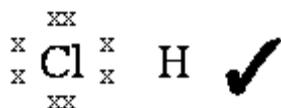
- (e) magnesium chloride  
*accept MgCl<sub>2</sub> (if correctly written)*

1

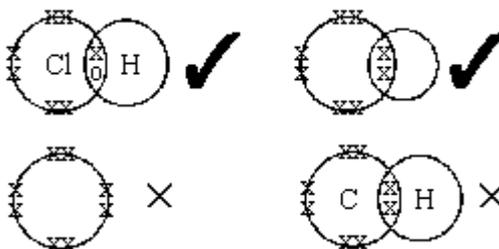
[6]

**Q4.**

- (a) bonding pair in the overlap **and** 6 other electrons arranged around the chlorine



*must have either circles or symbols  
 need not be pairs but must not be in the overlap region  
 accept without H and Cl if clear  
 accept all x's or all o's*



1

- (b)  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$   
*accept multiples or fractions  
 accept correct formulae but not balanced for 1 mark  
 correctly balanced equation containing  
 'correct' lower / upper case symbols gets 1 mark*

2

- (c)  $\text{MgCl}_2$   
*accept Mg<sup>2+</sup>(Cl<sup>-</sup>)<sub>2</sub>*

1

- (d) because magnesium chloride is made of ions **or** is ionic  
*accept there are strong forces of attraction between the ions  
 / particles in MgCl<sub>2</sub> or strong electrostatic attractions  
 accept more energy to separate particles in MgCl<sub>2</sub>  
 do **not** accept MgCl<sub>2</sub> molecules  
 do **not** accept reference to breaking bonds*

1

hydrogen chloride is made of molecules **or** is covalent  
*accept there are only weak forces of attraction (between the  
 particles / molecules) in HCl  
 do **not** accept weak covalent bonds  
 do **not** accept reference to breaking bonds  
 do **not** accept MgCl<sub>2</sub> is a solid and HCl is a gas*

1

[6]

**Q5.**

- (a) nanotubes can slide (over each other)

*allow nanotubes can roll (over each other)*

1

because no (covalent) bonds between the nanotubes

*accept weak forces between the nanotubes or weak intermolecular forces*

*allow layers for nanotubes throughout*

1

(b) delocalised electrons

*accept free electrons*

1

so (delocalised) electrons can move through the graphite

*accept so (delocalised) electrons can carry charge through the graphite*

1

[4]

**Q6.**

(a) (i) *mention of molecules or any reference to incorrect bonding = max 2*

giant structure / lattice or particles arranged in a regular pattern

*allow close packed / layers*

1

sea of electrons / delocalised electrons

*allow free electrons*

1

positive ions and electrons attract each other

*ignore metallic bonds*

*appropriately labelled diagrams can gain first two marks*

1

(ii) (sea of) electrons can move through the structure

*allow free / roaming / mobile electrons*

**or** delocalised electrons

1

(b) (metal) oxide / ionic compound formed

1

ions not free to move

**or**

electrons cannot move through the structure

*allow no / fewer delocalised / free / roaming / mobile electrons*

1

[6]