

# Ionic Compounds

## Question Paper

Level	GCSE
Subject	Chemistry
Exam Board	Edexcel IGCSE
Module	Double Award (Paper 1C)
Topic	Principles of Chemistry
Sub-Topic	Ionic Compounds
Booklet	Question Paper

**Time Allowed:** 106 minutes

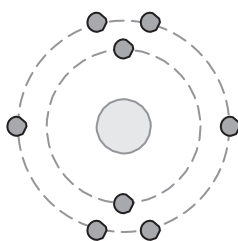
**Score:** /88

**Percentage:** /100

**Grade Boundaries:**

A*	A	B	C	D	E	U
>85%	75%	70%	60%	55%	50%	<50%

1 The diagram shows how the electrons are arranged in an atom of oxygen.



Oxygen atoms form both covalent and ionic bonds.

(a) Water is formed when two atoms of hydrogen combine with one atom of oxygen.

(i) Draw a dot and cross diagram of a molecule of water. You need only show the electrons in the outer shells.

(2)

(ii) Explain how the covalent bonds in the water molecule hold the hydrogen and oxygen atoms together.

(2)

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(b) The electronic configuration of a sodium atom is 2.8.1

Sodium oxide, Na<sub>2</sub>O, is an ionic compound formed when sodium reacts with oxygen.

(i) Describe, in terms of electrons, what happens when sodium oxide is formed in this reaction. (3)

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(ii) The reaction of sodium to form sodium oxide can be described as oxidation because it involves the addition of oxygen.

State one other reason why this reaction can be described as oxidation. (1)

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(c) Explain why water has a much lower melting point than sodium oxide. (2)

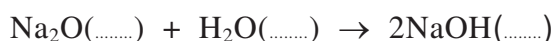
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(d) A teacher added sodium oxide to water in a beaker.  
The equation shows the reaction that occurred.



(i) Insert the appropriate state symbols in this equation. (2)

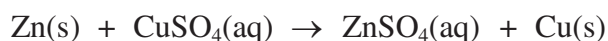
(ii) Some universal indicator was then added to the beaker. A colour change occurred. State the final colour of the universal indicator and identify the ion responsible for the colour change. (2)

Final colour .....

Ion responsible for colour change .....

**(Total for Question 1 = 14 marks)**

- 2 Some students investigated displacement reactions involving three different metals and solutions of their salts. This equation represents one of these reactions:



This reaction occurs because zinc is more reactive than copper.

When a displacement reaction occurs, there is a temperature rise. The bigger the difference in reactivity between the two metals, the bigger the temperature rise.

- (a) What word is used to describe reactions in which there is a temperature rise?

(1)

- (b) The students used this method.

- Pour some metal salt solution into a beaker, place a thermometer in the beaker and record the temperature
- Add some of the metal and stir the mixture
- Record the maximum temperature

- (i) State **two** variables that the students should keep the same to ensure that the experiment was valid.

(2)

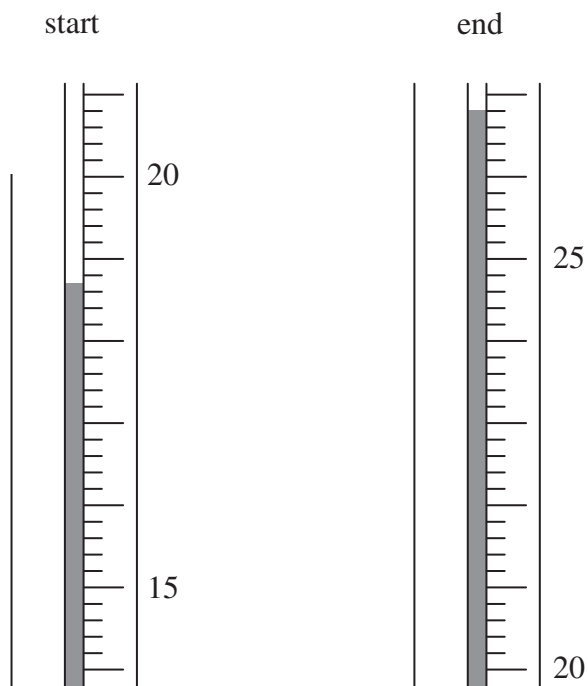
1 .....

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2 .....

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(ii) The diagrams show the thermometer readings at the start and at the end of one of the experiments.



Record the temperatures and calculate the temperature rise in this experiment

(3)

Temperature at start ..... °C

Temperature at end ..... °C

Temperature rise ..... °C

(iii) Each experiment was repeated twice. The table shows the average temperatures obtained.

Metal and metal salt used	Average temperature rise in °C
Zn + CuSO <sub>4</sub>	12.2
X + CuSO <sub>4</sub>	8.3
X + ZnSO <sub>4</sub>	0.0
Cu + ZnSO <sub>4</sub>	0.0
Zn + XSO <sub>4</sub>	2.7
Cu + XSO <sub>4</sub>	0.0

Use these results to identify the more reactive metal in each of the following pairs.

(2)

Zn and X .....

Cu and X .....

(c) Write an equation for the reaction with a temperature rise of 2.7 °C.

(1)

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(d) Suggest why the students did not use calcium metal in their experiments.

(1)

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**(Total for Question 2 = 10 marks)**

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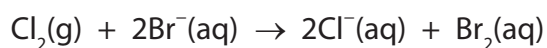
- (d) Chlorine reacts quickly with hot iron to form iron(III) chloride.  
Bromine reacts less quickly with hot iron to form iron(III) bromide.

Suggest how fluorine reacts with hot iron and name the compound formed.

(2)

- (e) When chlorine gas is bubbled through an aqueous solution of sodium bromide, a displacement reaction takes place.

The ionic equation for the reaction is:



State the colour change that you would observe in the solution during this reaction.

(2)

Colour at start .....

Colour at end .....

**(Total for Question 3 = 11 marks)**



4 Water is needed for iron to rust.

(a) (i) State **one** other substance needed for iron to rust.

(1)

(ii) When iron rusts, a brown compound forms that can be represented by the formula  $\text{Fe}_2\text{O}_3$

State the name of this compound.

(1)

(b) Three students decided to investigate the rusting of some iron nails. They measured the mass of each nail before placing it in some water. After rusting had occurred, the nails were removed and their masses were measured.

The table shows their results.

Student	Mass of nail before rusting in g	Mass of nail after rusting in g
A	3.0	3.3
B	1.5	1.7
C	1.8	1.7

(i) Suggest **one** problem in measuring the mass of a nail after rusting.

(1)

(ii) Student **A** thought that the results showed that his nail had rusted most.

Suggest why he thought this.

(1)

(iii) Student **B** thought that the results showed that her nail had rusted most.

Suggest why she thought this.

(1)

(iv) How do the results of Student C show that he must have made an error in his experiment?

(1)

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(c) Most methods used to prevent iron objects from rusting use a physical barrier. This involves covering the iron object with another substance to keep out the water.

Complete the table by choosing words from the box to suggest the substance that should be used to prevent each named iron object from rusting.

(2)

aluminium	grease	oil	paint	plastic
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Iron object	Substance used to prevent rusting
bicycle chain	
railway bridge	

(d) Some iron objects are coated with zinc to prevent rusting. The zinc initially acts as a physical barrier, but an extra advantage of using zinc is that it continues to prevent rusting even if the layer of zinc is damaged.

State the name of this type of rust prevention and explain how it works.

(3)

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(Total for Question 4 = 11 marks)

5 The reactivity of metals can be studied using displacement reactions. In these reactions, one metal is added to a solution of a salt of a different metal.

If a displacement reaction occurs, there is a temperature rise.

A student used the following method in a series of experiments.

- Pour some metal salt solution into a polystyrene cup supported in a glass beaker and record the temperature of the solution.
- Add a known mass of a metal and stir.
- Record the maximum temperature of the mixture.

(a) Suggest **three** variables that should be kept the same for the student's experiments to be a fair test.

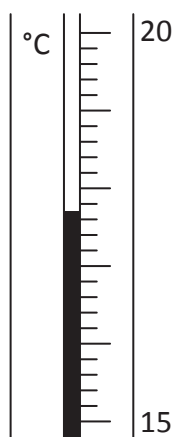
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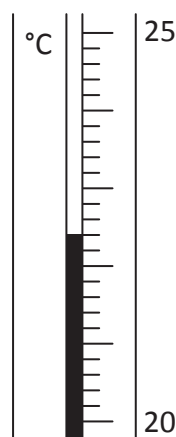
2 .....

3 .....

(b) The student used a thermometer to measure the temperature rise. The diagrams show the thermometer readings before and after adding the metal.



before adding metal



after adding metal

Use the diagrams to complete the table.

(3)

Temperature after adding the metal in °C	
Temperature before adding the metal in °C	
Temperature change in °C	

- (c) The student used copper(II) sulfate solution in all her experiments. She used five different metals. She did not know the identity of the metal labelled X.

The student did each experiment twice. The table shows her results.

Metal	Temperature rise in °C		Average temperature rise in °C
	Run 1	Run 2	
magnesium	10.5	15.5	13.0
silver	0.0	0.0	0.0
iron	3.5	4.5	4.0
X	0.0	0.0	0.0
zinc	8.0	9.0	8.5

- (i) Which of the metals gave the least reliable temperature rise?

Explain your choice.

(2)

Metal .....

Explanation .....

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.....

- (ii) Identify the most reactive of the metals used.

Explain how the results show that it is the most reactive.

(2)

Metal .....

Explanation .....

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- (iii) Why is there no temperature rise when silver is added to copper(II) sulfate solution?

(1)

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(iv) Why do the results make it impossible to decide which of the metals is the least reactive?

(1)

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(d) A word equation for one of the reactions is



Write a chemical equation for this reaction.

(1)

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**(Total for Question 5 = 13 marks)**

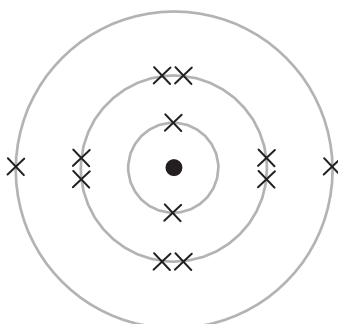
6 Distress flares are used to attract attention in an emergency. The flares contain magnesium, which burns with a bright, white flame to form magnesium oxide.

(a) The reaction between magnesium and oxygen is exothermic.

What is meant by the term **exothermic**?

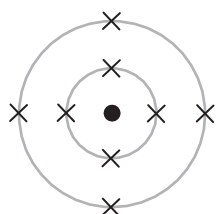
(1)

(b) The diagram shows the electronic configuration of a magnesium atom.

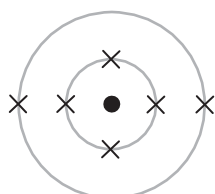


Put a cross in a box to indicate the diagram that shows the electronic configuration of an oxygen atom.

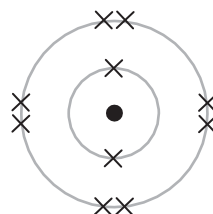
(1)



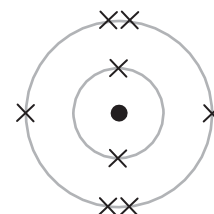
A



B



C



D



(e) Magnesium oxide is also used as an antacid. It helps relieve indigestion by neutralising hydrochloric acid in the stomach.

Give the name and formula of the salt produced when magnesium oxide reacts with hydrochloric acid.

(2)

Name .....

Formula .....

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**(Total for Question 6 = 9 marks)**



7 The table shows some properties of four substances A, B, C and D.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when solid?	Conducts electricity when molten?
A	-101	-35	no	no
B	1063	2970	yes	yes
C	801	1413	no	yes
D	3550	4830	no	no

(a) Use the information in the table to identify the substance that

(i) is a metal

(1)

A     B     C     D

(ii) could be diamond

(1)

A     B     C     D

(iii) is a gas at 20°C

(1)

A     B     C     D

(iv) contains oppositely charged ions

(1)

A     B     C     D

(b) Some of the substances in the table are compounds.

What is meant by the term **compound**?

(2)

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(c) (i) The electronic configurations of atoms of sodium and chlorine are

Na 2.8.1

Cl 2.8.7

Describe the changes in the electronic configurations of sodium and chlorine when these atoms form sodium chloride.

(3)

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(ii) Calculate the relative formula mass of sodium chloride (NaCl).

Use the Periodic Table on page 2 to help you.

(2)

relative formula mass = .....

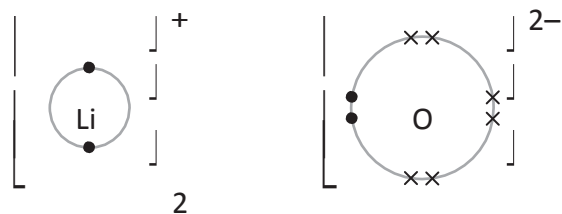
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**(Total for Question 7 = 11 marks)**

- 8 When lithium is burned in air, the two compounds lithium oxide ( $\text{Li}_2\text{O}$ ) and lithium nitride ( $\text{Li}_3\text{N}$ ) are formed.

Both compounds are ionic and their ions can be represented by dot and cross diagrams.

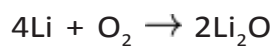
The dot and cross diagram for the ions in lithium oxide is



- (a) Draw a dot and cross diagram for the ions in lithium nitride.

(3)

- (b) The chemical equation for the reaction between lithium and oxygen is



Write a chemical equation for the reaction between lithium and nitrogen.

(2)

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- (c) (i) Lithium nitride reacts violently with water to form a solution of lithium hydroxide and ammonia gas.

Complete the following equation by inserting the appropriate state symbols. (1)



- (ii) Suggest a value for the pH of the solution formed.

Give a reason for your answer. (2)

pH.....

reason .....

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- (d) Solid lithium nitride conducts electricity and is used in batteries.

Why would you expect solid lithium nitride **not** to conduct electricity? (1)

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**(Total for Question 8 = 9 marks)**

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