

GCSE Chemistry (9 – 1)

Ionic Bonding

Name:

Group:

Instructions

- Read each question carefully before you begin to answer it.
- Use black ink or black ball-point pen for your answers.
- Fill in the boxes at the top of this page with your name and group.
- Attempt to answer every question in the booklet.
- Answer the questions in the spaces provided – there may be more space than you need in some answer spaces.
- Calculators may be used for this booklet.
- For any calculations, you **must** show all your working.
- Any and all drawings or graphs should be completed in pencil.



For markers use	
Question	Mark
1	/4
2	/6
3	/7
4	/8
5	/9
6	/10
7	/4
8	/4
9	/9
Total	/61
%	
Grade	

Information

- The maximum mark for this paper is 61 marks.
- The marks for each question are shown in brackets.
- Please be aware that good English and clear presentation are required in your answers.



1. Ionic bonding is the strong electrostatic force of attraction between oppositely charged ions.

Circle the letter of the correct answer for each of the following questions.

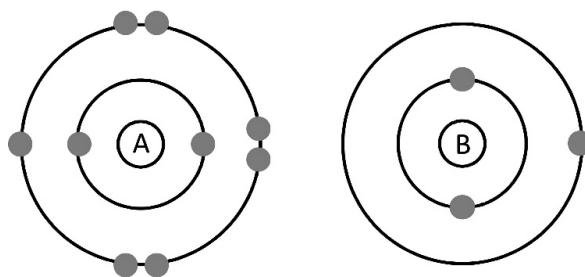
a) Calcium reacts with chlorine to produce calcium chloride.

What happens when a calcium ion forms during this reaction?

- A The calcium atom gains one electron.
- B The calcium atom gains two electrons.
- C The calcium atom loses one electron.
- D The calcium atom loses two electrons.

(1 mark)

The electronic structures of two atoms, A and B, are shown.



A and B combine together to form a compound.

b) What is the type of bonding in the compound and what is the formula of the compound?

	Type of bonding	Formula
A	ionic	AB
B	covalent	AB ₂
C	ionic	AB ₂
D	covalent	AB ₃

(1 mark)

Magnesium is in Group 2 of the periodic table and chlorine is in Group 7.

c) What is the correct chemical formula for the ionic compound magnesium chloride?

A	B	C	D
MgCl	Mg ₂ Cl	MgCl ₂	Mg ₂ Cl ₂

(1 mark)

The compound magnesium nitrate has the formula Mg(NO₃)₂.

d) What is the relative formula mass of magnesium nitrate?

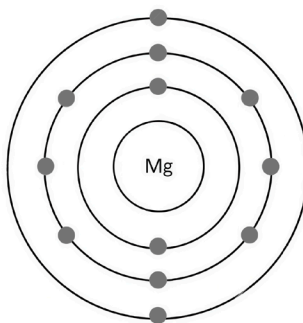
A	B	C	D
134	86	148	172

(1 mark)

(Total for Question 1 is 4 marks)

2. Magnesium is in group 2 of the Periodic Table.

The figure below shows the electronic configuration of magnesium.



- a) Explain why magnesium is in group 2 of the Periodic Table.

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.....

(1 mark)

- b) Give the electron configuration of a magnesium **ion**.

.....
(1 mark)

Magnesium and chlorine bond to form magnesium chloride, MgCl_2 .

- c) In the space below, draw a dot-and-cross diagram to show the **transfer of electrons** from **one magnesium atom to the chlorine atoms** to form magnesium chloride.

You should show the following:

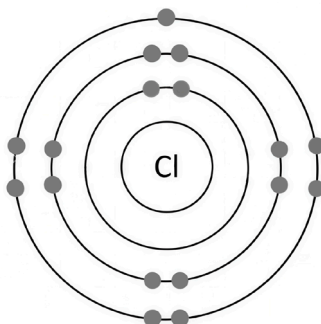
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

(Total for Question 2 is 6 marks)

3. Chlorine is in group 7 of the Periodic Table.

The figure below shows the electronic configuration of chlorine.



a) Explain why chlorine is in Group 7 of the Periodic Table.

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(1 mark)

b) Aluminium is a metal in Group 3 of the periodic table. Chlorine is a non-metal in Group 7.
They react to form an ionic compound called aluminium chloride.

State the electronic configuration of:

i. an aluminium **ion**:

ii. a chlorine **ion**:

(2 marks)

c) In the space below, draw a dot-and-cross diagram to show the **transfer of electrons** from **one aluminium atom to the chlorine atoms** to form aluminium chloride.

You should show:

- The correct number of atoms.
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

(Total for Question 3 is 7 marks)

4. Sodium is a metal in Group 1 of the periodic table. Fluorine is a non-metal in Group 7.
They react to form the ionic compound sodium fluoride, NaF.

a) State the electronic configuration of:

i. a sodium **atom**

ii. a fluorine **ion**

(2 marks)

b) Sodium and fluorine form an ionic bond.

What is an ionic bond?

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(2 marks)

d) In the space below, draw a dot-and-cross diagram to show the **transfer of electrons** between sodium and fluorine **atoms** to form sodium fluoride, NaF.

You should show:

- The correct number of atoms.
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

(Total for Question 4 is 8 marks)

5. Magnesium reacts with oxygen to form the ionic compound magnesium oxide, MgO.
- a) In the space below, draw a dot-and-cross diagram to show how electrons are transferred from a magnesium atom to an oxygen atom to form magnesium oxide.

You should show:

- The correct number of atoms.
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

- b) Use your diagram from part (a) to explain why the chemical formula for magnesium oxide is MgO.

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(2 marks)

- c) Solid magnesium oxide does not conduct electricity. Molten magnesium oxide does conduct electricity. Explain this difference in terms of the particles in magnesium oxide.

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(3 marks)

(Total for Question 5 is 9 marks)

6. The position of an element in the Periodic Table allows us to predict the charge on the ion it will form.

a) Complete the table below to show how different atoms form ions. The first one has been done for you.

Element	Group Number	Electrons to Lose or Gain	Formula of Ion Formed
Sodium	1	Lose 1	Na ⁺
Calcium	2		
Oxygen	6		
Fluorine	7		
Helium	0		

(4 marks)

b) Explain why helium does not form an ion.

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(2 marks)

Scientists can identify an element by working out the number of protons and electrons in its atoms and ions. An ion, represented by the symbol X^{3+} , has the electronic configuration 2,8.

c) What is the electronic configuration of the original atom, X?

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(1 mark)

d) Identify element X.

.....

(1 mark)

e) Explain why atom X forms an ion with a 3+ charge and not a 5- charge. Refer to energy in your answer.

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(2 marks)

(Total for Question 6 is 10 marks)

7. Sodium reacts with oxygen to form the ionic compound sodium oxide.
- a) In the space below, draw a dot-and-cross diagram to show how electrons are transferred from sodium to oxygen to form sodium oxide.

You should show:

- The correct number of atoms.
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

(Total for Question 7 is 4 marks)

8. Aluminium reacts with oxygen to form the ionic compound aluminium oxide.
- b) In the space below, draw a dot-and-cross diagram to show how electrons are transferred from the aluminium atoms to the oxygen atoms to form aluminium oxide.

You should show:

- The correct number of atoms.
- The electrons in the outer shells only.
- The charges on the resulting ions.

(4 marks)

(Total for Question 8 is 4 marks)

9. Most ionic compounds are formed when a metal reacts with a non-metal.
However, ionic bonding can also occur between non-metal atoms.

A common example is **ammonium nitrate**, which has the chemical formula NH_4NO_3 .
Ammonium nitrate is an ionic compound made of ammonium ions and nitrate ions.

a) State the chemical formula for:

i. the ammonium ion (1 mark)

ii. the nitrate ion (1 mark)

b) Explain why ammonium nitrate is classified as an ionic compound, even though it contains no metal atoms.

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(2 marks)

c) The ions in ammonium nitrate are polyatomic. This means they consist of several atoms joined together.

What type of bonding holds the nitrogen and hydrogen atoms together within the ammonium ion?

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(1 mark)

d) In the space below, draw a dot-and-cross diagram to show the bonding in an ammonium ion (NH_4^+).

You should show:

- The outer shell electrons of all atoms.
- The overall charge on the ion.

(4 marks)

(Total for Question 9 is 9 marks)