

GCSE Combined Science: Trilogy

Worksheet: Ionic bonding

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Ionic bonding

NAME _____	CLASS _____	DATE _____
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

Ionic compounds form when metals react with non-metals.

0 1 . 1

When a metal atom reacts with a non-metal atom, what happens to the electrons in the outer shell of the metal atom?

Tick (✓) **one** box.

They are transferred to the non-metal atom.

☐

They are shared with the non-metal atom.

☐

They are gained from the non-metal atom.

☐

They become delocalised.

☐

[1 mark]

0 1 . 2

What is the charge on a sodium ion?

Tick (✓) **one** box.

1–

☐

1+

☐

2+

☐

2–

☐

[1 mark]

0 1 . 3

What is the charge on an oxide ion?

.....

.....

[1 mark]

0 1 . 4

Complete the sentence.

Tick (✓) **one** box.

The ions formed by Group 1 metals have the same electronic structure as

.....

a noble gas

☐

a halogen

☐

a transition metal

☐

an alkali metal

☐

[1 mark]

0 2

Sodium reacts with chlorine to form the ionic compound sodium chloride.

0 2 . 1

Complete the sentences. Use words from the box.

electrostatic gravitational negative positive shared transferred

When sodium reacts with chlorine, an electron is from each sodium atom to a chlorine atom.

Each sodium atom becomes a ion.

The ions are held together by strong forces of attraction.

.....

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.....

.....

[3 marks]

0 3

Potassium reacts with chlorine to form potassium chloride, KCl. The electronic structure of potassium is 2,8,8,1 and the electronic structure of chlorine is 2,8,7.

0 3 . 1

Draw a dot and cross diagram to show the ions in potassium chloride.
Show the outer-shell electrons only, and give the charge on each ion.

.....

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[3 marks]

0 4

Lithium reacts with oxygen to form lithium oxide, Li_2O . The electronic structure of lithium is 2,1 and the electronic structure of oxygen is 2,6.

0 4 . 1

Draw a dot and cross diagram to show the ions in lithium oxide.
Show the outer-shell electrons only, and give the charge on each ion.

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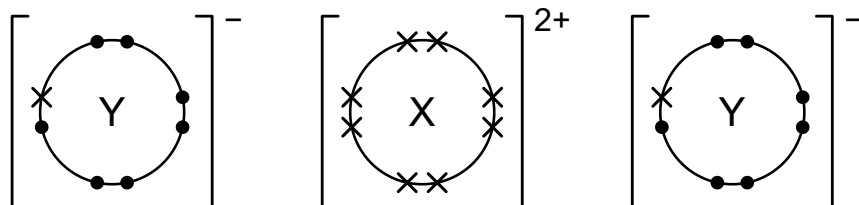
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[4 marks]

0 5

Figure 1 shows a dot and cross diagram for the ionic compound formed when element **X** reacts with element **Y**. Only the outer electrons are shown.

Figure 1



0 5 . 1

What is the formula of the compound?

Tick (✓) **one** box.

XY

X₂Y

XY₂

X₂Y₂

☐
☐
☐
☐

[1 mark]

0 5 . 2

In which group of the periodic table is element **Y**?

Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 5 . 3

How many electrons does each atom of **X** lose?

.....

.....

.....

[1 mark]

0 5 . 4

Explain how the diagram shows which electrons were transferred.

.....

.....

[1 mark]

0 6

Aluminium fluoride, AlF_3 , is an ionic compound. The electronic structure of aluminium is 2,8,3.
The electronic structure of fluorine is 2,7.

A student wrote:

'In aluminium fluoride, each aluminium atom shares three electrons with three fluorine atoms.
The aluminium ion has a charge of 3- and each fluoride ion has a charge of 1+.'

0 6 . 1

Identify **two** mistakes in the student's description. Correct each mistake.

.....

.....

.....

.....

[2 marks]

0 6 . 2

Give the electronic structure of an aluminium ion.

.....

.....

.....

[1 mark]

0 6 . 3

Explain why each aluminium atom reacts with three fluorine atoms.

.....

.....

[1 mark]

0 7

Lithium reacts with fluorine to form lithium fluoride, LiF.

The electronic structure of lithium is 2,1. The electronic structure of fluorine is 2,7.

0 7 . 1

Describe what happens when a lithium atom reacts with a fluorine atom.
Answer in terms of electrons.

.....

.....

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.....

[3 marks]

0 7 . 2

Give the electronic structures of the lithium ion and the fluoride ion.

.....

.....

.....

.....

[2 marks]

0 7 . 3

Which noble gas has the same electronic structure as the fluoride ion?

.....

.....

.....

.....

[1 mark]

0 8

Magnesium reacts with sulfur to form magnesium sulfide, MgS . The electronic structure of magnesium is 2,8,2 and the electronic structure of sulfur is 2,8,6.

0 8 . 1

Draw a dot and cross diagram to show the ions in magnesium sulfide.
Show the outer-shell electrons only, and give the charge on each ion.

.....

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[3 marks]

END OF QUESTIONS

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Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Ionic bonding · 32 marks

Question 1 (4 marks)

01.1 [1 mark]

Correct: They are transferred to the non-metal atom.

01.2 [1 mark]

Correct: 1+

01.3 [1 mark]

Answer: 2–

- 2– / –2 (1)

Notes: The sign must be shown. Do not accept 2 or 2+.

01.4 [1 mark]

Correct: a noble gas

Question 2 (3 marks)

02.1 [3 marks]

Answer: transferred; positive; electrostatic

- transferred (1)
 - positive (1)
 - electrostatic (1)
-

Question 3 (3 marks)

03.1 [3 marks]

Answer: $[\text{K}]^+$ with no outer electrons; $[\text{Cl}]^-$ with 8 outer electrons (7 of its own and 1 from potassium, shown with a different symbol).

- potassium ion shown with no outer-shell electrons (or with a complete outer shell of 8) (1)
- chloride ion shown with 8 outer-shell electrons: 7 of one symbol and 1 of the other symbol (the electron from potassium) (1)
- charges: + on the potassium ion and – on the chloride ion (1)

Notes: Square brackets are not required. Allow the positive ion drawn with no outer-shell electrons or with a complete outer shell. Ignore inner shells if drawn correctly. Any symbols may be used, provided the transferred electrons are shown with a different symbol from the non-metal's own electrons. Do not credit shared pairs of electrons (a covalent bond) between the ions.

Question 4 (4 marks)

04.1 [4 marks]

Answer: Two $[\text{Li}]^+$ ions, each with no outer electrons; one $[\text{O}]^{2-}$ ion with 8 outer electrons (6 of its own and 1 from each lithium atom).

- two lithium ions shown (not one) (1)
- each lithium ion shown with no outer-shell electrons (or with a complete shell of 2) (1)
- oxide ion shown with 8 outer-shell electrons: 6 of one symbol and 2 of the other symbol (one from each lithium atom) (1)
- charges: + on each lithium ion and 2– on the oxide ion (1)

Notes: Square brackets are not required. Allow the positive ion drawn with no outer-shell electrons or with a complete outer shell. Ignore inner shells if drawn correctly. Any symbols may be used, provided the transferred electrons are shown with a different symbol from the non-metal's own electrons. Do not credit shared pairs of electrons (a covalent bond) between the ions.

Question 5 (5 marks)

05.1 [1 mark]

Correct: XY_2

05.2 [2 marks]

Answer: Group 7; each Y atom had 7 outer electrons and gained one electron to form a 1^- ion.

- Group 7 (1)
 - each Y atom had 7 outer electrons (dots) / gained one electron / forms a 1^- ion (1)
-

05.3 [1 mark]

Answer: 2

- 2 (1)
-

05.4 [1 mark]

Answer: The electrons from X are shown as crosses, so the cross in each Y ion is the electron transferred from X.

- electrons from X are shown as crosses (and Y's own electrons as dots), so the cross in each Y ion came from X (1)
-

Question 6 (4 marks)

06.1 [2 marks]

Answer: Electrons are transferred, not shared; the aluminium ion is 3^+ and the fluoride ion is 1^- .

- electrons are transferred from aluminium to fluorine atoms, not shared (1)
 - the charges are the wrong way round: aluminium ions are 3^+ and fluoride ions are 1^- (1)
-

06.2 [1 mark]

Answer: 2,8

- 2,8 (1)
-

06.3 [1 mark]

Answer: Each aluminium atom loses three electrons, and each fluorine atom gains only one.

- each aluminium atom loses three electrons, and each fluorine atom gains one electron (1)
-

Question 7 (6 marks)

07.1 [3 marks]

Answer: The lithium atom loses its outer electron, which is transferred to the fluorine atom; Li^+ and F^- ions form.

- the lithium atom loses one electron (1)
- the electron is transferred to / gained by the fluorine atom (1)
- Li^+ and F^- ions are formed (1)

Notes: Do not accept references to sharing electrons.

07.2 [2 marks]

Answer: Li^+ : 2; F^- : 2,8

- Li^+ : 2 (1)
- F^- : 2,8 (1)

07.3 [1 mark]

Answer: neon

- neon / Ne (1)

Question 8 (3 marks)

08.1 [3 marks]

Answer: $[\text{Mg}]^{2+}$ with no outer electrons; $[\text{S}]^{2-}$ with 8 outer electrons (6 of its own and 2 from magnesium, shown with a different symbol).

- magnesium ion shown with no outer-shell electrons (or with a complete outer shell of 8) (1)
- sulfide ion shown with 8 outer-shell electrons: 6 of one symbol and 2 of the other symbol (the electrons from magnesium) (1)
- charges: 2+ on the magnesium ion and 2- on the sulfide ion (1)

Notes: Square brackets are not required. Allow the positive ion drawn with no outer-shell electrons or with a complete outer shell. Ignore inner shells if drawn correctly. Any symbols may be used, provided the transferred electrons are shown with a different symbol from the non-metal's own electrons. Do not credit shared pairs of electrons (a covalent bond) between the ions.