

# GCSE Chemistry

## Worksheet: Ionic bonding

|                       |                          |                              |                                   |
|-----------------------|--------------------------|------------------------------|-----------------------------------|
| TIME<br><b>30 min</b> | TOTAL<br><b>29 marks</b> | CALCULATOR<br><b>Allowed</b> | DIFFICULTY<br><b>Easy, Medium</b> |
|-----------------------|--------------------------|------------------------------|-----------------------------------|

**Topics:** Ionic bonding

|             |              |             |
|-------------|--------------|-------------|
| <b>NAME</b> | <b>CLASS</b> | <b>DATE</b> |
|-------------|--------------|-------------|

- 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.

.....

.....

.....

.....

.....

.....

[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.

.....

.....

.....

.....

.....

.....

[3 marks]

0 4

Table 1 shows the groups of four elements.

Table 1

| Element   | Group |
|-----------|-------|
| Potassium | 1     |
| Calcium   | 2     |
| Sulfur    | 6     |
| Bromine   | 7     |

0 4 . 1

Give the charge on the ion formed by each element.

.....

.....

.....

.....

[2 marks]

0 4 . 2

Describe, in terms of electrons, how a calcium atom becomes a calcium ion.

.....

.....

.....

.....

[2 marks]

0 4 . 3

Selenium is also in Group 6.

Predict the charge on a selenide ion. Explain your answer.

.....

.....

.....

.....

[2 marks]

0 5

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 5 . 1

Describe what happens when a lithium atom reacts with a fluorine atom.

Answer in terms of electrons.

.....

.....

.....

.....

.....

.....

[3 marks]

0 5 . 2

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

.....

.....

.....

.....

[2 marks]

0 5 . 3

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

.....

.....

.....

.....

[1 mark]

0 6

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 6 . 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]

0 7

Aluminium fluoride,  $\text{AlF}_3$ , 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 7 . 1

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

.....

.....

.....

.....

[2 marks]

0 7 . 2

Give the electronic structure of an aluminium ion.

.....

.....

.....

.....  
[1 mark]

0 7 . 3

Explain why each aluminium atom reacts with three fluorine atoms.

.....

.....

[1 mark]

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## END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

# Mark scheme

## GCSE Chemistry · Worksheet: Ionic bonding · 29 marks

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### Question 1 (4 marks)

01.1 [1 mark]

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

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01.2 [1 mark]

**Correct:** 1+

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01.3 [1 mark]

**Answer:** 2-

- 2- / -2 (1)

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

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01.4 [1 mark]

**Correct:** a noble gas

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### Question 2 (3 marks)

02.1 [3 marks]

**Answer:** transferred; positive; electrostatic

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

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### Question 3 (3 marks)

#### 03.1 [3 marks]

**Answer:**  $[K]^+$  with no outer electrons;  $[Cl]^-$  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.

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### Question 4 (6 marks)

#### 04.1 [2 marks]

**Answer:**  $K^+$ ,  $Ca^{2+}$ ,  $S^{2-}$ ,  $Br^-$

- potassium 1+ and calcium 2+ (1)
- sulfur 2– and bromine 1– (1)

**Notes:** All four correct scores 2 marks. Two or three correct scores 1 mark.

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#### 04.2 [2 marks]

**Answer:** A calcium atom has two outer electrons, which it loses to get a full outer shell (the electronic structure of argon).

- a calcium atom has 2 electrons in its outer shell (1)
- it loses (these) 2 electrons (to get a full outer shell / the electronic structure of a noble gas) (1)

**Notes:** Do not accept references to sharing electrons.

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#### 04.3 [2 marks]

**Answer:** 2–; selenium atoms have 6 outer electrons, so they gain 2 electrons to fill the outer shell.

- 2– / –2 (1)
- selenium atoms have 6 electrons in the outer shell, so they gain 2 electrons (to get a full outer shell) (1)

**Notes:** The sign must be shown for the first mark.

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## Question 5 (6 marks)

### 05.1 [3 marks]

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

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

**Notes:** Do not accept references to sharing electrons.

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### 05.2 [2 marks]

**Answer:**  $\text{Li}^+$ : 2;  $\text{F}^-$ : 2,8

- $\text{Li}^+$ : 2 (1)
  - $\text{F}^-$ : 2,8 (1)
- 

### 05.3 [1 mark]

**Answer:** neon

- neon / Ne (1)
- 

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## Question 6 (3 marks)

### 06.1 [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.

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## Question 7 (4 marks)

### 07.1 [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)

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### 07.2 [1 mark]

**Answer:** 2,8

- 2,8 (1)

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### 07.3 [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)
-