



Ionic Bonding

Topic Summary

- Ionic bonding happens when **metals transfer electrons to non-metals** so both achieve the stability from having full shells of outer electrons.
- Metals lose electrons (forming positive ions), while non-metals gain electrons (forming negative ions).
- These oppositely charged ions attract each other and form giant **ionic lattices**, such as MgO , NaCl , Na_2O and MgCl_2 .
- The dot-and-cross diagram is a simple way to show how electrons move from metal atoms to non-metal atoms during ionic bonding. The electrons around one atom (or ion) are shown as 'dots' and the others as crosses.
- The ratio of ions depends on how many electrons are lost or gained, which determines the empirical formula of the compound. See the video for examples of each main type of compound.
- Reactivity links to the strength of the electrostatic forces between atoms — a topic explored further in the episode looking at reactivity within Group 1 of the periodic table.



Quick Checks to Build Recall

1. Complete the following sentences

Metal atoms gain the stability of a full shell of electrons by [**giving away**] a small number of electrons. (1 mark)

Nonmetal atoms gain the stability of a full shell of electrons by [**taking**] a small number of electrons. (1 mark)

In an ionic compound the metal ion has a ..**positive**.. charge while the nonmetal ion has a ...**negative**.. charge. (1 mark)

2. Write the electron configurations of the following **atoms**.

Sodium : ..2., ..8., ..1.. (1 mark)

Chlorine : ..2., ..8., ..7.. (1 mark)

Magnesium : ..2..., ...8., ..2... (1 mark)

3. What is the empirical formula of the compound formed when magnesium reacts with chlorine?

..... MgCl_2 (must show subscript '2') (1 mark)

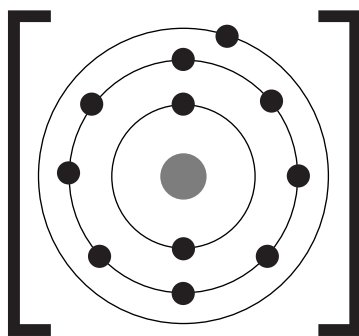


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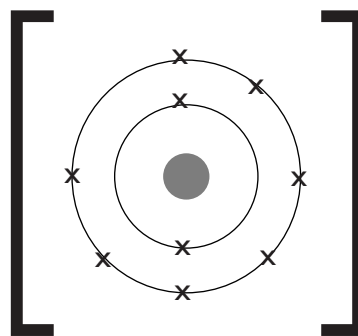


Exam Style Questions

1. Complete these diagrams to show the **full electron configurations** of these atoms sodium (2, 8, 1) and fluorine (2, 7) (2 marks)



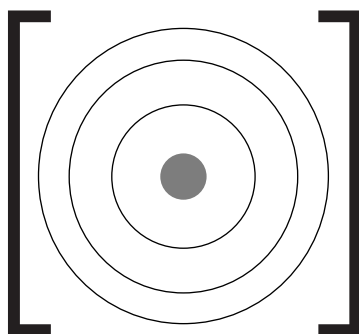
Sodium
(2, 8, 1)



Fluorine
(2, 7)

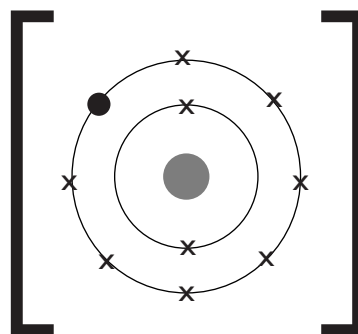
Sodium diagram correct (1)
Fluoride diagram correct (1)

2. How many electrons does sodium need to lose to gain the stability of having a full outer shell of electrons?
..... 1 (1 mark)
3. What will be the charge on the new sodium ion?
..... 1+ (must show 'plus') (1 mark)
4. How many electrons does fluorine need to take to gain the stability of having a full outer shell of electrons?
..... 1 (1 mark)
5. What will be the new charge on the fluorine ion?
..... 1- (must show 'minus') (1 mark)
6. Complete these diagrams to show the **full electron configurations** of the sodium and fluoride ions in the compound sodium fluoride, remember to show the charges on each ion in the diagrams. (6 marks)



Sodium
(.2., .8.)

..1 +



Fluoride
(.2., .8.)

....1 - ...

Sodium diagram correct (1)
Fluoride diagram correct (1)
Sodium 1+ (1)
Fluoride 1+ (1)
Sodium (2,8) (1)
Fluoride (2,8) (1)

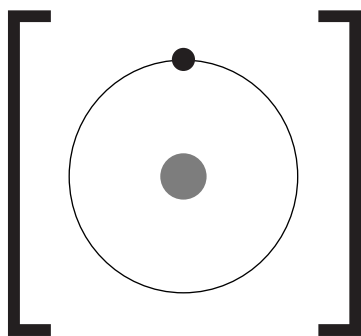


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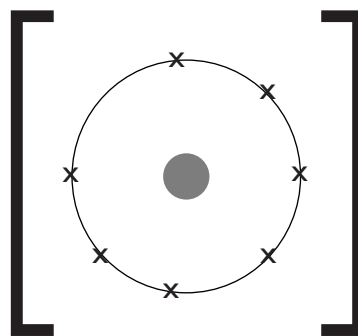


Exam Style Questions

7. Complete these diagrams to show only the **outer shells of electrons** on these atoms of potassium and chlorine. Complete the full electron configuration of chlorine in the space below its diagram. (3 marks)

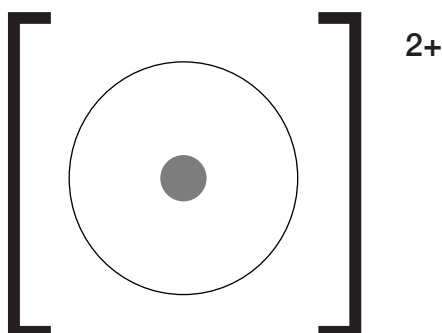


Potassium
(2, 8, 8, 1)

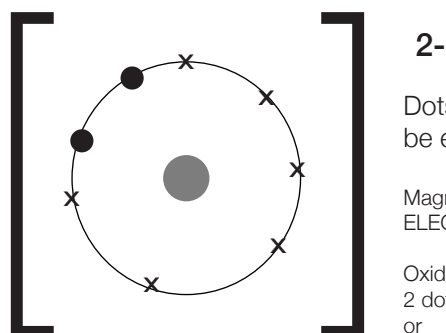


Chlorine
(2, ..8.., ..7...)

8. Complete this 'dot and cross' diagram to show only the **outer shell of electrons** on the **oxide ion** in the compound magnesium oxide. Complete the full electron configuration of both ions in the space below the diagrams. (4 marks)



Magnesium
(2, ..8....)



Oxide
(..2...., ...8...)

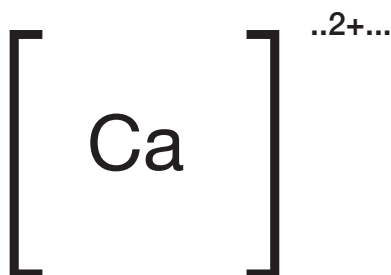
Dots and crosses can be either way round.

Magnesium should have NO ELECTRONS shown (1)

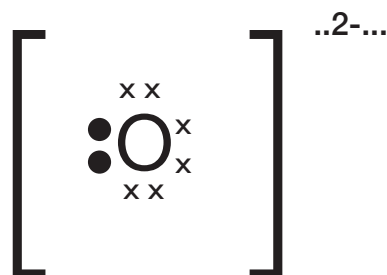
Oxide should have either 2 dots and 6 crosses or 6 dots and 2 crosses (1)

Mg²⁺ (2,8) (1)
O²⁻ (2,8) (1)

9. Complete this simplified dot and cross diagram to show the bonding in **calcium oxide (CaO)**. Make sure to show the correct charges on the ions. (4 marks)



Calcium
(2, 8, 8)



Oxide
(.....,)

Dots and crosses can be either way round.

Magnesium should have NO ELECTRONS shown (1)

Oxide should have either 2 dots and 6 crosses or 6 dots and 2 crosses (1)

Both charges correct
2+/2- (1)
O²⁻ (2,8) (1)



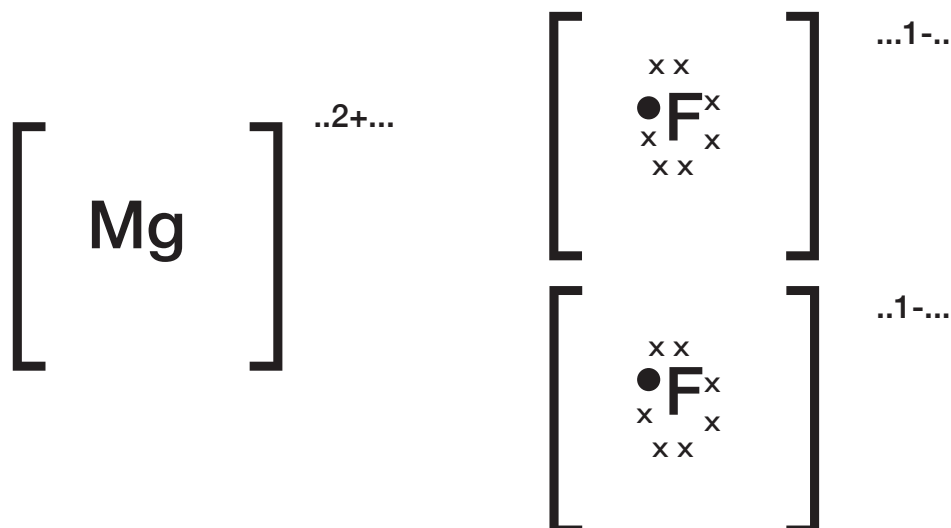
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Extension Questions - (A level style)

1. Complete these simple dot and cross diagrams to show the bonding in magnesium fluoride.

(4 marks)



2. Use a dot and cross diagram to explain why aluminium chloride has an empirical formula of AlCl_3 .

(4 marks)

Dots and crosses can be either way round.

Al^{3+} should have NO ELECTRONS shown (1)

3 chlorides shown (1)

Chlorides should EACH have either

1 dot and 7 crosses

or

7 dots and 1 cross (1)

Chlorides ALL have 1- charge shown (1)



Do this later...

Give your brain a break and come back to these questions later. Cover the rest of the sheet while you have a go. By doing this 24-48 hours after watching the video you will boost your chances of remembering the key points in an exam. If you struggle with these questions, re-watch the video and then try again.

- Write out the electron configuration for a magnesium atom and an Mg^{2+} ion.
Atom (2,8,2) Ion (2,8)
- Draw out a dot and cross diagram to show the bonding in calcium oxide.
See question 9
- Why is the electron configuration of the chloride ion (2,8,8) more stable than the electron configuration of a chlorine atom (2,8,7)?
it is a FULL SHELL
- What is the charge on a sodium ion in the compound NaCl ?
1+

