Your notes

GCSE Chemistry: revision notes

Ionic bonding

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Start here: why atoms form ions

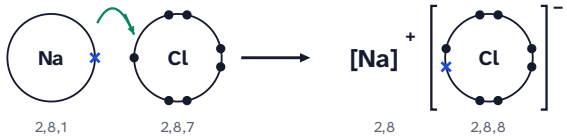
- Atoms are most stable with a full outer shell, like the noble gases. A metal and a non-metal can both get one by moving electrons from one to the other.
- Metal atoms lose their few outer electrons and become positive ions. Non-metal atoms gain electrons and become negative ions.
- The positive and negative ions attract each other strongly. This attraction is an **ionic bond**.

Three types of bonding

- Ionic bonding happens between metals and non-metals: oppositely charged ions attract.
- Covalent bonding happens between non-metals: atoms share pairs of electrons.
- Metallic bonding happens in metals and alloys: atoms share delocalised electrons.

Forming ions

- When a metal reacts with a non-metal, electrons are transferred from the metal atoms to the non-metal atoms.
- Metal atoms lose electrons to become positive ions; non-metal atoms gain electrons to become negative ions.
- The ions have the electronic structure of a noble gas (a full outer shell).
- Group 1 ions are +1, group 2 are +2, group 6 are –2 and group 7 are –1.
- **Dot and cross diagrams** show the transfer: for example, sodium gives one electron to chlorine to form Na^+ and Cl^-.



Only outer shells drawn. Sodium loses one electron; chlorine gains it.

Ionic compounds

- An **ionic compound** is a giant structure of ions (a **giant ionic lattice**), like sodium chloride.
- It is held together by strong **electrostatic forces** of attraction between oppositely charged ions. These act in all directions.
- The formula shows the ratio of ions so the charges balance: Na^+ and Cl^- give NaCl; Mg^{2+} and Cl^- give $MgCl_2$.
- Diagrams have limitations: **dot and cross diagrams** don't show the 3D structure; ball and stick models show gaps between ions that aren't really there.

Properties of ionic compounds

- They have high melting and boiling points, because lots of energy is needed to break the many strong bonds.
- They conduct electricity when melted or dissolved in water, because the ions are free to move and carry charge.
- They do not conduct when solid, because the ions are held in fixed positions.

Exam tip

- Say electrons are transferred, and that the bond is a strong electrostatic attraction between oppositely charged ions, in all directions.
- In **dot and cross diagrams**, show the outer shells, square brackets and the charge.

Common mistakes

- Saying **ionic bonds** share electrons.
- Saying electrons carry the current in a molten **ionic compound**. It's the ions that move.
- Forgetting the charges on a diagram.

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Worked examples

Work out the formula of magnesium chloride.

Magnesium is in group 2, so it loses 2 electrons. **Mg^{2+}**

Chlorine is in group 7, so it gains 1 electron. **Cl^-**

The charges must cancel out: one 2+ ion needs two 1– ions. **(2+) + 2 × (1–) = 0**

Answer: $MgCl_2$

Key terms

Ion	An atom or group of atoms with an electric charge because it has lost or gained electrons.
Ionic bond	The strong electrostatic attraction between oppositely charged ions.
Ionic compound	A compound made of positive and negative ions in a giant lattice.
Giant ionic lattice	A regular 3D arrangement of oppositely charged ions.
Electrostatic force	The force of attraction between opposite charges.
Dot and cross diagram	A diagram showing how electrons are transferred or shared, using dots and crosses.
Cation	A positive ion.
Anion	A negative ion.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What type of bonding forms between a metal and a non-metal?
2. What happens to a metal atom in ionic bonding?
3. What is the charge on a magnesium ion?
4. What is the charge on an oxide ion?
5. What holds the ions together in sodium chloride?
6. Why does sodium chloride have a high melting point?
7. When can ionic compounds conduct electricity?
8. What is the formula of the compound formed from Mg^{2+} and Cl^- ions?

Answers

1. Ionic
2. It loses electrons to become a positive ion
3. 2+
4. 2–
5. Strong electrostatic forces between oppositely charged ions
6. Lots of energy is needed to break the many strong ionic bonds

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7. When melted or dissolved in water
8. $MgCl_2$

What to do next

Practise 11 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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