Exercise walk-through

2.1
Ionic, covalent and metallic bonding (4.2.1.1–4.2.1.5)

AQA · GCSE · Chemistry

Three kinds of strong bond

- All chemical bonds come from the same force: the **electrostatic force** of attraction between opposite charges.
- What changes from one kind of bond to another is where the electrons go.
- **Ionic bonding.** In an **ionic bond** , a metal atom loses its outer electrons and becomes a positive ion; a non-metal atom gains them and becomes a negative ion.
- The opposite ions then attract each other.

Carbon: one element, four structures

- **Diamond** is a **giant covalent structure** in which every carbon atom is bonded to four others. It is very hard, has a very high melting point and does not conduct electricity, because all its outer electrons are in bonds.
- **Graphite** is made of layers of hexagonal rings. Each carbon is bonded to three others, so one electron per atom is delocalised. There are no covalent bonds between the layers, only weak forces, so the layers slide: **graphite** is soft and slippery and is used in pencils and as a lubricant. The delocalised electrons let it conduct electricity.

Common errors

- Saying that covalent bonds break when a simple molecular substance melts or boils; only the weak intermolecular forces are overcome.
- Saying that solid ionic compounds do not conduct because they have no ions; they have ions, but the ions cannot move.
- Calling an ionic compound a molecule, or reading a lattice drawing such as Mg_6Cl_{12} as a formula.

Exercises 2.1·2.2

2.1 Give the type of bonding in sodium chloride, in methane and in copper. [2]

sodium chloride | methane | copper

2.2 Use the ion charges to write the formulae of calcium chloride and sodium oxide. [2]

Ca^{2+} | Cl^{-} | Na^{+} | O^{2-}

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2.1

- sodium chloride: ionic; methane: covalent; copper: metallic: all three; two correct

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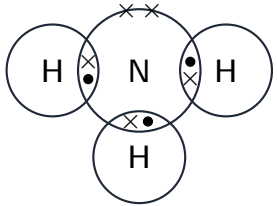
Ca^{2+} | Cl^{-} | Na^{+} | O^{2-}

2.2

- **$CaCl_2$; Na_2O**

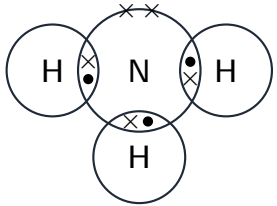
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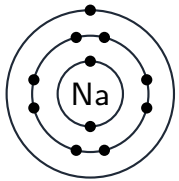


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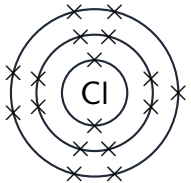
- **3** shared pairs; **1** lone pair

Exercise 3.1

3.1 Sodium reacts with chlorine to form sodium chloride. Describe what happens to the electrons. [3]



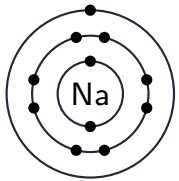
sodium



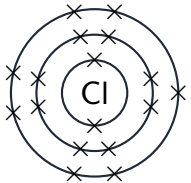
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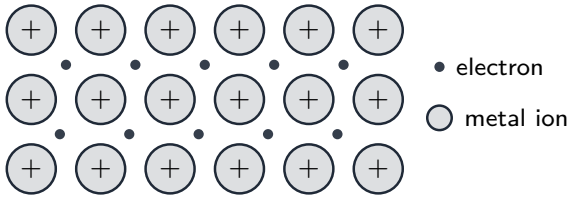
3.1

- the sodium atom loses its one outer electron, which moves to the chlorine atom
- this gives Na^+ (2, 8) and Cl^- (2, 8, 8), both with full outer shells
- the oppositely charged ions attract each other by strong electrostatic forces

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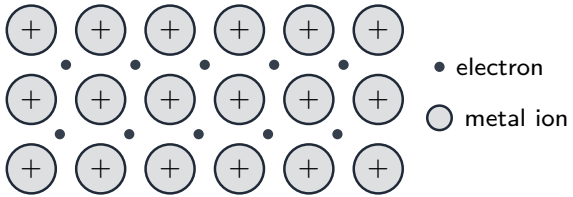
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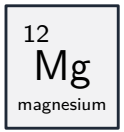
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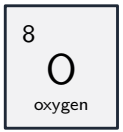
- metals have delocalised electrons
- these electrons move through the metal and carry charge
- the layers of ions can slide over each other, so the metal can be bent

Exercise 3.3 (a)

3.3 Magnesium burns in oxygen to form magnesium oxide, MgO.

(a) Give the electronic structures of a magnesium atom and an oxygen atom. [2]

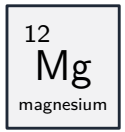


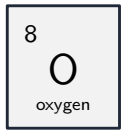


Exercise 3.3 (a)

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(a) magnesium **2, 8, 2**; oxygen **2, 6**

Exercise 3.3 (b)

3.3 Magnesium burns in oxygen to form magnesium oxide, MgO.

(b) Explain how magnesium oxide forms, in terms of electrons. [3]

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(b) each magnesium atom loses its two outer electrons to an oxygen atom; this forms Mg^{2+} and O^{2-} ions, both with the structure 2, 8; the ions are held together by strong electrostatic forces in a giant lattice

Exercise 3.3 (c)

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(c) Nitride ions are N^{3-}. Work out the formula of magnesium nitride. [2]

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(c) $3 \times (+2) = +6$ and $2 \times (-3) = -6$; $\mathbf{Mg_3N_2}$

Exercise 3.3 (d)

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(d) Compare ionic, covalent and metallic bonding. Describe the particles involved and how they are held together in each. [6]

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(d) points to include:

- ionic: between a metal and a non-metal; electrons are transferred
- ionic: positive and negative ions held by strong electrostatic forces in a giant lattice
- covalent: between non-metal atoms; pairs of electrons are shared
- covalent: most are small molecules, some are giant structures
- metallic: positive metal ions in a regular pattern
- metallic: delocalised electrons hold the ions together by electrostatic attraction

Levels: **5–6** a full, logical answer with correct chemistry and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.