Your notes

GCSE Chemistry: revision notes

Covalent bonding and simple molecules

Contents

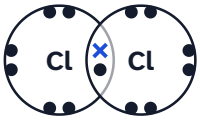
1. Start here: sharing electrons
2. Covalent bonds
3. Examples of small molecules
4. Properties of small molecules
5. Polymers
6. Exam tip
7. Common mistakes
8. Worked examples
9. Key terms
10. Quick questions
11. What to do next

Start here: sharing electrons

- When non-metal atoms bond with each other, neither can take electrons from the other, so they share them instead.
- Each shared pair of electrons is a **covalent bond**. Sharing lets both atoms have a full outer shell.
- Atoms joined by **covalent bonds** make **molecules**, like water (H_2O) and methane (CH_4), or giant structures, like diamond.

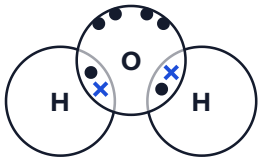
Covalent bonds

- A **covalent bond** is a shared pair of electrons between two atoms. **Covalent bonds** are strong.
- Covalent bonding happens in non-metal elements and compounds.
- Dot and cross diagrams show the shared pairs: for example, in H_2O the oxygen shares one pair with each hydrogen.
- Some atoms share two pairs (a **double bond**), as in O_2 and CO_2.



Examples of small molecules

- Hydrogen (H_2), chlorine (Cl_2), oxygen (O_2) and nitrogen (N_2).
- Hydrogen chloride (HCl), water (H_2O), ammonia (NH_3) and methane (CH_4).
- The number of bonds an atom forms usually equals the number of electrons it needs to fill its outer shell: H forms 1, O forms 2, N forms 3 and C forms 4.



Properties of small molecules

- Substances made of small **molecules** are usually gases or liquids with low melting and boiling points.
- They have weak **intermolecular forces** between the **molecules**. It is these forces, not the **covalent bonds**, that are overcome when the substance melts or boils.
- **Intermolecular forces** increase with the size of the **molecules**, so larger **molecules** have higher melting and boiling points.
- They do not conduct electricity, because the **molecules** have no overall electric charge.

Polymers

- **Polymers** are very large **molecules**. Atoms in each **polymer** chain are joined by strong covalent bonds.
- The **intermolecular forces** between **polymer molecules** are relatively strong, so polymers are solids at room temperature.
- Example: poly(ethene) is made from many ethene **molecules**.

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Exam tip

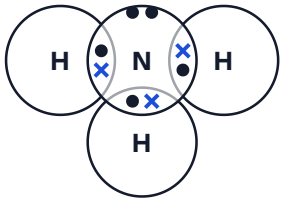
- Decide which structure you've got. Simple **molecules** have low boiling points because of weak forces between the **molecules**. Giant covalent structures have high melting points because strong bonds must break.
- Explain graphite's conductivity with delocalised electrons.

Common mistakes

- Saying boiling water breaks the **covalent bonds**. It only overcomes the forces between **molecules**.
- Saying diamond conducts electricity.

Worked examples

How many covalent bonds does a nitrogen atom form, and why?



Nitrogen is in group 5, so it has 5 electrons in its outer shell. **5 outer electrons**

It needs 8 for a full outer shell. **8 – 5 = 3 more**

Each shared pair gives it one more electron. **3 shared pairs**

Answer: 3 covalent bonds, as in ammonia, NH_3

Key terms

Covalent bond	A shared pair of electrons between two atoms.
Molecule	Two or more atoms joined by covalent bonds.
Double bond	Two shared pairs of electrons between two atoms.
Intermolecular forces	Weak forces of attraction between molecules.
Simple molecular substance	A substance made of small molecules, such as water or methane.
Polymer	A very large molecule made of many repeating units joined by covalent bonds.

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Molecular formula	The number of each type of atom in a molecule, for example H_2O.

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Quick questions

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

1. What is a covalent bond?
2. Between which types of element do covalent bonds form?
3. How many covalent bonds does carbon form in methane?
4. Why does water have a low boiling point?
5. What is broken when a simple molecular substance boils?
6. Why don't simple molecular substances conduct electricity?
7. How does the boiling point change as molecules get larger?
8. Why are polymers solid at room temperature?

Answers

1. A shared pair of electrons
2. Non-metals
3. 4
4. The intermolecular forces are weak
5. The weak intermolecular forces
6. The molecules have no overall charge
7. It increases
8. The forces between their large molecules are relatively strong

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

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.