

CHEMISTRY 2 | Structure and bonding

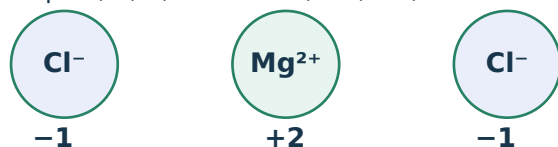
AQA Combined Science Trilogy • Paper 1 • Core knowledge + a labelled Higher Tier reminder

1 Ionic: transfer, then attraction

Metal loses electrons → positive ion.

Non-metal gains → negative ion.

Groups 1, 2, 6, 7 form +1, +2, -2, -1 ions.



Formulae balance charges: NaCl, MgO, MgCl_2 , Na_2O . Use the simplest ratio.

Giant lattice: strong electrostatic attraction between opposite ions in all directions.

High melting point: much energy needed to overcome these attractions.

Conducts molten or dissolved: ions move and carry charge. **Not solid:** ions are fixed. Ion diagrams: full outer shells, brackets, charges.

2 Covalent: shared electron pairs

Covalent bond = shared electron pair attracted to both nuclei. Non-metals share.



Bonds: H 1, O 2, N 3, C 4 in key molecules.

O=O: 2 shared pairs. **N≡N:** 3 shared pairs.

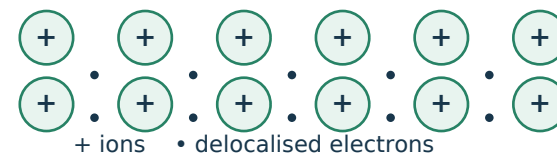
Small molecules: strong bonds inside; weak **intermolecular forces** between molecules.

Low melting/boiling points: little energy overcomes forces **between** molecules. Covalent bonds stay intact.

No conduction: no mobile charged particles. Larger molecules usually have stronger intermolecular forces → higher boiling points.

3 Metals and alloys

Metallic bonding: strong attraction between positive metal ions and **delocalised electrons**.



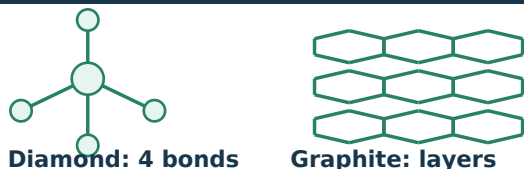
Conduct: delocalised electrons move to carry charge and transfer energy (heat).

Usually high melting points: strong attractions need much energy to overcome.

Pure metal: regular layers can slide, so it can bend and be shaped (**malleable**).

Alloy: metal mixed with other elements. Different-sized atoms distort layers → layers slide less easily → usually **harder**.

4 Giant covalent and carbon sheets



Diamond: 4 bonds per carbon in a rigid 3D network → **hard**; useful for cutting tools. No mobile electrons → **does not conduct**.

Graphite: 3 bonds per carbon in hexagonal sheets. Weak interlayer forces → layers **slide**; soft. One delocalised electron per carbon → **conducts**.

Both: high melting points; many strong covalent bonds need much energy to break.

Silica, SiO_2 : giant covalent; high melting point; does not conduct.

Graphene: one atom-thick sheet; strong and conducting. Used in electronics.

5 Polymers, fullerenes and nanotubes

Polymers: long molecules with strong covalent bonds **along** chains. Relatively strong forces **between** chains → usually solid at room temperature.



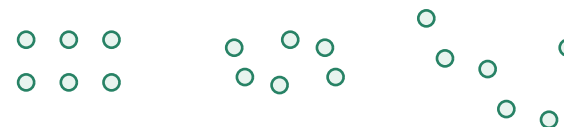
Poly(ethene): n means many repeats

Bonds pass through brackets: chain continues. Each repeat shown contains **2 C and 4 H**.

Fullerenes: hollow carbon molecules. C_{60} : 60 carbons in a spherical cage. Strong covalent bonds inside; weaker forces between separate cages.

Nanotubes: hollow cylinders, long compared to their diameter. Strong covalent bonds → **high tensile strength** → reinforce composites. Suitable nanotubes conduct → electronics.

6 States, symbols and model limits



Solid

Liquid

Gas

Solid: close, fixed positions; vibrate.

Liquid: close, irregular; move past each other.

Gas: far apart; move randomly.

Melting: solid → liquid. **Freezing:** reverse.

Boiling: liquid → gas. **Condensing:** reverse.

Below melting point: **solid**. Between melting/boiling points: **liquid**. Above boiling point: **gas**.

(s) solid; (l) liquid; (g) gas;

(aq) dissolved in water, not just any liquid.

Higher Tier: simple particle models treat particles as solid inelastic spheres and omit forces.