

Topic 2: Bonding, structure and the properties of matter

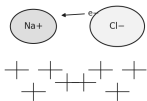
AQA GCSE Chemistry 8462 · spec 4.2 · sheets 2.1–2.4

One idea, three bonds

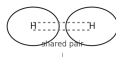
- Electrostatic forces explain ionic, covalent and metallic bonding.
- Structure follows bonding — lattice, molecule, polymer, network, metal.
- Structure predicts melting point and conductivity.

Ionic bonding

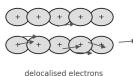
ionic — electrons transferred,
oppositely charged ions attract



covalent — shared
pairs of electrons



metallic — lattice of ions in a
sea of delocalised electrons



- Metal atoms lose electrons; non-metals gain them.
- Ion charges read straight off the group number.
- Opposite ions attract in a giant lattice.

Covalent and metallic bonding

- Covalent — non-metals share pairs of electrons: H_2 , O_2 , H_2O , NH_3 , CH_4 .
- Metallic — a lattice of positive ions in delocalised electrons.
- A line in a formula stands for one shared pair.

Reading properties from structure

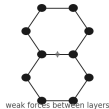
- Ionic lattice — high melting point; conducts only molten or dissolved.
- Small molecules — low melting points; only weak intermolecular forces break.
- Metals — delocalised electrons carry charge and heat; alloys distort the layers.

Carbon's four forms

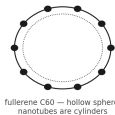
diamond — 4 bonds per atom,
very hard, no conduction



graphite — 3 bonds per atom, layers,
one delocalised electron



fullerene / nanotube



- Diamond — four bonds per atom; hard, high-melting, non-conducting.
- Graphite — three bonds, layers, one delocalised electron.
- Graphene one layer; fullerenes hollow; nanotubes cylinders.

Nanoparticles

1 nm cube
 $SA:V = 6 : 1$



side $\times 0.1 \rightarrow SA:V \times 10$

0.1 nm side
 $SA:V = 60 : 1$



side $\times 0.1 \rightarrow SA:V \times 10$

0.01 nm side
 $SA:V = 600 : 1$



side $\times 0.1 \rightarrow SA:V \times 10$

- Chemistry only — 1 to 100 nm; fine particles to 2500 nm; coarse to 10 micrometres.
- Side shrinks ten times — surface-to-volume ratio grows ten times.
- Uses — catalysts, medicine, cosmetics; concerns — unknown long-term effects.

Check yourself

- Checklist before you call this topic done.
- Three bonds from electrons; the properties table rebuilt.
- Diamond vs graphite vs graphene; the factor-of-ten surface rule.