Exercise walk-through

Metallic bonding ▪ 3.3

eXercise

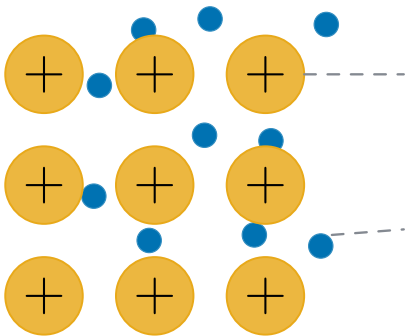
You must be able to

- define metallic bonding as the attraction between positive metal ions and delocalised electrons
- use it to explain electrical conductivity and strength

Method — Metallic bonding

Metallic bonding 金属键 is the **electrostatic attraction** between positive metal ions and a "sea" of **delocalised electrons** 离域电子.
The free electrons explain why metals **conduct electricity** (the electrons move and carry charge) and are **strong** (the attraction acts throughout the lattice).

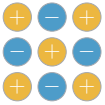
Method — Metallic bonding



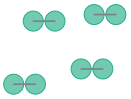
positive
metal ions
sea of delocalised
electrons (free to move)

A regular grid of positive metal ions with electrons scattered in the gaps

Method — Metallic bonding

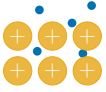


giant ionic
NaCl: high m.p.,
conducts when molten



simple molecular
I_2, ice: low m.p.,
weak forces between

giant covalent
diamond, SiO_2: very
high m.p., insulating



giant metallic
copper: high m.p.,
conducts (solid + molten)

The metallic lattice among the four structures

Practice 2.1 ▪ 2 marks

Define **metallic bonding**.

Solution 2.1

Method: Metallic bonding

Worked steps

the electrostatic attraction **B1** between positive metal ions and delocalised (sea of) electrons **B1**.

Practice 2.2 ▪ 1 mark

Name the particles that carry charge when a metal conducts electricity.

Solution 2.2

Method: Metallic bonding

Worked steps

delocalised electrons B1.

Exam-style 3.1 ▪ 1 mark

Metals conduct electricity because they contain:

A oppositely charged ions

B delocalised electrons that are free to move

C shared pairs of electrons

D weak intermolecular forces

Solution 3.1

Method: Metallic bonding

A oppositely charged ions

B delocalised electrons that are free to move ✓

C shared pairs of electrons

D weak intermolecular forces

Worked steps

B. Delocalised electrons are free to move and carry charge.

Exam-style 3.2 ▪ 2 marks

Explain, in terms of metallic bonding, why metals are good conductors of electricity.

Solution 3.2

Method: Metallic bonding

Worked steps

the delocalised electrons are free to move through the metal **M1**; they carry charge when a voltage is applied **A1**.

Exam-style 3.3 ▪ 2 marks

Magnesium has a higher melting point than sodium. Suggest why, in terms of metallic bonding.

Solution 3.3

Method: Metallic bonding

Worked steps

magnesium ions have a $2+$ charge (vs $1+$ for sodium) and contribute more delocalised electrons **M1**; the stronger attraction needs more energy to break, so a higher melting point **A1**.