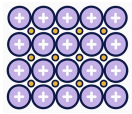
Metallic Bonding Map

Cambridge International AS & A Level Chemistry · Topic 3 Chemical bonding · Metallic bonding

1 Structure

3.3.1, 4.2.1(d)

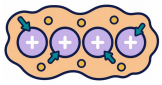
- Atoms lose their **outer electrons**
- A **giant lattice** of positive ions
- The electrons are **delocalised**
- Free to move through the whole lattice
- Often called a **sea** of electrons



2 Metallic bonding

3.3.1

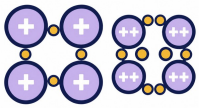
- Electrostatic **attraction** between ions and electrons
- Acts in **all directions**
- Not a shared pair between two atoms
- Strong: most metals melt high
- Holds the whole lattice together

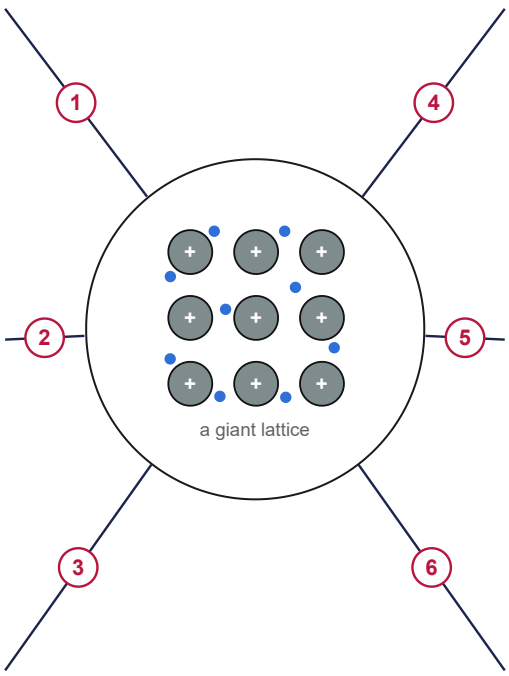


3 What makes it stronger

3.3.1

- A **higher charge** on the ion
- **More** delocalised electrons per atom
- A **smaller** ion
- Na < Mg < Al: b.p. 883, 1090, 2470 °C
- Boiling: a better guide than melting

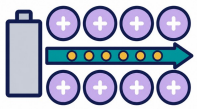




4 Conductivity

4.2.2

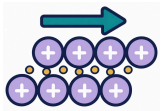
- Delocalised electrons **move** under a p.d.
- They carry the **charge**; the ions stay put
- Conduct as **solid and liquid**
- Heat: electrons and vibrating ions
- More electrons per atom: better conductor



5 Malleable and ductile

4.2.2

- **Malleable**: hammered into shape
- **Ductile**: drawn into wires
- Layers of ions **slide**
- The electron sea still **holds every ion**
- Ionic crystals shatter: like charges repel



6 Melting temperatures

4.2.2

- Giant lattice: bonding **throughout**
- Much energy to overcome: **high** m.p.
- Group 1: large 1+ ions, soft, low m.p.
- Mercury: liquid at room temperature
- Alloys: layers disrupted, harder



Comparing metals

temperatures rounded; b.p. tracks the strength of the bonding best

Metal	Ion	e⁻ per atom	Ion size	m.p. / °C	b.p. / °C
Li	Li^+	1	small	181	1342
Na	Na^+	1	larger	98	883
K	K^+	1	largest	63	759
Mg	Mg^{2+}	2	small	650	1090
Ca	Ca^{2+}	2	larger	842	1484
Al	Al^{3+}	3	smallest	660	2470

Worked examples

Describing the bonding

- Lattice of positive ions
- Sea of delocalised electrons
- Attraction between them

Comparing two metals

- Charge on the ion
- Electrons per atom
- Size of the ion

Metal or ionic?

- Metal: conducts as a solid
- Metal: bends; ionic: shatters
- Ionic: conducts molten only

Metallic, ionic and covalent giant lattices are compared in 4.2 Structure types.

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