

3.3 Metallic bonding

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS delocalised electrons

• metallic bonding

• electron

• ion • electrostatic attraction

Objective

Build the skills to answer exam questions on **metallic bonding** – defining it and using it to explain the properties of metals.

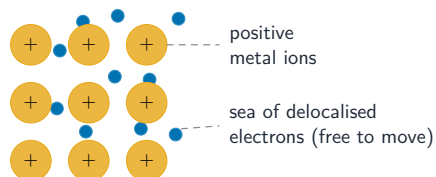
You must be able to:

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

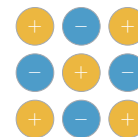
1 Key knowledge and worked examples

■ Metallic bonding

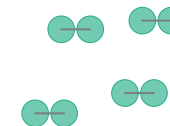
Metallic bonding is the **electrostatic attraction** between positive metal ions and a “sea” of **delocalised electrons**.



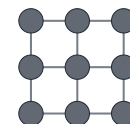
Positive metal ions sit in a sea of delocalised electrons that are free to move



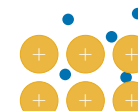
giant ionic
NaCl: high m.p.,
conducts when molten



simple molecular
I₂, ice: low m.p.,
weak forces between



giant covalent
diamond, SiO₂: very
high m.p., insulating



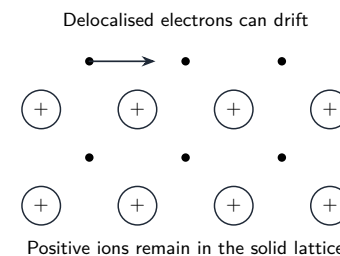
giant metallic
copper: high m.p.,
conducts (solid + molten)

The metallic lattice among the four structures

The free electrons explain why metals **conduct electricity** (the electrons move and carry charge) and are **strong** (the attraction acts throughout the lattice).

■ Worked application: Explain charge movement without moving the lattice

A solid metal conducts because delocalised electrons can drift through its lattice when a potential difference is applied. The positive metal ions remain in their lattice positions, apart from vibration; they are not the moving charge carriers in the solid. Under a force, layers of ions can slide while attraction to the delocalised electrons remains, explaining malleability. Do not use the ionic-solid argument that sliding necessarily brings like-charged ions together and breaks the crystal: metallic attraction is not restricted to one neighbouring ion pair. An alloy can impede layer movement when differently sized atoms disturb the regular arrangement.



2 Practice

2.1 Define **metallic bonding**. [2]

2.2 Name the particles that carry charge when a metal conducts electricity. [1]

3 Exam-style questions

3.1 Metals conduct electricity because they contain: [1]

☐

A oppositely charged ions

B delocalised electrons that are free to move

C shared pairs of electrons

D weak intermolecular forces

3.2 Explain, in terms of metallic bonding, why metals are good conductors of electricity. [2]

3.3 Magnesium has a higher melting point than sodium. Suggest why, in terms of metallic bonding. [2]

3.4 A metal wire carries current and can be bent without shattering. Explain both properties using metallic structure and identify which particles carry the current. [4]
