# 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.

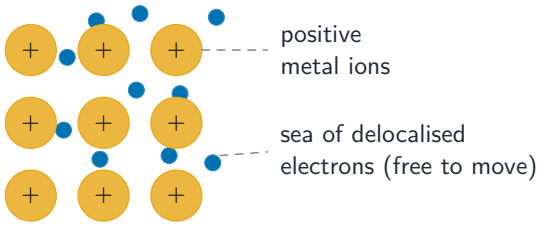
**You must be able to:**

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

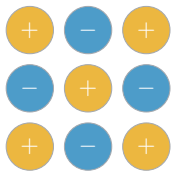
## 1 Key knowledge and worked examples

### Metallic bonding

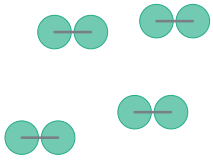
**Metallic bonding** is the **electrostatic attraction** between positive metal ions and a "sea" of **delocalised electrons** .



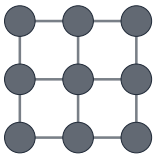

*Positive metal ions sit in a sea of delocalised electrons that are free to move*



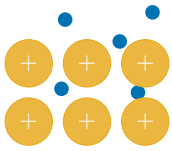
**giant ionic**
NaCl: high m.p.,
conducts when molten



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



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



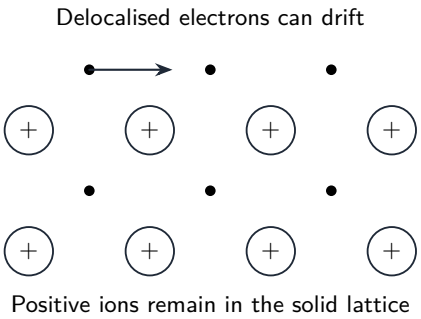
**giant metallic**
copper: high m.p.,
conducts (solid + molten)

*The metallic lattice among the four structures*

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]