

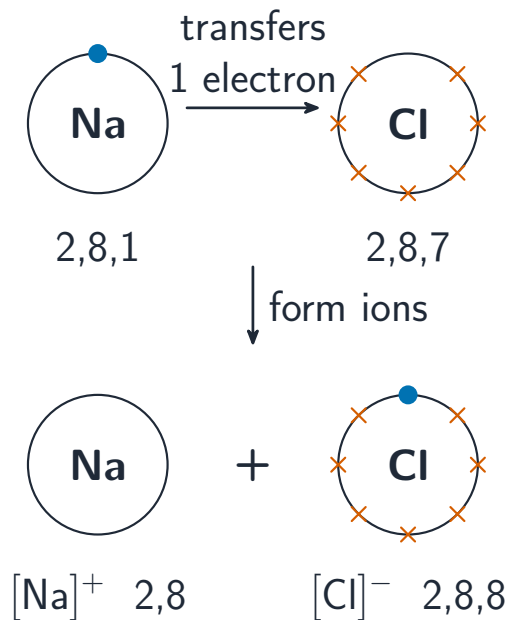
Exercise walk-through

2.7

Metallic bonding

IGCSE Chemistry

Ionic bonding



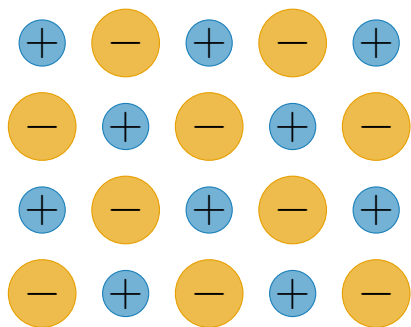
opposite charges
attract:
a strong **ionic
bond**

A metal **gives** electrons to a non-metal; both reach full shells.

- metal → positive **cation**
- non-metal → negative **anion**

An **ionic bond** is the pull between + and - ions.

Ionic lattices and their properties



— Cl^- ion

+ Na^+ ion

a regular, repeating
3-D pattern of
alternating + and —
ions

Ions pack into a giant **lattice**
of alternating + and —.

- **high** melting & boiling points
- solid: does **not** conduct (ions fixed)
- molten / aqueous: **does** conduct (ions free)

Dot-and-cross diagrams, and what the bonding explains

a dot-and-cross diagram

draw each atom's **outer-shell** electrons – dots for one element, crosses for the other – and show where they end up

ionic

electrons are **transferred**; show the ion charges and use square brackets

covalent

electrons are **shared**; show the overlapping outer shells

electrostatic attraction

the strong force between oppositely charged ions – so ionic compounds have high melting points

electrical conductivity

an **ionic compound** conducts only when molten or dissolved, because the ions must be **free to move**

metals

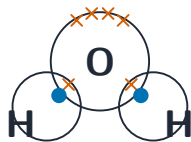
delocalised electrons give conductivity, **ductility**, and malleability

Draw **only the outer shell** unless asked otherwise, and label which atom the dots came from. Both are marked.

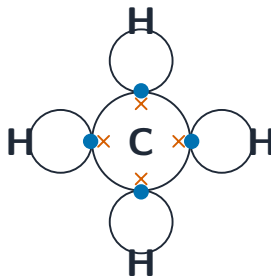
Covalent bonding



hydrogen, H_2
one shared pair



water, H_2O
two shared pairs



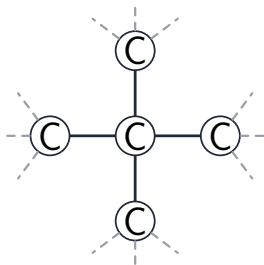
methane, CH_4
four shared
pairs

Non-metals **share** pairs of electrons in a **covalent bond**.

Simple molecules (H_2O , CH_4): **low** melting points (weak **intermolecular forces**) & poor conductors.

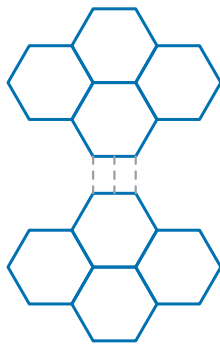
Giant covalent structures

diamond



each carbon
bonded to **4**
others: a hard
3-D network

graphite



flat layers of
hexagonal rings
(each C bonded
to **3**); weak forces
let the layers slide

Millions of atoms bonded into one network:

- **diamond** – 4 bonds each;
very **hard**
- **graphite** – 3 bonds, sliding
layers ; soft, conducts

Graphite's free electrons let it conduct.

Exercises 2.1·2.2

2.1 Define metallic bonding.

[1]

2.2 State what carries the electric charge in a metal.

[1]

Exercises 2.1·2.2

2.1 Define metallic bonding.

[1]

2.1

- metallic bonding is the **electrostatic attraction** between **positive metal ions** and a **sea of delocalised electrons**
-

2.2 State what carries the electric charge in a metal.

[1]

2.2

- charge is carried by the **delocalised (free) electrons**

Exercise 3.1

3.1 A metal can be hammered into a sheet because:

[1]

☐

A the bonds are weak

B layers of ions can slide over each other

C it contains molecules

D the electrons are fixed

Exercise 3.1

3.1 A metal can be hammered into a sheet because:

[1]

☐

A the bonds are weak

B layers of ions can slide over each other

C it contains molecules

D the electrons are fixed

3.1 B

- layers of **positive ions can slide** over each other
- A would make the metal weak; C is molecular; D would not conduct

Exercise 3.2 (a)

3.2 A piece of copper conducts electricity and can be drawn into a wire.

(a) Explain why copper conducts electricity.

[2]

Exercise 3.2 (a)

3.2 A piece of copper conducts electricity and can be drawn into a wire.

(a) Explain why copper conducts electricity.

[2]

(a)

- copper has **delocalised electrons** that are free to move
- they **carry charge** through the metal

Exercise 3.2 (b)

3.2 A piece of copper conducts electricity and can be drawn into a wire.

(b) Explain why copper is ductile (can be pulled into a wire).

[2]

Exercise 3.2 (b)

3.2 A piece of copper conducts electricity and can be drawn into a wire.

(b) Explain why copper is ductile (can be pulled into a wire).

[2]

(b)

- layers of positive ions can **slide** over each other
- metallic bonding is not broken, so the metal **changes shape** instead of breaking

Exercise 3.3

3.3 State why metals generally have high melting points.

[2]

Exercise 3.3

3.3 State why metals generally have high melting points.

[2]

3.3

- **strong electrostatic attraction** between positive ions and delocalised electrons
- a lot of energy is needed to overcome it, so the **melting point is high**