

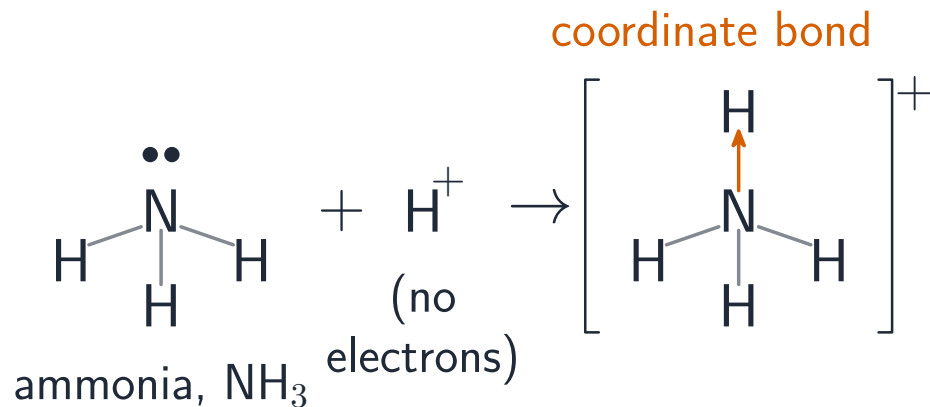
Exercise walk-through

3.3

Metallic bonding

A-Level Chemistry

Covalent and coordinate bonds



A **covalent bond** is a shared pair of electrons.

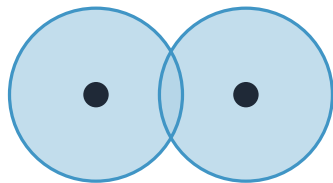
In a **coordinate bond** (dative) **both** electrons come from one atom – e.g. N's lone pair makes NH_4^+ .

Sigma and pi bonds

Covalent bonds form when **orbitals** overlap:

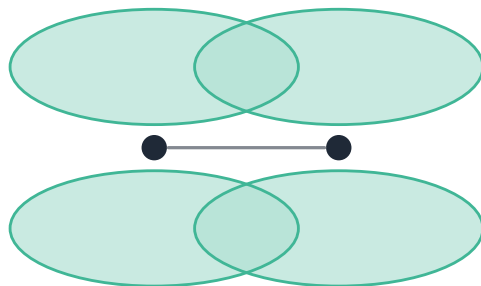
- a **sigma bond** σ – head-on **overlap**
- a **pi bond** π – sideways p-orbital overlap

Double = $1\sigma + 1\pi$; triple = $1\sigma + 2\pi$. **Hybridisation** : sp , sp^2 , sp^3 .



σ bond:

head-on overlap



π bond: sideways overlap
of p orbitals

Bond energy and bond length

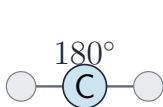
- **bond energy** is the energy needed to break one mole of a particular covalent bond in the gas state.
- **bond length** is the distance between the centres of the two bonded atoms.

Shapes of molecules

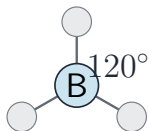
VSEPR theory : electron pairs push apart as far as possible.

A **lone pair** repels harder than a bonding pair, squeezing the **bond angle** ($\sim 2.5^\circ$ each) – so NH_3 is 107° , H_2O 104.5° .

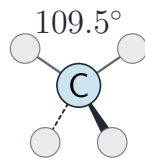
Shapes of molecules, in detail



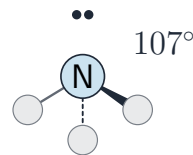
linear
CO2



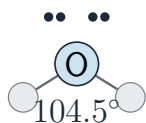
trigonal planar
BF3



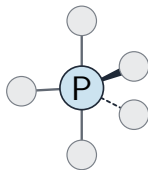
tetrahedral
CH4



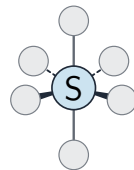
pyramidal
NH3



bent
H2O



trig. bipyramidal
PF5, 120° & 90°



octahedral
SF6, 90°

The seven shapes from VSEPR theory; the lone pairs on NH3 and H2O push harder, squeezing the bond angle below 109.5°

Exercises 2.1-2.2

2.1 Define **metallic bonding**.

[2]

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

[1]

Exercises 2.1·2.2

2.1 Define **metallic bonding**.

[2]

2.1

- the electrostatic attraction between positive metal ions and delocalised (sea of) electrons

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

[1]

2.2

- delocalised electrons

Exercises 3.1·3.2

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]

Exercises 3.1-3.2

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

3.1 B

- Delocalised electrons are free to move and carry charge

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

3.2

- the delocalised electrons are free to move through the metal; they carry charge when a voltage is applied

Exercises 3.3-3.4

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]

Exercises 3.3-3.4

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

3.3

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

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]

3.4

Delocalised electrons are mobile and carry charge through the solid under an applied potential difference; metal-ion layers can slide while attraction between positive ions and delocalised electrons remains.