

Exercise walk-through

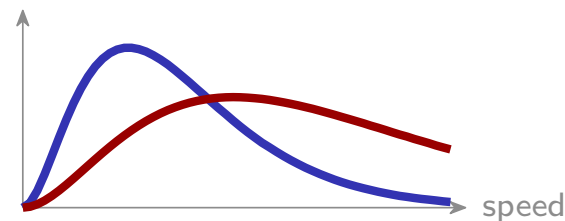
3.1

Intermolecular and Interparticle Forces

AP Chemistry

What we will cover

- 1 Intermolecular forces
- 2 Types of solids
- 3 States of matter and the gas law
- 4 Kinetic molecular theory
- 5 Solutions and solubility
- 6 Separation methods
- 7 Spectroscopy and Beer-Lambert



Why each kind of solid behaves as it does

metallic

conducts electricity and heat, **malleable** and **ductile**
– all because the **free valence electrons** are delocalised across the lattice

ionic

hard and brittle, high melting point; conducts only when molten or dissolved, because the ions must be free to move

covalent network

very high melting point – breaking it means breaking covalent bonds

molecular

low melting point – only the intermolecular forces are broken, not the bonds

the states

differ in how tightly particles are held; rising **temperature** raises average kinetic energy until it overcomes the attractions

Every property follows from **what has to be broken** and **what can move**. Answer those two questions and the property follows.

Exam tips

- **Intermolecular forces** (dispersion < dipole–dipole < hydrogen bonding) set boiling points – they are much weaker than the bonds inside a molecule.
- Boiling breaks the forces **between** molecules, not the covalent bonds within them.
- Use $PV = nRT$ with temperature in **kelvin** and R matched to your pressure/volume units.
- For solutions use molarity $M = \text{mol/L}$; dilution conserves moles, so $M_1 V_1 = M_2 V_2$.
- “Like dissolves like” – polar/ionic solutes dissolve in polar solvents, non-polar in non-polar.

Exercises 2.1-2.3

2.1 Which intermolecular force is present in **all** molecules?

[1]

2.2 Name the strongest IMF in H_2O .

[1]

2.3 State the IMF in CH_4 .

[1]

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2.1 Which intermolecular force is present in **all** molecules? [1]

2.1

- London dispersion forces
-

2.2 Name the strongest IMF in H_2O . [1]

2.2

- Hydrogen bonding
-

2.3 State the IMF in CH_4 . [1]

2.3

- London dispersion forces only

Exercise 3.1

3.1 Hydrogen bonding occurs when H is bonded directly to

[1]

☐

A C, N, or O

B N, O, or F

C any nonmetal

D a metal

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3.1 B

- H bonded to N, O, or F

Exercise 3.2 (a)

3.2 Compare H_2O and H_2S (both bent, similar size).

(a) State the strongest IMF in each.

[2]

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(a)

- H_2O : hydrogen bonding; H_2S : dipole-dipole

Exercise 3.2 (b)

3.2 Compare H_2O and H_2S (both bent, similar size).

(b) Predict which has the higher boiling point, with a reason.

[2]

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[2]

(b)

- H_2O – its hydrogen bonds are stronger than the dipole-dipole forces in H_2S , so more energy is needed to boil it

Exercise 3.3

3.3 Explain why Br_2 (a liquid at room temperature) boils higher than Cl_2 (a gas), even though both are nonpolar. [2]

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3.3

- Br_2 has more electrons than Cl_2 , so its London dispersion forces are stronger, giving a higher boiling point