

Exercise walk-through

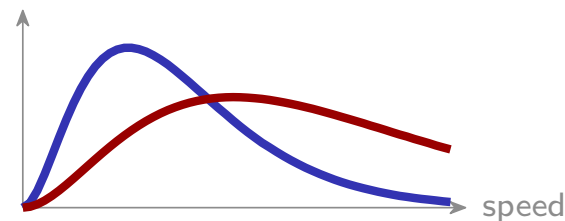
3.10

Solubility

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



The ladder of intermolecular forces

London dispersion

present in **all** molecules – Coulombic attraction between **temporary, fluctuating dipoles**. Stronger with more electrons and a larger, more polarisable cloud

dipole–dipole

–

between polar molecules; strength depends on the size of the dipoles **and their relative orientation**

hydrogen bonding

the strongest of these – H bonded to N, O or F

ion–dipole

an ion beside a polar molecule – what dissolves a salt in water

how to reason

the whole ladder is judged **qualitatively** from the **sign and size of the partial charges**, and how well they can align

Bigger or better-aligned partial charges, or a more polarisable electron cloud, means a stronger force – and a higher boiling point.

Drawing a particulate diagram of a solution

what it shows

the **solute** and **solvent** particles, at the particle level

an ionic solute

show it fully **dissociated** into **separate ions**, each surrounded by solvent molecules

the orientation

water's δ^- oxygen faces the cations, its δ^+ hydrogens face the anions

a molecular solute

show whole molecules, not fragments – sugar does not dissociate

a strong acid

fully ionised: no intact HCl molecules should appear

the marks

come from correct **ratio**, **dissociation and orientation**, not from artistic quality

Count the particles you draw. A diagram showing the wrong stoichiometric ratio loses the mark however neat it is.

Exercises 2.1-2.3

2.1 State the “like dissolves like” rule.

[1]

2.2 Will a nonpolar substance dissolve in water? Give a reason.

[2]

2.3 Name a good solvent for an ionic compound.

[1]

Exercises 2.1-2.3

2.1 State the “like dissolves like” rule.

[1]

2.1

- A solute dissolves in a solvent with similar intermolecular forces (polar dissolves polar, nonpolar dissolves nonpolar)

2.2 Will a nonpolar substance dissolve in water? Give a reason.

[2]

2.2

- No – water is polar; it cannot form favorable attractions with a nonpolar solute, so they stay separate

2.3 Name a good solvent for an ionic compound.

[1]

2.3

- Water (a polar solvent)

Exercise 3.1

3.1 A polar solute is most soluble in

[1]

☐

A a nonpolar solvent

B a polar solvent

C any solvent equally

D no solvent

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3.1 B

- a polar solvent

Exercise 3.2 (a)

3.2 Iodine (I_2 , nonpolar) is shaken with water and with hexane (nonpolar).

(a) In which solvent does it dissolve better?

[1]

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[1]

(a)

- Hexane

Exercise 3.2 (b)

3.2 Iodine (I_2 , nonpolar) is shaken with water and with hexane (nonpolar).

(b) Explain using intermolecular forces.

[2]

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[2]

(b)

- I_2 is nonpolar, so it mixes with the nonpolar hexane (similar dispersion forces) but not with polar, hydrogen-bonded water

Exercise 3.3

3.3 Explain why ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) is soluble in water but hexane is not. [2]

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3.3

- Ethanol has an $-\text{OH}$ group that hydrogen-bonds with water, so it dissolves; hexane is entirely nonpolar and cannot form such attractions with water