

Exercise walk-through

3.11

Spectroscopy and the Electromagnetic Spectrum

AP Chemistry

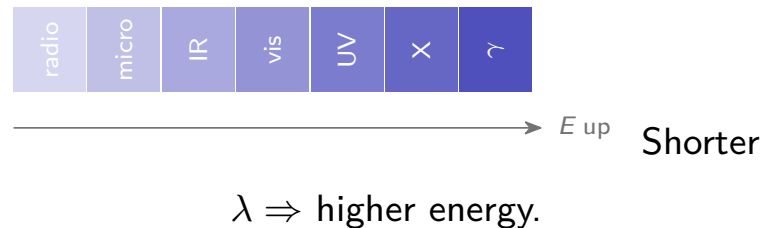
Spectroscopy and the EM spectrum

Absorbed light matches an energy gap:

Photon energy

$$E = h\nu = \frac{hc}{\lambda}$$

- microwave – **rotational**
- **infrared** – **vibrational**
- UV/visible – **electronic**



Properties of Photons

Light is carried by **photons** , each with energy $E = h\nu = \frac{hc}{\lambda}$.

Higher frequency (shorter wavelength) means higher energy.

The Beer-Lambert law

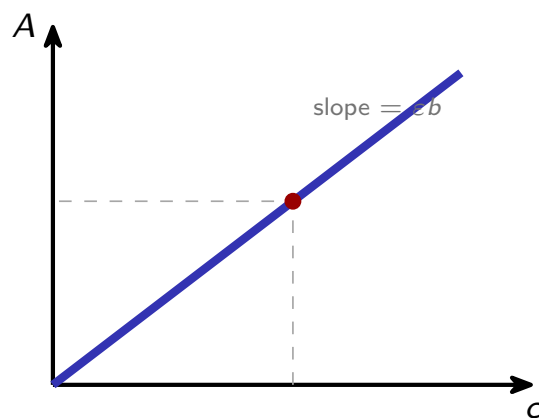
A coloured solution's **absorbance** is proportional to its concentration:

Beer-Lambert

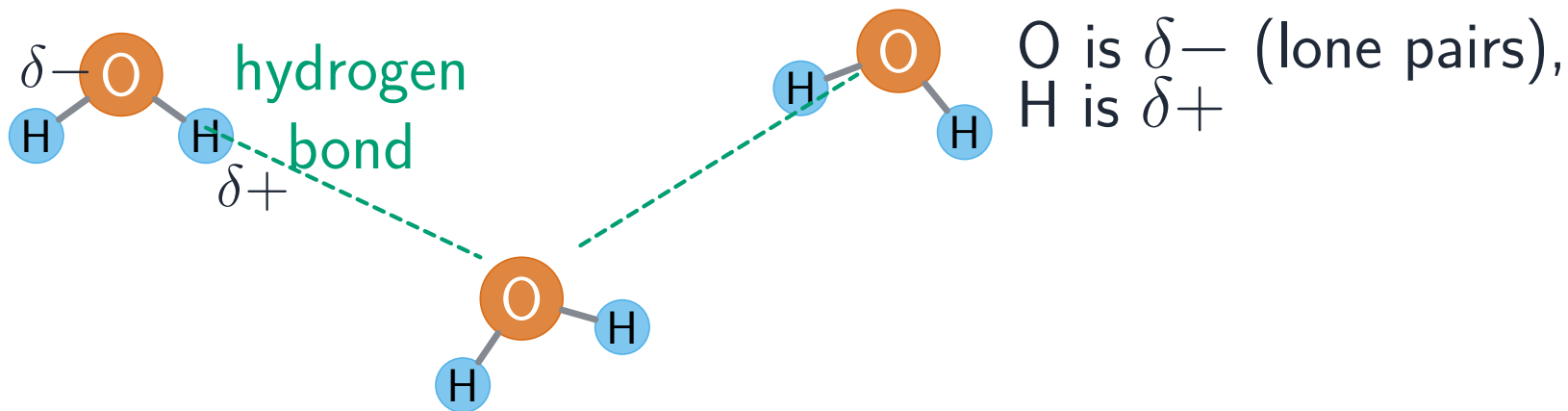
$$A = \epsilon bc$$

ϵ = **molar absorptivity** , b =
path length .

A **calibration curve** of A vs c is a straight line – read an unknown off it.

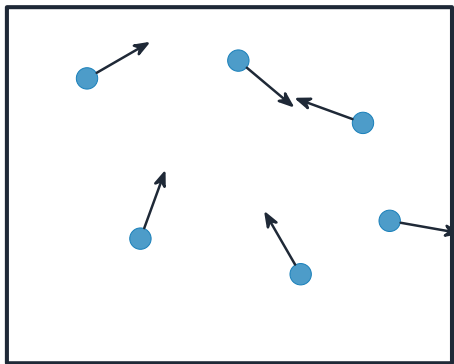


Intermolecular and Interparticle Forces

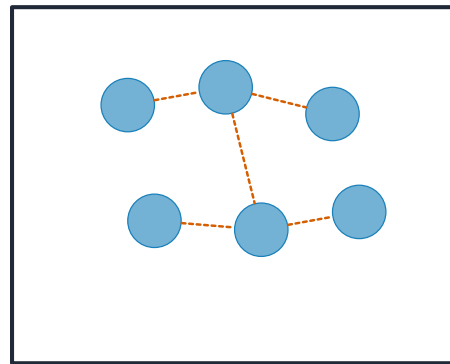


Hydrogen bonding: an H on N/O/F is attracted to a lone pair on another molecule

The Ideal Gas Law



ideal gas (model)
point particles, *no* forces



real gas: high p , low T
real size + attractions (dashed)

An ideal gas is a model of point particles with no forces between them

Exercises 2.1-2.3

2.1 Which has more energy: UV or infrared radiation?

[1]

2.2 Which region of the spectrum causes bond **vibration**?

[1]

2.3 As wavelength decreases, what happens to photon energy?

[1]

Exercises 2.1-2.3

2.1 Which has more energy: UV or infrared radiation? [1]

2.1

- UV
-

2.2 Which region of the spectrum causes bond **vibration**? [1]

2.2

- Infrared
-

2.3 As wavelength decreases, what happens to photon energy? [1]

2.3

- It increases

Exercise 3.1

3.1 Electron transitions between energy levels are typically caused by

[1]

☐

A microwaves

B infrared

C UV-visible light

D radio waves

Exercise 3.1

3.1 Electron transitions between energy levels are typically caused by

[1]

☐

A microwaves

B infrared

C UV-visible light

D radio waves

3.1 C

- UV-visible light drives electron transitions

Exercise 3.2 (a)

3.2 A molecule absorbs strongly in the infrared region.

(a) What kind of molecular motion is being excited?

[1]

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(a) What kind of molecular motion is being excited?

[1]

(a)

- Bond vibration

Exercise 3.2 (b)

3.2 A molecule absorbs strongly in the infrared region.

(b) Explain what “absorption” means at the particle level.

[2]

Exercise 3.2 (b)

3.2 A molecule absorbs strongly in the infrared region.

(b) Explain what “absorption” means at the particle level.

[2]

(b)

- The molecule takes in a photon whose energy exactly matches an allowed transition, raising it to a higher-energy state

Exercise 3.3

3.3 Arrange these in order of increasing energy: infrared, X-ray, visible, microwave. [2]

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3.3

- microwave < infrared < visible < X-ray