

CHM1011 - CHEMISTRY

ATOMIC STRUCTURE

Structure of atoms

- The number of protons = **atomic number (Z)**.
- **The mass number (A)** = protons + neutrons
- Atoms contain protons (+ve), neutrons & electrons (-ve).
- The number of protons governs each element.
- Electrons are ~2000 times lighter than protons!

Light and matter

- Light is a form of electromagnetic radiation and interacts with matter
- Wavelength (λ) is inverse to frequency (ν)
- All electronic radiation travels at the same velocity
- The speed of light $c = 3.00 \times 10^8 \text{ m/s}$
- Frequency (Hz or s^{-1}) * wavelength (m) = speed of light
- $\nu \lambda = c$

Quanta and the photoelectric effect

- Photons have energy proportional to frequency: $E = h \nu$
- $h = 6.63 \times 10^{-34} \text{ J/s}$, therefore $E = hc/\lambda$
- **Quantum theory** – energy comes in packets and is discrete

Wave particle duality

- Light is an example of wave particle duality.
- If light can have material properties, matter should exhibit wave-like properties
- Moving particles have a wavelength given by $\lambda = h/p$, where $p = mv$. (P is momentum)
- *For very light things (e.g. electrons), λ is significant*
- But macroscopic objects λ is far too small to be detected

Schrodinger wave equation – Quantum mechanics

- ψ can only be used to make statements as to the *probability* of locating the electron. $H\psi = E\psi$
- It tells us where and what for electrons
- **Probability density** - describes the probability of finding an electron at a point in space

Quantum numbers

- The Rydberg and Balmer equations may be used to describe the energy difference between energy levels which are described by quantum numbers.
- Quantum numbers represent the unique solutions to the Schrodinger equation

Name	Symbol	Allowed Values	Property
principal	n	positive integers (1, 2, 3,...)	orbital energy (size)
angular momentum	l	integers from 0 to $n-1$	orbital shape (l value 1, 2 and 3 correspond to p , d and f orbitals, respectively.)
magnetic	m_l	integers from $-l$ to 0 to $+l$	orbital orientation

- $L=0$, orbital is s
- $L=1$, orbital is p
- $L=3$, orbital is d
- $L=4$, orbital is f