Atomic Structure

- The smallest part of an element is an atom

$$^{A}_{Z}X^{n+/n-}$$

A: atomic mass / sum of protons + neutrons
Z: atomic number or number of protons
n+/n-: charge

- Ions are charged particles that are formed when an atom losses or gains an electron(s).

Cation (+ ion) loses electron(s)
Anion (- ion) gains electron(s)

- Isotopes are different atoms of the same element with different mass number: i.e same number of protons but different number of neutrons.

↓

Have same chemical properties as the number of electrons and protons are same. Further the chemical reactions depend only on the ~~composition~~ number and arrangement of electrons and not on the composition of nucleus.

↓

They have different physical properties eg different melting points and boiling points. For example the different masses mean that their atoms moves at different speeds.

- The relative atomic mass (A_r) of an element is the average of the masses of the isotopes in a naturally occuring sample of the element relative to the mass of 1/12 of an atom of carbon-12

Eg: 75% $^{35}_{17}Cl$ and 25% $^{37}_{17}Cl$

$$\frac{(75 \times 35) + (25 \times 37)}{100} = 35.5\ g\,mol^{-1}$$

- Mass Spectrometer

Vaporized sample injected → Atoms are ionized and bombarded with a high energy ste electrons in the ionization chamber → Unipositive ions pass through holes and are accelerated under the influence of an electric field. → Deflected by magnetic field. → Deflection depends on mass and its charge.

- The electromagnetic spectrum

$c = f\lambda$ frequency $\propto \frac{1}{\text{wavelength}}$ $\propto$ energy

radio waves	microwaves	infrared	visible light	ultraviolet	X-rays

→ increasing frequency → increasing energy → decreasing wave

In the visible region, the spectrum consists of a series of sharp, bright lines. This is line spectrum, as opposed to a continuous spectrum, which consists of all the colours merging into each other

Lines get closer at higher frequency

Line spectrum - only certain frequency / wavelengths of light present

Continuous spectrum - all frequencies / wavelengths of light present.

- The electron is in the lowest energy level. This is called the ground state → The electron gains energy and moves to a higher energy level → This is the excited state → The electron is unstable in this higher level and will fall to a lower

energy level. ⟶ The extra energy is given out in the form of a photon of light. ⟶ This contributes to the emission spectrum.

Gives evidence for electrons being in energy levels (shells)

Infrared – Paschen series
Visible – Balmer series
Ultraviolet – Lyman series

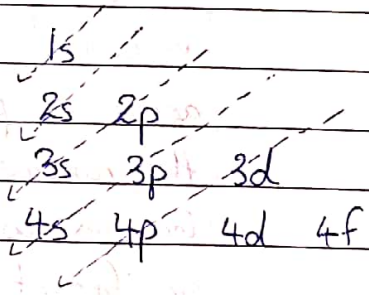
All atoms have different emission spectrum as the number of protons in the nucleus also influences the electron energy levels

γ-rays
length

The lines get closer at higher frequency/energy and eventually at the convergence limit, the lines merge to form a continuum. The electrons falling from outside the atom.

- The Aufbau principle
Electrons fill sub-levels from the lowest energy level upwards - Each orbital can contain a maximum of 2 electrons

An orbital is a region of space in which there is a high probability of finding an electron. It represents a discrete energy level.



- Pauli exclusion principle - the maximum number of electrons in an orbital is two. If there are two electrons in an ~~of~~ orbital, they must have opposite spin.

- Hunds rule - subshells are filled singly first then doubly

- Ionisation energy is the minimum amount of energy required to remove an electron from a gaseous atom.

$E = hf$ $\quad\quad$ $c = f\lambda$

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

- Second ionization is always higher than the first
  - As one electron is removed the atom becomes more positive and it attracts negatively charged electrons more strongly than the neutral atom. Therefore more energy required.
  - As an electron is removed there is less repulsion between the remaining electrons. They are therefore pulled in closer to the nucleus, thus strongly attracted and more difficult to remove.

Ionisation energy ⟶ large jumps when an electron is removed from a new main energy level.

↓ in general increases across a period as the nuclear charge increases with no significant change in sheilding

↓ The electrons in the new energy level is closer to the nucleus and so more strongly attached.

↓ Eg:- B has a lower ionisation energy Be because, from different shells. electrons are removed