# Atomic Structure Summary

| Subatomic particle | Symbol | Relative mass | Relative charge | Deflection in electric field |
|---|---|---|---|---|
| Proton | p | 1 | +1 | Towards **negative** electrode |
| Neutron | n | 1 | 0 | Not deflected |
| Electron | e | $\frac{1}{1840}$ | –1 | Towards **positive** electrode |

Behavior of particles in an electric field:

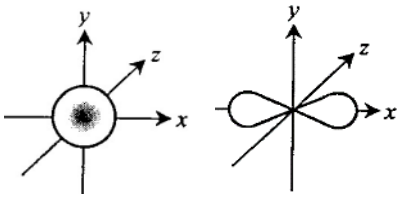
$$\text{angle of deflection} \propto \frac{\text{charge}}{\text{mass}} \text{ of particle}$$

Isotopes are atoms of the same element which contain the same number of protons but different number of neutrons.

Isoelectronic species are atoms/molecules/ions that have the same number of electrons.

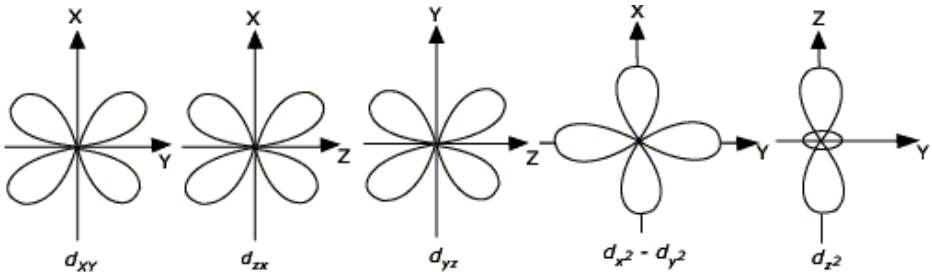
| Principal Quantum Number, n | Number of subshells | Types of subshells | Names of subshells |
|---|---|---|---|
| 1 | 1 | s | 1s |
| 2 | 2 | s p | 2s 2p |
| 3 | 3 | s p d | 3s 3p 3d |
| 4 | 4 | s p d f | 4s 4p 4d 4f |

Shape of s and p orbitals:




s orbital p orbital

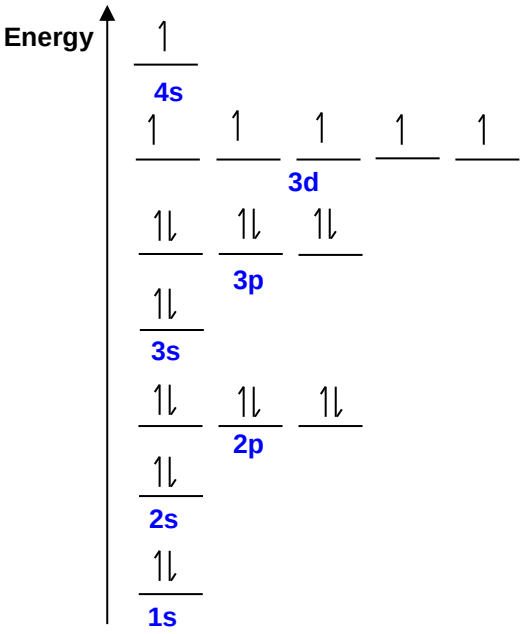
Shape of d orbitals:




Example: Cr: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

Electronic configuration: **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2$** ← fill 4s before 3d

(Cr and Cu has extra stability for half-filled and fully filled 3d subshell)




4s subshell has a **lower energy** level than 3d subshell (when it is **not occupied** by electrons).

Once the 4s subshell is **occupied** by electrons, 4s subshell will have a **higher energy** level than 3d subshell.

Due to repulsion and close energy gap between of 4s and 3d subshells.

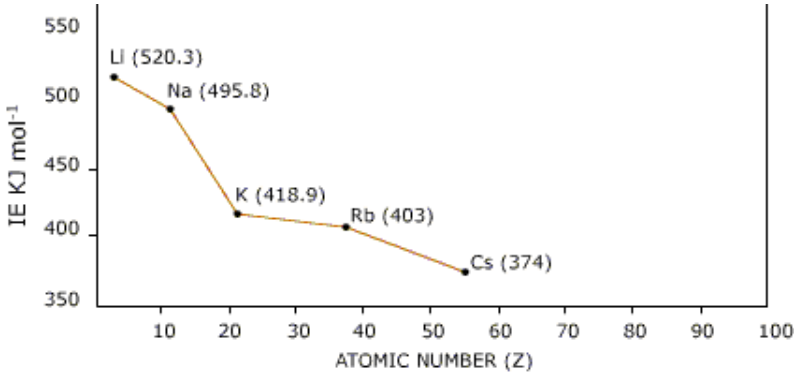
**First ionisation energy is the energy required to remove one mole of electrons from one mole of gaseous atoms of the element to form one mole of singly charged positive gaseous ions.**

$$X(g) \longrightarrow X^{+}(g) + e$$

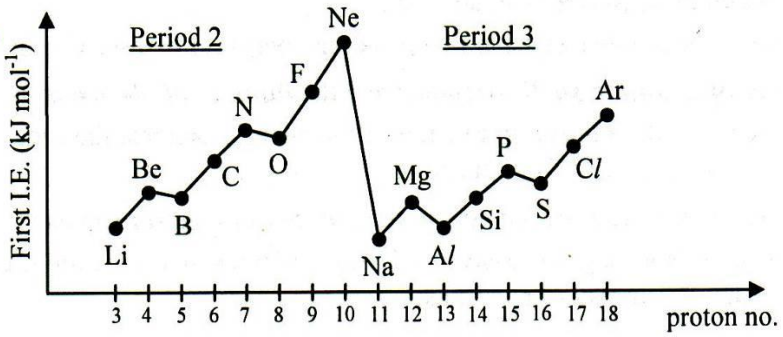
**Factors affecting Ionisation Energy**

1. Nuclear Charge
2. Shielding Effect
3. Atomic Size

**1) Trend Down** the Group: **decreases** down a group due to increasing shielding effect & **increasing atomic radius.**




**2) Trend Across** a period: **generally increases** across the period. Nuclear charge increases but shielding effect is relatively constant. Thus **effective nuclear charge increases.**




**Two anomalies** across period:

1. Group 2 to 13 – due to **change in subshell** from s orbital to p orbital.
2. Group 15 to 16 – due to **interelectronic repulsion** between paired electrons in p orbital.

**3) Trend** Successive ionization energy **increases** as increasing amount of energy is needed to remove successive electrons from an **increasingly positive ion**.

We can deduce from successive ionization data/chart:

- the number of electrons in an atom
- number of quantum shells and subshells
- group number