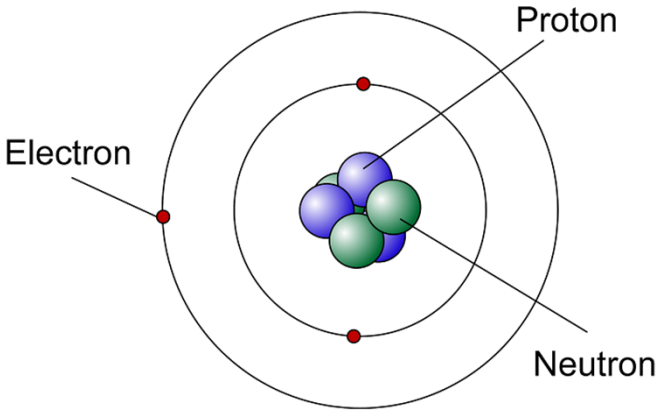
# P4 Knowledge Organiser – 4.4.1 – Atomic structure

## The Structure of an Atom

Atoms have a radius of about $1 \times 10^{-10}$m.

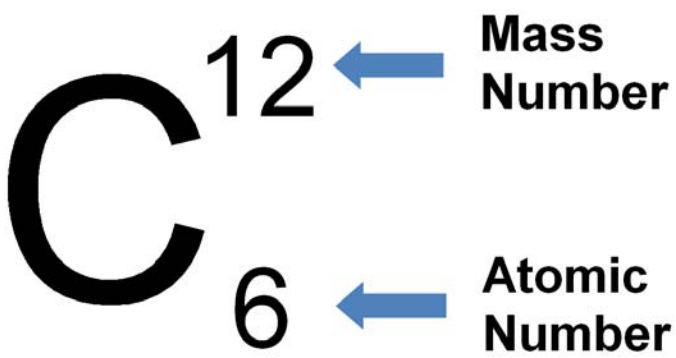



- In an atom the number of electrons is equal to the number of protons in the nucleus and atoms have no overall electrical charge.

| Particle | Mass (amu) | Charge |
|---|---|---|
| Proton | 1 | +1 |
| Neutron | 1 | 0 |
| Electron | 0 | -1 |

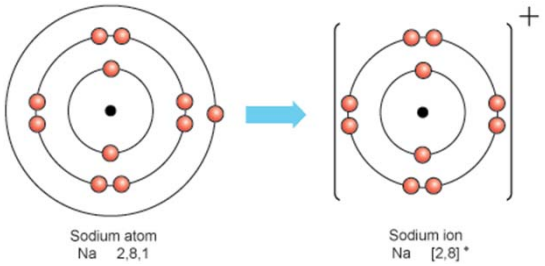
## Mass Number and Atomic Number

- The atomic mass is the total number of protons and number of neutrons.
- Atomic number is the number of protons in an atom



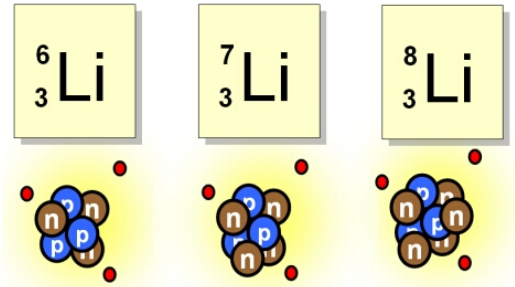

## Ions

A positive ion can be created is an atom loses one or more electrons.




## Isotopes

An isotope is an atom of the same element with a different number of neutrons.




## Development of the Model of the Atom

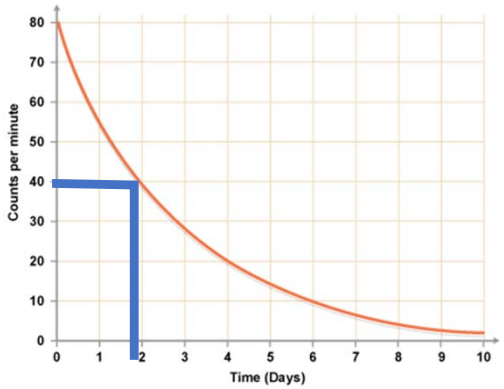
- Dalton suggested that atoms were tiny spheres that could not be divided.
- JJ Thompson then discovered the electron. He also suggested the Plum Pudding Model.
- Then due to results from the alpha particle scattering experiment the nuclear model of the atom was suggested.
- Niels Bohr suggested that electrons orbit the nucleus at specific distances and then James Chadwick proved the existence of neutrons.

| Nuclear model | Plum pudding |
|---|---|
| Protons in nucleus | Positive ball of charge |
| Electrons in shells | Electrons randomly scattered |
| Neutrons in nucleus | No neutrons |
| Nucleus present | No Nucleus |

# P4 Knowledge Organiser – 4.4.1 – Atomic structure

## Half-Life

The time it takes for the number of nuclei of the isotope in a sample to halve, or the time it takes for the count rate to fall to half its start level.




## Radioactive Decay and Nuclear Radiation

- Some atomic nuclei are unstable.
- A nucleus can give out radiation in order to become more stable.
- This is a random process called radioactive decay.
- The nuclear radiation emitted can be in the form of alpha, beta or gamma radiation.

## Gamma Decay

The emission of a gamma ray does not cause the mass or the charge of the nucleus to change.

## Contamination

Contamination is the unwanted presence of materials containing radioactive atoms ending up on other materials.

## Irradiation

Irradiation is the process of exposing an object to nuclear radiation. The irradiated object does not become radioactive.

## Alpha Decay

An alpha particle (helium nucleus) is emitted from the nucleus.

$$^{219}_{86}\text{radon} \longrightarrow {}^{215}_{84}\text{polonium} + {}^{4}_{2}\text{He}$$

The $^{4}_{2}\text{He}$ is the symbol for the alpha particle. Notice that the mass number and atomic number are balanced on each side.

## Beta Decay

A beta particle (electron) is emitted from the nucleus when a neutron turns into a proton.

$$^{14}_{6}\text{carbon} \longrightarrow {}^{14}_{7}\text{nitrogen} + {}^{0}_{-1}\text{e}$$

The $^{0}_{-1}\text{e}$ is the symbol for the beta particle. Notice that the mass number and atomic number are balanced on each side. The element has mutated because it now has an extra proton.

| Radiation | Symbol | Consists of.. | Blocked By.. | Range in Air | Ionising Power |
|---|---|---|---|---|---|
| Alpha | $\alpha$ | 2 neutrons and 2 protons | Paper | 5cm | High |
| Beta | $\beta$ | High speed electron | Thin Aluminium | 1m | Medium |
| Gamma | $\gamma$ | Electromagnetic Radiation | Thick Lead/ Concrete | Infinite | Low |