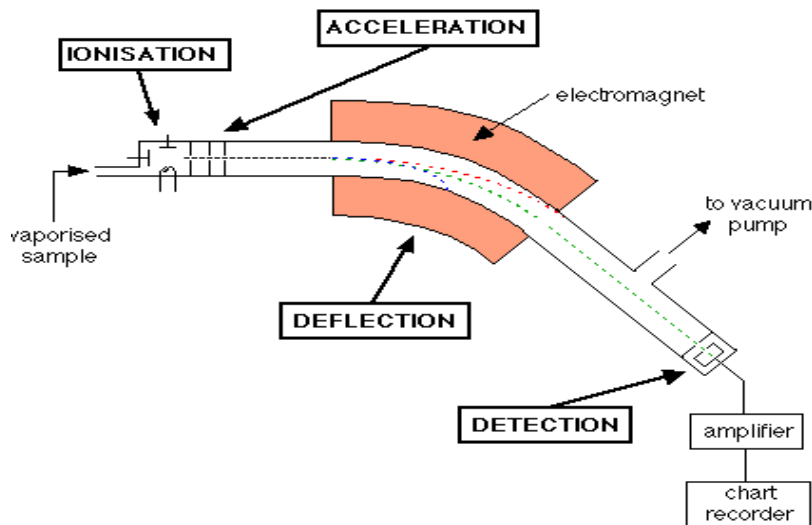


THE MASS SPECTROMETER

The most accurate method of determining atomic masses is by the use of the mass spectrometer. The principle is to determine the relative abundance of the isotopes of the element, and their isotopic masses; the weighted mean of these (that is, taking into account the percentage abundances) is then the atomic mass.



Five main operations are performed by the spectrometer:

1. The sample of the element is vaporized
2. Positive ions are produced from the vapour
3. The positive ions are accelerated by a known electric field
4. The ions are then deflected by a known magnetic field
5. The ions are then detected

*Study Aid: an easy way to remember this is through an antonym; **VIADD**:
(Vaporization, Ionization, Acceleration, Deflection, Detection)

The manner in which these stages are achieved may be seen from the above figure:

A stream of vaporized element enters the main apparatus which is maintained under high vacuum.

The atoms of the element are bombarded by a stream of high-energy electrons, which on collision with the atoms knock electrons out of them and produce positive ions.

The positive ion stream passes through holes in two parallel plates to which a known electric field is applied, and the ions are accelerated by this field.

They then enter a region to which a magnetic field is applied, and they are deflected by it.

For given electric and magnetic fields only ions with one particular mass will reach the detector at the end of the apparatus, all other ions having hit the walls of the instrument.

By gradually increasing the strength of the magnetic field, ions of different masses may be brought successively to the detector.

Their masses are calculated from the known applied fields, and their relative abundance is found from the relative magnitudes of the current produced in the detector.

The amount of deflection is dependent on the mass of the ion and on its charge.

Lighter ones are deflected more than heavier ones.

Ions with a greater charge are deflected more than those with smaller charge.