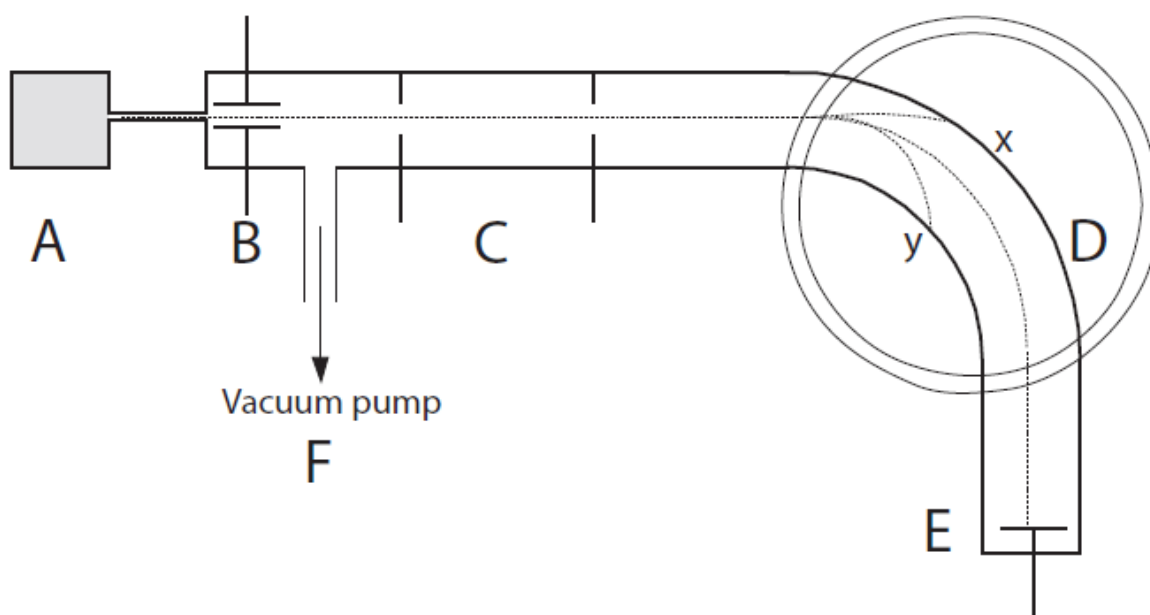


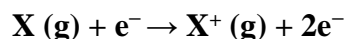
Mass Spectrometer

- A **mass spectrometer** is an instrument which *separates particles according to their masses and records the relative proportions*.
- Substance is **first converted to atoms or molecules in the vapour phase (A)**.
- Then **turned into positive ions (B) and accelerated (C)**.
- The **fast moving ions are deflected (D)** - *the lighter the particle the greater the deflection*.
- **Particles of a particular mass will be detected (E)**.
- Body of instrument must be **maintained at high vacuum by pump (F)**.



- **Region A** contains *vaporized substance*.
 - If already a gas, then it will contain gas at low pressure, if sample is a solid or liquid, it must be heated to produce vapour.
 - It is connected to rest of mass spectrometer by a fine tube, or capillary, so that transfer of material into body of instrument occurs slowly.
 - This is vital as body of mass spectrometer must be kept at high vacuum for correct operation, which depends on particles being able to pass through it without colliding with each other.
- In **region B**, particles are *converted from neutral atoms or molecules into positive ions* which is done by **bombarding them with fast moving electrons, accelerated between two plates**.

- Electrons *collide with electrons in particle knocking them out and leaving a positive ion.*



- In **region C**, *positive ions are accelerated by high electrical potential difference between two parallel electrodes with holes in their centres.*
- In **region D**, *fast moving ions enter a magnetic field* produced by an electromagnet, *causing them to deflect.*
 - Particles of certain mass (dependent on the field strength) will continue round the tube and strike detector plate. Those with greater mass will not be deflected as much and those with a smaller mass will be deflected more (*deflection depends on the charge to mass ratio m/z*).
- *Only ions of a certain mass are detected at E*, usually by means of current flow required to neutralize the positive charge - greater the number of particles of given mass, greater the current.
- By varying strength of magnetic field, ions of different masses can be brought to focus on detector.
- In this way *relative abundances of ions of different masses produced from sample can be determined*. This is known as **a mass spectrum**.
- Usually electron bombardment is adjusted to produce ions with only a single charge.
- Doubly charged ions will be deflected more than singly charged ions and will in fact behave in same way as a singly charged ion of half the mass.
- **To summarize, the main operations are:**
 - A vaporized sample introduced
 - B ionization by electron bombardment
 - C positive ions accelerated by electrical field
 - D ions deflected by a magnetic field
 - E detector records ions of a particular mass
 - F vacuum prevents molecules colliding