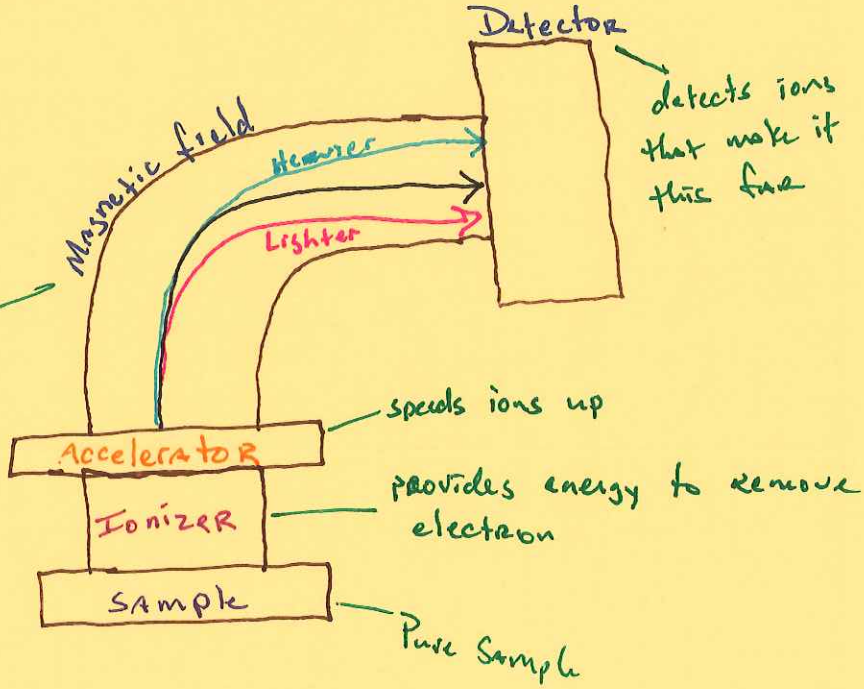
Mass Spectrometry

Intro: Atomic models are based upon current scientific data. When new evidence comes forth models must be revised. Dalton's early atomic model stated that all atoms of an element are identical so when mass spectrometry was invented and provided direct evidence of isotopes, Dalton's model needed revision.

Mass spectrometer:
early 1900's



Amount of effect of magnetic field is proportional to mass of ion

Mass Spec Lines show

These are isotopes of each other

- **Black Line** - according to Dalton's Model should only see this ion in the pure sample
- Blue Line - ions that are heavier
- Pink Line - ions that are Lighter

Take away from Detector data:

- multiple peaks detected
- means masses are not identical

↳ therefore in a pure sample not all atoms are exactly the same

Early 1800s : Daltons Atomic Theory

True 1.) elements made of extremely small particles called atoms

~~First~~ Revised 2.) Atoms of a given element are identical in size, mass, and other properties

↳ needed revision because of discovery of isotopes

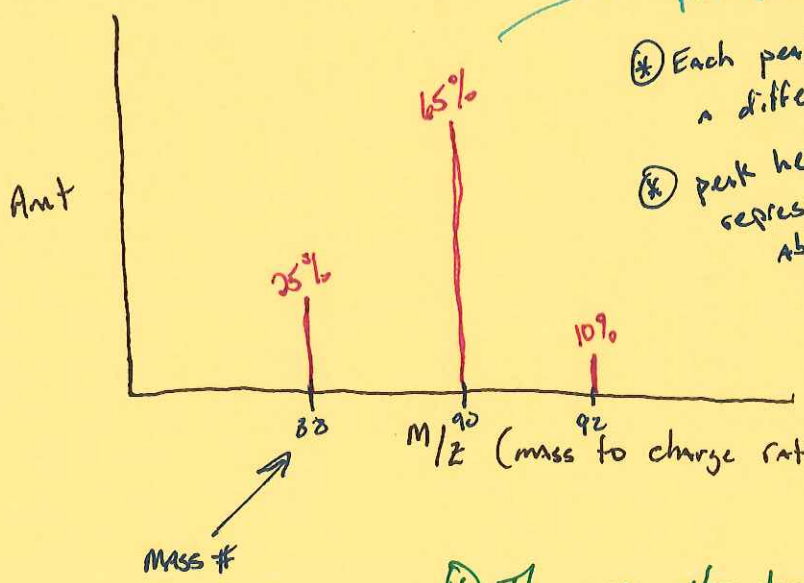
Revised 3.) Atoms cannot be subdivided, created, or destroyed

↳ nuclear chemistry proved this part Incorrect

True 4.) Atoms of different elements combine in simple whole # ratios to form chemical compounds

True 5.) In a chemical reaction atoms are combined, rearranged or separated

output from Mass Spec



Amount can be:

1.) Percent Abundance

2) Relative amount, which we will need to convert to percent

* percentage is percent abundance in this case

* Each peak represents a different isotope

* peak height is representative of abundance

* The more abundant an isotope is the closer the average atomic mass is to that isotope

* Can use graph to estimate average atomic mass (combine peaks)

Calculating Avg Atomic Mass

1.) Multiply: % Abundance x Mass

2) Add all values together

Isotopes - same # of protons, different # of neutrons

↘

Isotope mass denoted by mass #

$$\text{Mass \#} = (\#\ p+) + (\#\ n)$$

mass #: will always be whole #

(*) May be slightly different than average atomic mass

Isotope Notation:

element abbreviation or name

mass #

1.) Hyphen notation: X - 88

Cl - 36

Chlorine - 36

↙

determining # of neutrons:

$36 = 17 + n$

$n = 19$.

# of protons NOT ALWAYS equal to neutrons

2.) Nuclear Notation

mass # ↓ 88

Atomic # → 17

$^{36}_{17}Cl$ ← always abbreviation!

Calculating Average atomic mass for Sample above:

$$88(0.25) + 90(0.65) + 92(0.10) = 89.7\ \frac{g}{mol}$$

mass # ↑ percent abundance