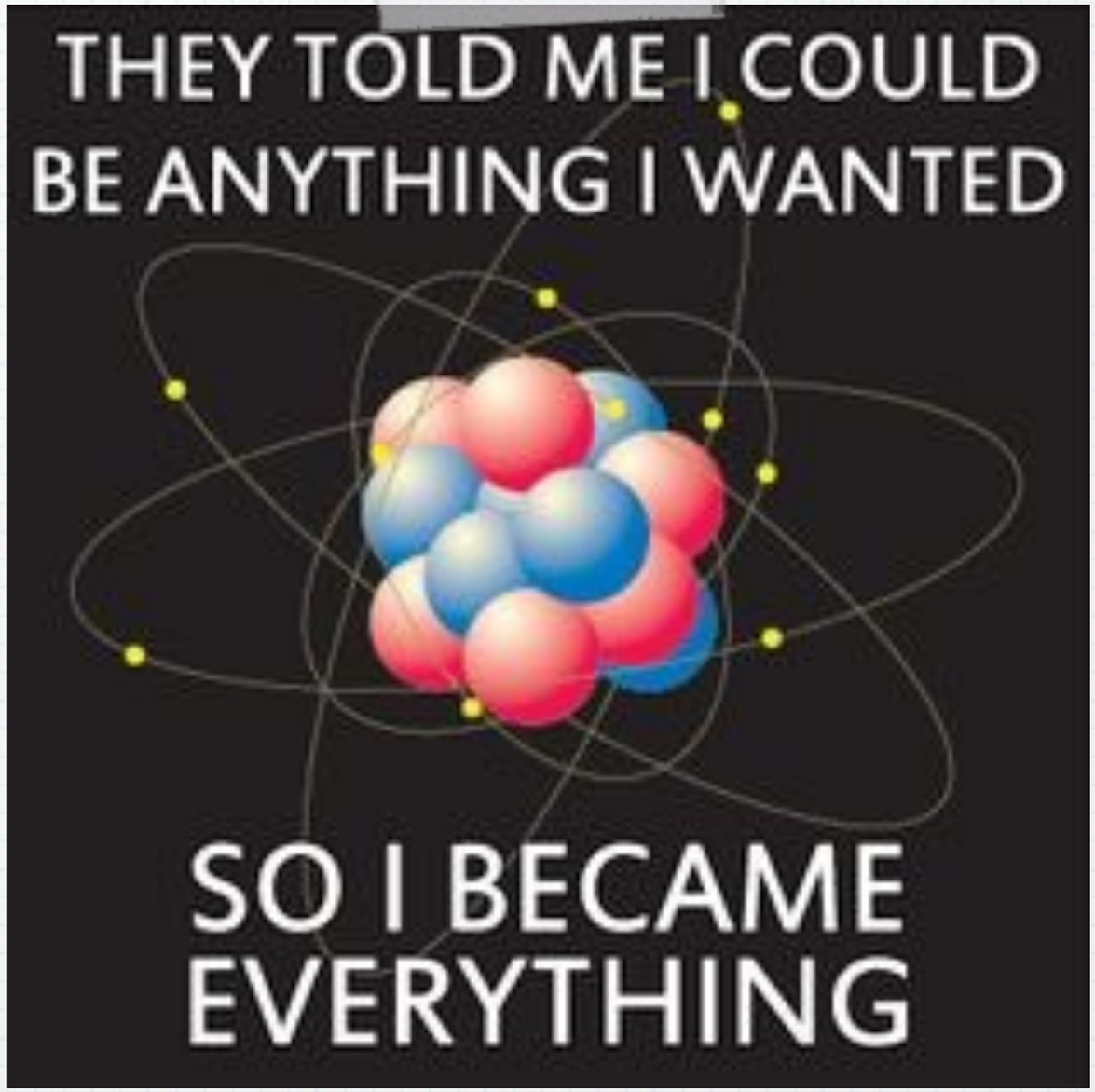
Atomic Structure

Tuesday 10.06.15



Agenda

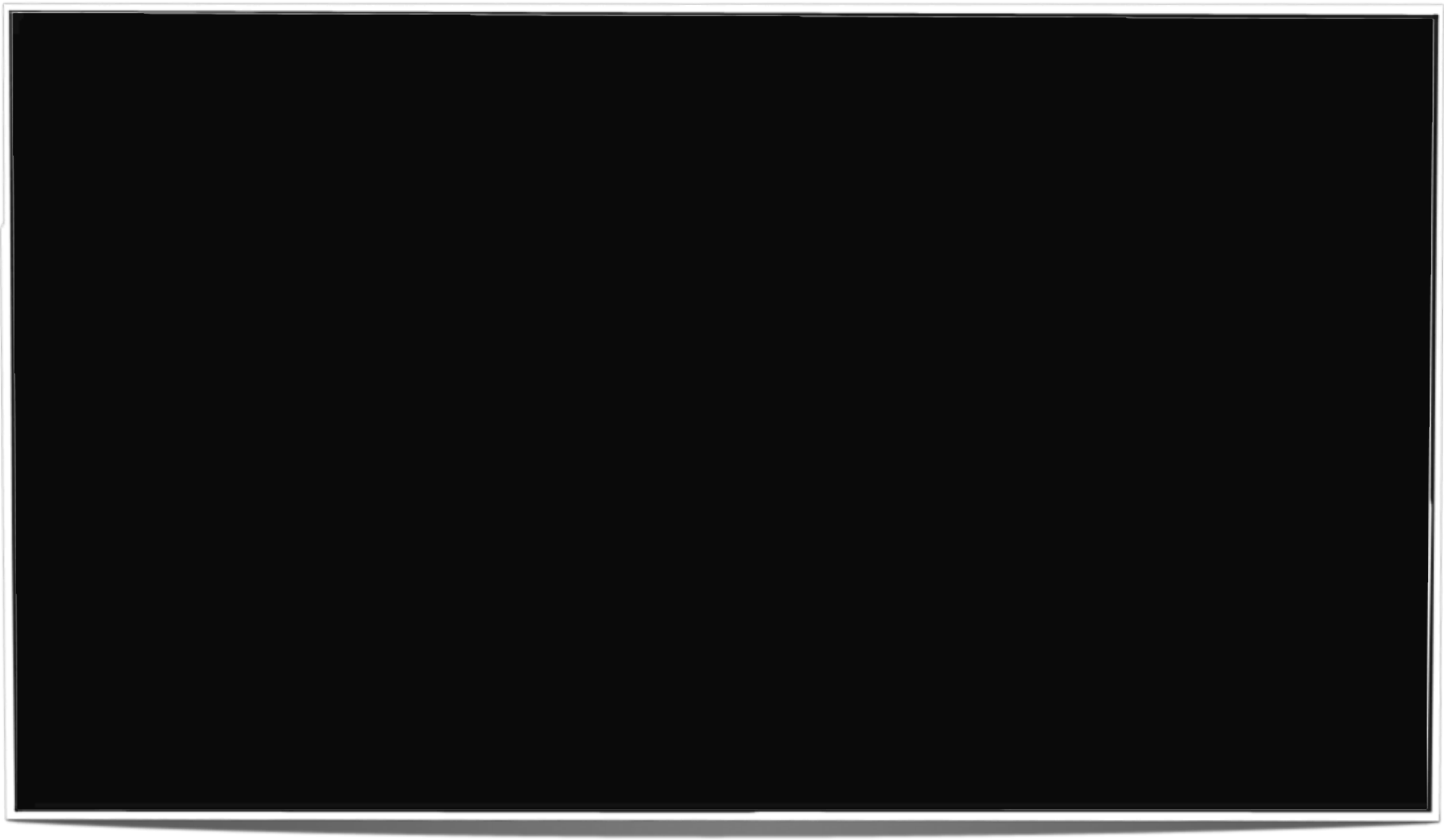
* Finish Topic 2.1
* Begin Protons, Neutrons, and Electrons practice worksheet
* Isotopes and Ions practice worksheet

Atomic Structure

The nuclear atom

Electron Configuration

Ms. Thompson - Honors Chemistry
Wooster High School



Atomic Structure

The nuclear atom

Subatomic particles and descriptions of the atom

- **Ions** are charged particles that are formed when an atom loses or gains an electron(s).
  - **Cations** are positively charged (meaning they lost electrons)
    - There are more protons (+) than electrons (-)
  - **Anions** are negatively charged (meaning they gained electrons)
    - There are more electrons (-) than protons (+)

The nuclear atom

Subatomic particles and descriptions of the atom

- The **nuclear symbol** includes both A and Z for a particular element X and is represented like this:
  ${}^{A}_{Z}\mathbf{X}$
- **Isotopes** are different forms of the same element but have different number of neutrons (different mass numbers, A)
  - Have <u>same</u> *chemical properties* (react in exact same way) but <u>different</u> *physical properties* (i.e. different melting points or boiling points)

Hydrogen has three isotopes:

${}^{3}_{1}\mathbf{H}$ (tritium)
1 proton, 1 electron, 2 neutrons

${}^{2}_{1}\mathbf{H}$ (deuterium)
1 proton, 1 electron, 1 neutron

${}^{1}_{1}\mathbf{H}$ (hydrogen)
1 proton, 1 electron, 0 neutrons

The nuclear atom

Why do isotopes react in the same exact way????

Turn to your partner and discuss why you think that is the case?

Isotopes react the same way because they have the same number of electrons and electrons are what is responsible for all chemical reactions! Chemical reactions depend only on the number and arrangement of electrons - not the composition of the nucleus!

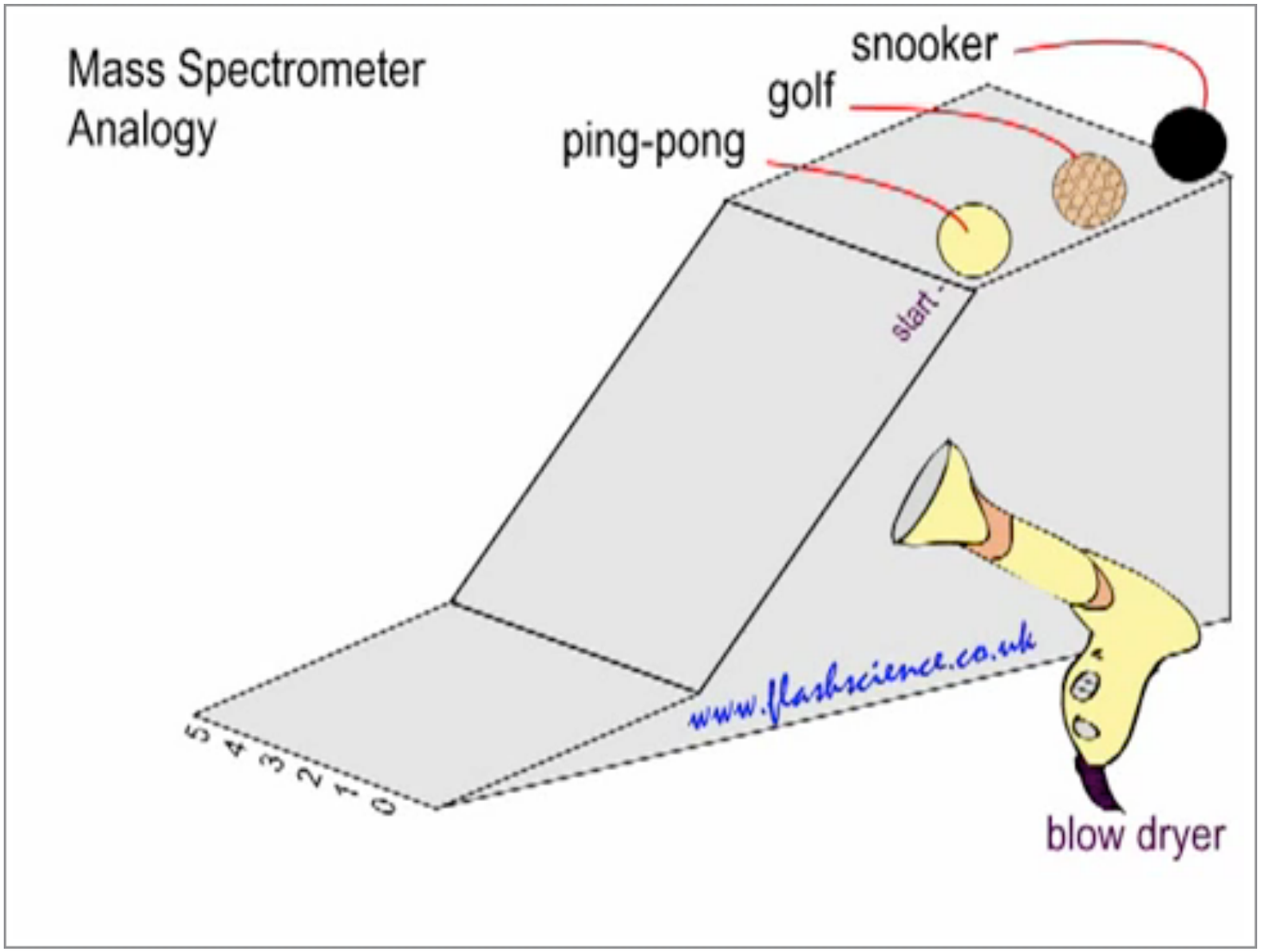
The nuclear atom

Relative atomic masses

- Because multiple isotopes can exist for one element, it is most convenient to quote an average mass for an atom – **relative atomic mass (A_r)**
- **The relative atomic mass (A_r) for an element is based on taking the average of all the masses of the isotopes in a naturally occurring sample of the element**

The nuclear atom

Mass spectrometer



Mass Spectrometer

Process	vaporization	ionization	acceleration	deflection	detection
Equipment	vaporizer	ionizer	accelerator	deflector	detector
Details	the atom is changed into a gaseous state	the atom is bombarded by a beam of electrons to form positive ions	the positive ions will pass through an electrical field where it will be accelerated	the positive ions will pass through a magnetic field where the lighter ions will be deflected more than the heavier ions	the difference ions will be detected

Practice Problem

... I Do ...

Boron has two naturally occurring isotopes with the natural abundances shown below:

Isotope	Natural Abundance/%
^{10}B	19.9
^{11}B	80.1

Calculate the relative atomic mass of boron:

$$\text{relative atomic mass} = (10 \times \frac{19.9}{100}) + (11 \times \frac{80.1}{100}) = 10.8$$

Practice Problem

... We Do ...

Rubidium has a relative atomic mass of 85.47 and consists of two naturally occurring isotopes, ^{85}Rb (u=84.91) and ^{87}Rb (u=86.91). Calculate the percentage composition of these isotopes in a naturally occurring sample of rubidium.

$$A_r = 85.47 = \frac{84.91x + 86.91(100-x)}{100}$$

$85.47 \times 100 = 84.91x + 86.91(100-x)$

$8547 = 84.91x + 8691 - 86.91x$

$-2.00x = -144$

$x = 72.00$

The sample contains 72.00% ^{85}Rb and 28.00% ^{87}Rb

Topic 2.1
The nuclear atom

- ➡Atoms contain a positively charged dense nucleus composed of protons and neutrons (nucleons).
- ➡Negatively charged electrons occupy the space outside the nucleus.
- ➡The mass spectrometer is used to determine the relative atomic mass of an element from its isotopic composition.