

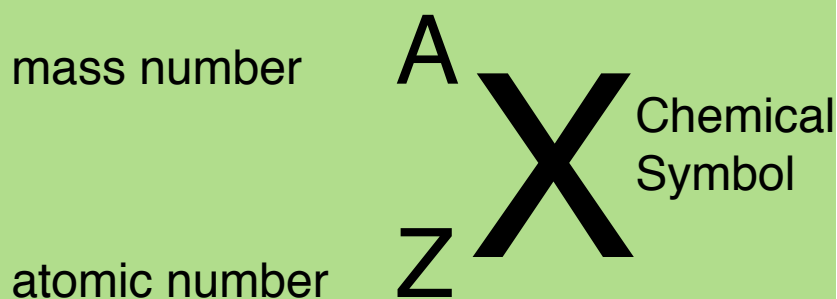
Isotopes

- Two atoms are isotopes if they have the same number of protons, but they have different numbers of neutrons.
- This means that:
 - Isotopes are atoms of the **same element**.
 - Isotopes have **different atomic masses**.
 - Isotopes have **different number of neutrons** in their nuclei.

Isotope Notation

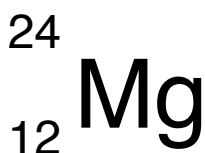
- When using isotope notation we use:
 - Z to represent atomic number (Reminder: this represents the number of protons in an atom).
 - A to represent mass number (Reminder: this is the sum of the number of protons and neutrons).

To find the number of neutrons, N, subtract the atomic number from the mass number: $N = A - Z$.



Example Using Magnesium:

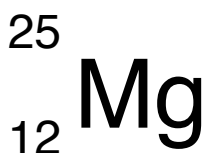
- Magnesium has 3 isotopes, here is how they compare.
Using isotope notation, they are:



P=

E=

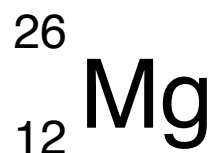
N=



P=

E=

N=



P=

E=

N=

- They have the same number of protons, same number of electrons, and the same appearance and chemical properties.
- They have different number of neutrons and different atomic masses.

The Role of the Neutron

- In smaller atoms, the number of neutrons and protons are often proportional.
- However, as the atom grows, the number of neutrons increases more rapidly.
- This is because in larger atoms neutrons have a stabilizing effect caused by strong nuclear force (the fact that protons and neutrons are attracted to each other).

- **Radioisotopes** are isotopes that have a unstable nuclei (protons and neutrons are not properly balanced) that decay into different stable isotopes.

Average Atomic Mass

- In the periodic table, the atomic mass of element is given in atomic mass units(u).
 - An amu is based on the mass of a carbon-12 atom, and represents the mass of one twelfth of a carbon-12 atom.
 - Since all masses are compared to a carbon-12 atom, we call them *relative atomic masses*.
- Most atoms have more than one naturally occurring stable isotopes.
- To determine the atomic mass of an element, you must determine the *average atomic mass*.

Isotopic Abundance (% Abundance)

- The isotopic abundance is fixed so that every sample of the element (in the universe) has the same proportions of naturally occurring isotopes.
- **Isotopic Abundance** is the amount of a given isotope of an element that exists in nature, expressed as a percentage of the total amount of this element.

Calculating Average Atomic Mass

- There are two strategies that may be used when calculating average atomic mass.

Problem: Using the information in the table below to calculate the average atomic mass of copper:

Isotope	Mass(u)	Isotopic Abundance (%)
copper-63	62.93	69.2
copper-65	64.93	30.8

Strategy A

Plan Your Strategy	Act on Your Strategy
Multiple the mass of each isotope by its isotopic abundance, expressed as a decimal, to determine the contribution of each isotope to average atomic mass.	contribution of isotope copper-63 contribution of isotope copper-65
Add the contributions of the isotopes to determine the average atomic mass of the element.	average atomic mass of Cu

Strategy B

- The calculation can be combined into one step as follows:

Homework

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