SCH 3U
J. Kropac

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 **<u>same element</u>**.
  - Isotopes have **<u>different atomic masses</u>**.
  - Isotopes have **<u>different number of neutrons</u>** in their nuclei.

<u>Isotope Notation</u>

- 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.

mass number A

$${}^{A}_{Z}X$$

Chemical Symbol

atomic number Z

Example Using Magnesium:

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

$^{24}_{12}\mathrm{Mg}$ $^{25}_{12}\mathrm{Mg}$ $^{26}_{12}\mathrm{Mg}$

P=	P=	P=
E=	E=	E=
N=	N=	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 on step as follows:

Homework

pg. 19 #1, 2, 3, 4, 8