

Isotopes, Radioisotopes and Atomic Mass

Some of the properties of elements which may seem straight forward may actually be more complex upon closer investigation. For example, you have learned that the relative atomic mass of an atom can be found on the periodic table. Atomic theory suggests that atoms of the same element are identical, all atoms given sample of an element should have the same atomic mass. This is not the case.

What are Isotopes?

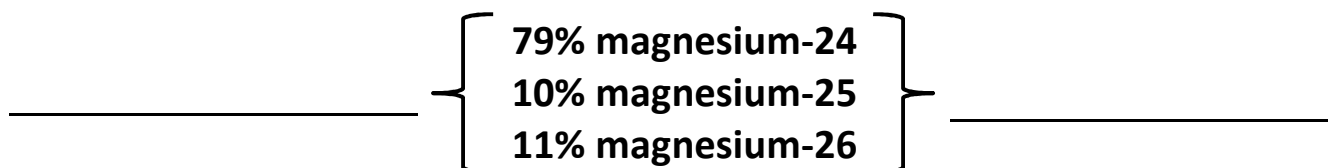
What are neutrons for?

As you might imagine, tightly packed positively charged protons in the nucleus of atoms produces strong repulsive forces. Neutrons have a stabilizing effect on the nucleus when they are properly balanced with protons. As the number of protons increases, the number of neutrons increases more rapidly.

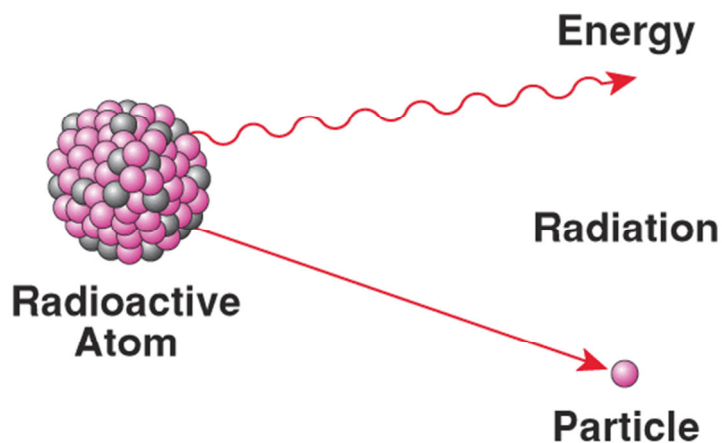
Stable vs. Radioactive Isotopes

Many atoms have more than one balance of protons and neutrons that produce a stable nucleus.

For example, Magnesium can exist as **Mg-24, Mg-25 and Mg-26**. Each of these has a different but specific probability of occurrence in nature. As a result, any given sample of an element will have a fairly predictable percentage of each stable isotope. These percentages are known as the **relative abundance** or **isotopic abundance** of each isotope.



For some atoms, when the number of neutrons is changed, this throws off the balance between protons and neutrons and destabilizes the nucleus. When this occurs, the nucleus begins to decay into a nucleus that *is* stable by emitting sub atomic particles. Atoms in this state are said to be _____.

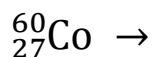


Types of Radiation

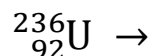
Name	Composition	Description

Make a Prediction!

Cobalt-60 is a radioactive isotope of cobalt. It can become stable by emitting a β -particle. Let us write a chemical reaction predicting the outcome of this type of radiation.



Predict the result of the alpha particle radiation of Uranium-236

***If atoms exist as various stable isotopes, then what's that Atomic Mass listed on the Periodic Table?!?!***

The Atomic Mass listed on the Periodic Table is a _____ that factors in the presence of stable isotopes **and** their relative abundances (the proportion in which they are found in nature).

Atomic Mass Units

The relative masses of atoms are measured in **Atomic Mass Units (u)**. As a convenient reference point, one atom of _____ was assigned a mass of 12u. The mass of all of the other elements calculated as a proportion relative to carbon-12.

$$\mathbf{1\ u = 1/12\ of\ the\ mass\ of\ an\ atom\ of\ carbon-12.}$$

Working with Weighted Averages

Imagine you have 3 objects A, B and C.

a) What is their average mass if and individual masses are:

$$A = 4.0 \text{ kg}$$

$$B = 5.0 \text{ kg}$$

$$C = 6.0 \text{ kg}$$

$$m_{\text{average}} =$$

b) What if you had two of A, two of B and one of C?

$$m_{\text{average}} =$$

c) Do the same calculation using percentages rather than whole numbers.

<i>quantity</i>	<i>Percent Abundance</i>	<i>Relative Abundance Factor</i>
A = 2	= $2 / 5 \times 100\% = 40\%$	= 0.40
B = 2	= $2 / 5 \times 100\% = 40\%$	= 0.40
<u>C = 1</u>	= $1 / 5 \times 100\% = 20\%$	= 0.20
Tot = 5		

$$m_{\text{average}} =$$

d) Calculate the average atomic mass of Magnesium.