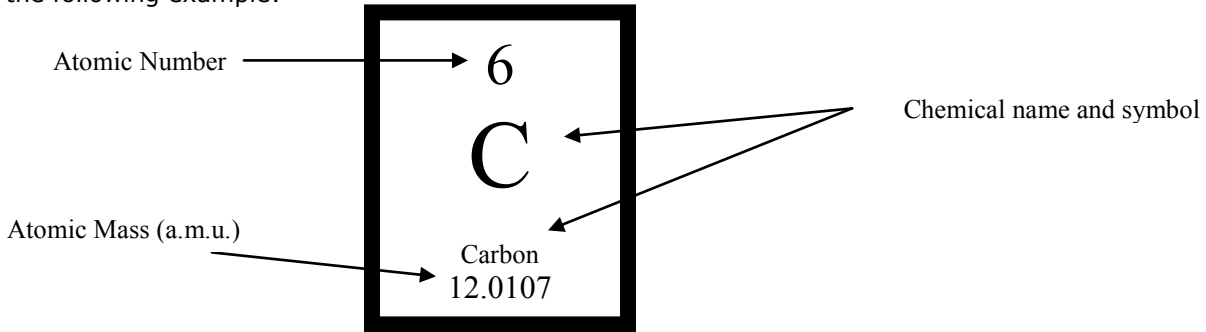


WHAT IS AN ISOTOPE?

I'd like to discuss with you the fact that **atoms of a chemical element can have different atomic masses**. These are called **isotopes**.

Isotopes are atoms that have the same number of protons (and electrons), but different numbers of neutrons. We can say that different isotopes of the same element have different masses. Because they have different numbers of neutrons, they do not all weigh the same.

Consider the following example:



From the periodic table we can tell that Carbon has 6 protons and that it has 6 neutrons. Remember the formula from before:

mass of protons + mass of neutrons = atomic mass of the atom

$$\underline{6 \text{ a.m.u.}} + \underline{\quad ? \quad} = \underline{12 \text{ a.m.u.}}$$

However, there are other atoms of Carbon that still have the same number of protons (which make it Carbon), but they differ in the number of neutrons that they have in their nucleus. Take for example the Carbon-13 isotope. It has 6 protons in its nucleus. However, in Carbon-13 it has 7 neutrons. Plug these numbers into the equation and see what happens:

mass of protons + mass of neutrons = atomic mass of the atom

$$\underline{6 \text{ a.m.u.}} + \underline{7 \text{ a.m.u.}} = \underline{13 \text{ a.m.u.}}$$

Notice how the atomic mass changes. Carbon-13 gets its name from the fact that it now has a mass of 13 amu.

WHAT HAPPENS IF WE ADD PROTONS TO THE NUCLEUS? While the number of neutrons in an atom can change to form a new isotope, you can never change the number of protons. Changing the number of protons would change the atomic number. When you change the atomic number, you end up with a new element. For example, adding a proton to Carbon-12 would make Nitrogen which has 7 protons in its nucleus with an atomic number of 7.

WHY IS THE ATOMIC MASS ON THE PERIODIC TABLE WRITTEN WITH A DECIMAL? Remember back to the definition of atomic mass - the **average** mass of all known isotopes (atoms) of that element. The important thing here is the word average.

So what are they averaging? Answer – Take for example all of the known Carbon isotopes – Carbon-12, Carbon-13 and Carbon-14. They take the average mass of these known isotopes (including the percentage of each type) to come up with quoted atomic mass on the periodic table.

** While we say Carbon-12 isotope, isotopes are usually written scientifically as ^{12}C , ^{13}C , ^{14}C .