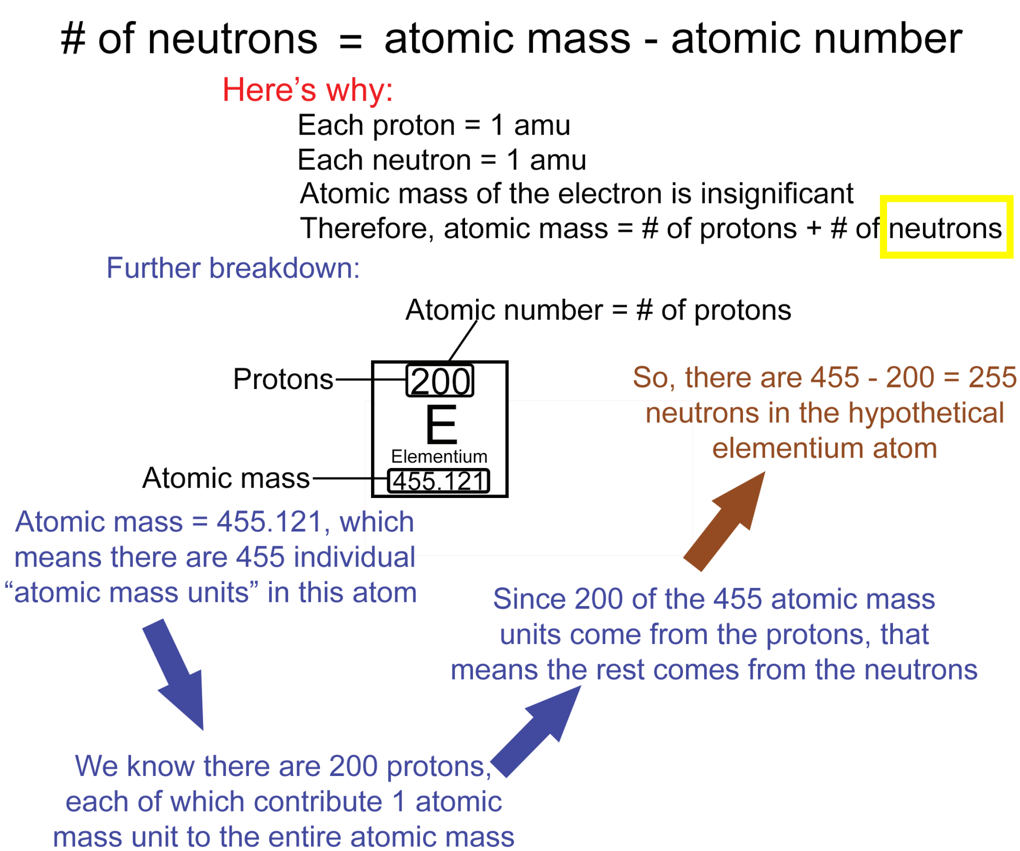
Figure 4.7.1

Atomic Number and Atomic Mass—Getting More Information from the "Little Box"

Note that atomic mass is also called atomic weight. I tend to use atomic mass more often than atomic weight, but you will find both terms used to indicate the same value. Below is a flow diagram that walks you through the following information. Because chemists have defined 1 atomic mass unit to be equal to the mass of one proton, and also equal to the mass of one neutron, there is a nice relationship between the atomic number (which is the number of protons) and the atomic mass of the entire atom that allows us to easily determine the number of neutrons the nucleus contains. Let's take a fictional element—elementium—that has an atomic number of 200 and an atomic mass of 455.121, which is rounded to 455. We always round the atomic mass to the nearest whole number. The atomic number is equal to the number of protons, so "elementium" has 200 protons. The atomic mass – determined by the sum of the number of protons and the number of neutrons—is 455. Therefore, to determine how many neutrons the element has, subtract the protons (again, this is the atomic number) from the atomic mass. So, for "elementium", 455 atomic mass minus the 200 protons, gives 255 mass units leftover. Since the mass of the atom is determined by the number of protons plus the number of neutrons in the nucleus AND neutrons have the same "mass unit amount" as protons, that can only mean that the remaining 255 mass units are neutrons, 455 – 200 = 255.



As a brief side note, we use this relative measure of the atomic mass unit not because we don't know the actual mass of the subatomic particles; we do. However, the numbers are definitely not easy to work with. The mass of a proton is $1.6726219 \times 10^{-27}$kg and of a neutron is 1.674929×10^{-27}kg. It is way easier to use the concept of a proton's and neutron's mass being "1" rather than using these unwieldy numbers to perform calculations.

Let's do one more example. Carbon has an atomic mass of 12.011, how do we figure out how many neutrons it has? Remember the equation:

atomic mass = # of protons + # of neutrons

therefore, # of neutrons = atomic mass - # of protons.

Its atomic number is 6, so it has 6 protons. We round its atomic mass to the nearest whole number, which is 12, so plugging into our formula, 12 - 6 = 6. Carbon has 6 neutrons.