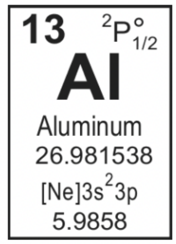
15.3: Reading a Periodic Table

If you look at a periodic table, there is a variety of information you may find on it. Every periodic table includes the symbol of the element (one or two big bold letters at the center of the element's box), and the atomic number of the element (the number of protons in that element, usually shown as a number in the upper left). For example, below is the entry for Aluminum from the NIST Periodic Table (Dragoset et al., 2003).



Here, you can see the symbol for the element is Al, and the atomic number is 13.

Usually, below the element symbol, you will find the atomic weight of the element. This is in units of “atomic mass units” or amu; one amu is equal to 1.66×10^{-27} kg. In this example, the atomic weight is given to eight significant figures, and is 26.981538 amu. The atomic weight in amu is approximately the number of protons and neutrons— which, together are just called “nucleons”— in the element, but there are a number of complications. First is the complication that for some elements, there are multiple isotopes. Different isotopes have the same number of protons but different numbers of neutrons. For example, the atomic weight of Chlorine is 35.45 amu. This is largely because in nature, we find Chlorine in two isotopes: Cl-35 and Cl-37, with 35 and 37 total nucleons respectively. There is a second complication, however. The mass of a nucleus is not exactly equal to the sum of the masses of the protons and neutrons that compose it! Each nucleus has what's called a binding energy. This binding energy is equivalent to the 13.6eV of energy that holds an electron on to a Hydrogen atom. It is the total energy for all of the nucleons in their bound states, and is negative for a stable nucleus. This binding energy is taken away from the effective mass of the nucleus, using the conversion $E = mc^2$. In fact, exactly the same thing is true for atoms! However, the binding energy compared to the mass of atoms is something like one part in a billion, so as such when dealing with chemical reactions and other electronic transitions, we can approximate mass as being conserved. Nuclear binding energy can get up to a few percent of the total mass. (It is this difference that makes nuclear power so much more efficient, in terms of energy produced per mass of fuel used, than chemical power.)

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