

Chemistry

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1 Khan Academy: AP Chemistry

1.1 Atoms, compounds, and ions

1.1.1 Introduction to the atom

Starting out with the basics. Atoms are made up of protons, neutrons, and electrons. What element the atom is depends on the number of protons, a single element can have multiple isotopes (varying numbers of neutrons) and different charges (varying numbers of electrons).

Atomic number, Z , is the number of protons in an atom's nucleus. **Mass number**, A , is the number of protons AND neutrons in an atom's nucleus. Hyphen notation is a way of writing out different isotopes of an element. For example, the hyphen notation of a carbon atom with 7 neutrons would be carbon-13.

Particle mass is measured in **unified atomic mass units**, u , equal to $\frac{1}{12}$ the mass of a carbon-12 atom. Protons have a mass of $1.673 \times 10^{-27} \text{kg}$, or $1.007u$, neutrons $1.675 \times 10^{-27} \text{kg}$, or $1.009u$, and electrons $9.109 \times 10^{-31} \text{kg}$, or $5.486 \times 10^{-4}u$. None of that is really useful to know outside of understanding that the relative mass of electrons is pretty insignificant.

Something that's more useful to know is isotopic notation, which looks like

$$\begin{array}{c} \text{Mass number} \\ \text{Atomic number} \end{array} \text{Symbol}^{\text{Charge}}$$

So, for an element with 6 protons, 7 neutrons, and 7 electrons, ${}^{13}_6\text{C}^{-1}$.

Some more useful numbers are the **atomic mass**, the mass of the isotope in u , and the **average atomic mass**, which is the number that tends to show up on periodic tables under the atomic symbol. The average atomic mass is the

average mass of all isotopes of an element weighted by **relative abundance**, the percentage of that element that is a given isotope in a naturally occurring sample. For example, if 70% of the carbon in a sample had 6 neutrons and 30% had 7, the relative abundance of carbon-12 and carbon-13 would be .7 and .3, respectively. In this hypothetical scenario, since the atomic masses of carbon-12 and carbon-13 are 12.096u and 13.105u, respectively, the average atomic mass of carbon would be 12.399u.