Counting Atoms

Atomic Number

All atoms are composed of the same basic particles. Yet all atoms are not the same. Atoms of different dements have different numbers of protons. Atoms of the same element al have the same number of protons. *The* **atomic number** (Z) of an element is the number of protons of each atom of that element. The atomic number identifies an element. If you want to know which element has atomic number 47, it is element silver Ag, on the periodic table. All silver atoms have 47 protons. Because atoms are neutral, we also know from the atomic number that all silver atoms must also have 47 electrons.

Isotopes

The simplest atoms are those of hydrogen. All hydrogen atoms have only one proton. However, like many naturally occurring elements, hydrogen atoms can have different numbers of neutrons.

There are three types of hydrogen atoms known. The most common type of hydrogen is sometimes called *protium*. It accounts for 99.9885% of the hydrogen atoms found on Earth. The nucleus of a protium atom consists of one proton only, and it has one electron moving about it. There are two other known forms of hydrogen. One is called *deuterium*, which accounts for 0.0115% of Earth's hydrogen atoms. Each deuterium atom has a nucleus with one proton and one neutron. The third form of hydrogen is known as *tritium*, which is radioactive. It exists in very small amounts in nature, but it can be prepared artificially. Each tritium atom has one proton, two neutrons, and one electron.

Protium, deuterium, and tritium are isotopes of hydrogen. **Isotopes** *are atoms of the fine element that have different masses.* The isotopes of a particular element all have the same number of protone and ble atoms but different numbers of neutrons. In all three isotopes of hydrogen, the positive charge of the single prop (i) balanced by the negative charge of the electron. Most of the elements consist of mixtures of isotopes. Tin hestle stable isotopes, for example, the most of any element.

Mass Number

Identifying an is copy requires knowing both the name of atomic number of the element and the mass of the isotope. *The* **mass number** *is the total number of protons and neutrons that make up the nucleus of an isotope*. The three isotopes of hydrogen described earlier have mass numbers of 1, 2, and 3.

Designating Isotopes

The isotopes of hydrogen are unusual in that they have distinct names. Isotopes are usually identified by specifying their mass number. There are two methods for specifying isotopes. In the first method, the mass number is written with a hyphen after the name of the element. Tritium, for example is written as hydrogen-3. This is referred as the *hyphen notation*. The uranium isotope used as fuel for nuclear power plants has a mass number of 235 and is therefore known as uranium 235. The second method shows the composition of a nucleus as the isotope's *nuclear symbol*. For example, uranium-235 is written as 235/92 U. The superscript indicates the mass number and the subscript indicates the atomic number. The number of neutrons is found by subtracting the atomic number from the mass number. The number of neutrons if found by subtracting the atomic number from the mass number.

Mass number - atomic number = number of neutrons 235(protons + neutrons) - 92 protons = 143 neutrons

Thus, a uranium-235 nucleus Is made up of 92 protons and 143 neutrons. Nuclide is a general term for a specific isotope of an element.

Relative Atomic Masses