

Chem11 Atoms/Atomic Mass/Isotopes : Notes/W.S.-50

All atoms are composed of protons, neutrons and electrons. The protons and neutrons are found in the nucleus. The number of neutrons is usually greater than the number of protons. The much smaller electrons orbit the nucleus. The number of electrons equals the number of protons in a neutral atom. But electrons may be added to, or removed from an atom making it an **ion**.

The a.m.u. is the **Atomic Mass Unit**. It is the unit of mass that is commonly used for atoms. 1.00 a.m.u.'s is equal to a mass of 1.66×10^{-24} grams. The mass of a hydrogen atom is about 1.0 a.m.u.'s. The mass of a carbon atom is about 12.0 a.m.u.'s. The mass of an oxygen atom is 16.0 a.m.u.'s, and so on. (see periodic table)

The **atomic mass** (or **atomic weight**) of an atom is the weighted average mass in a.m.u.'s. of all of the **isotopes** of that atom. The number of protons in any type of atom is fixed, but the number of neutrons varies. An element may have several different isotopes, each with differing numbers of neutrons.

The mass of both the proton and neutron is about 1.0 a.m.u.'s. The mass of the electron is about $1/1800$ a.m.u.'s. We will approximate the electron mass to zero.

As an example, we will look at lithium. The atomic number is 3. This means that there are always 3 protons in every lithium atom. There are also 3 electrons in every (neutral) lithium atom. The number of neutrons is either 3 (7.5% of the time) or 4 (92.5% of the time), so the atomic weight can be 6 or 7 a.m.u.'s. The atomic weight given in the periodic table is the weighted average of the two isotopes.

$$0.075 \times 6 + 0.925 \times 7 = 6.9 \text{ a.m.u.}$$

We can write the two isotopes of lithium as lithium-6 and lithium-7. These may also be written as ${}^6\text{Li}_3$ and ${}^7\text{Li}_3$, respectively.

Problems:

- 1) The mass of one a.m.u. equals _____ grams.

2) Give the masses of the following particles in a.m.u.'s:

proton _____ neutron _____ electron _____

3) What is atomic mass of chlorine in a.m.u.'s? (see periodic table)
chlorine has two isotopes, chlorine-35 and chlorine-37. Which is more common?

4) Oxygen has three isotopes; oxygen-16, oxygen-17, and oxygen-18.
Which isotope is the most common? (see periodic table)

5) Find the atomic mass of boron. It has two isotopes : boron-10 (19.6%) and boron-11 (80.4%).

6) The main isotope of potassium is: $^{39}\text{K}_{19}$.

The number of protons is _____

The number of neutrons is _____

The atomic mass is about _____ a.m.u.'s.

The number of electrons is _____ in a neutral potassium atom.

Answers: 1) 1.66×10^{-24} grams, 2) 1.0, 1.0, 0.0, 3) 35.5 a.m.u.'s, chlorine-35 (the atomic mass is closer to 35, than it is to 37), 4) oxygen-16, the atomic mass of oxygen is about 16.0 a.m.u.'s, oxygen-17 and oxygen-18 are very rare, 5) 10.8 a.m.u.'s, ($10 \times 0.196 + 11 \times 0.804$), 6) 19, 20, 39 a.m.u.'s, 19.