CHEQ 1094 ATOMIC MASS

Atoms are very tiny and hence have very low masses. For example, the mass of a H-1 atom is approximately 1.6733×10^{-24} g and the mass of a C-12 atom is approximately 1.9927×10^{-23} g. These numbers are too small for convenience and therefore a new mass scale, based on the **atomic mass unit** (amu), was defined for atomic masses. The atomic mass unit was defined as 1/12 of the mass of a C-12 atom.

Hence, 1 amu = $1/12 \times 1.9924 \times 10^{-23}$ g = 1.6606×10^{-24} g.

By definition, on the amu scale, C-12 has an atomic mass of 12.0000 (exactly). The atomic mass of H-1 can be calculated as shown below:

1.6733×10^{-24} g x 1 amu/1.6606×10^{-24} g = 1.0078 amu.

The masses of the elemental particles in amu are:

proton = 1.0073 amu, electron = 0.00055 amu, neutron = 1.0087 amu.

Most elements consist of a mixture of isotopes. Because they differ in the number of neutrons in the nucleus, isotopes of the same element differ in their atomic mass. For example, chlorine occurs naturally as a mixture of Cl-35, atomic mass = 34.969 amu (75.53%), and Cl-37, atomic mass = 36.966 amu (24.47%). We can calculate the mass of an **average** chlorine atom although no chlorine atom has such a mass. This mass is called the **atomic weight** (AW) of chlorine. The calculation must take account of the **masses** and **abundances** of the atoms. The atomic weight of an element is therefore the sum of the (mass x fractional abundance) of the naturally occuring isotopes. The fractional abundance is 1/100 of the percent abundance.

For chlorine, AW = (34.969 x 0.7553) + (36.966 x 0.2447) amu = 35.458 amu.

Exercise

Magnesium occurs as a mixture of three isotopes, Mg-24 (23.99 amu, 78.99%), Mg-25 (24.99 amu, 10.00%) and Mg-26 (25.98 amu). Calculate the atomic weight of magnesium.