



THE FUNDAMENTAL ATOMIC QUANTITIES AND ATOMIC WEIGHT

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Three fundamental quantities are associated with each atom of an element—atomic number, mass number, and mass. (1) The *atomic number* is the ordinal number of the element in the series of elements starting with 1 for hydrogen. It is the net positive charge of the nucleus of the atom, taking the charge of an electron as the unit, and is numerically equal to the number of extranuclear electrons in the un-ionized atom. (2) The *mass number* is the number of protons in the nucleus. (3) The *atomic mass* is the relative mass of the atom, taking oxygen as 16, *it being tacitly assumed in this definition that oxygen has no isotopes*. The atomic mass is, in general, slightly different from a whole number; this is not due to the presence of electrons in the atom, for the mass of an electron is negligible, but to the loss of mass of the protons which occur when they are packed together in the nucleus.

Atomic mass must not be confused with atomic weight. Chlorin, for example, consists of two kinds of atoms (two isotopes), having atomic masses of 34.982 and 36.980, respectively. In ordinary chlorin these two kinds of atoms always occur in such proportions as to give an *average* atomic mass of 35.458. This average mass per atom is the so-called *atomic weight*. In the case of elements having no isotopes, the atomic mass and atomic weight are identical. Atomic weight is an experimental number and its usefulness lies in the fact that it in itself, or when multiplied or divided by some small integer, expresses the *mass* by which the element enters into combination with other elements. Thus atomic weight is more properly a *combining mass*.

Since both the atomic mass and the atomic weight of oxygen are given the arbitrary value 16, it follows that the atomic weight of any ele-

ment is equal to the average value of its atomic masses only if oxygen has no isotopes. It now appears, however, that oxygen has an isotope of relative mass approximately 18 and a revision of one of the foregoing definitions doubtlessly will be found advisable, even though the " O_{18} " isotope apparently occurs in extremely small amounts.¹ Of the several

¹Giauque and Johnston, J. Am. Chem. Soc. 51, p. 1436 (1929); Nature 123, p. 318 (1929). See also Birge Reviews of Modern Physics, 1, p. 2 (1929).

possible revisions, perhaps it will be found simplest to evaluate the *atomic mass* of the " O_{18} " isotope in terms of the ordinarily occurring mixture of the two isotopes of oxygen taken exactly as 16. Only the value of the various atomic masses would be affected by such a change, and these only slightly.