1270: Types of atomic orbitals and their symbols

(Learn the meaning of the symbols for atomic orbitals)

Key words: Principal quantum number; azimuthal quantum number; magnetic quantum number

The azimuthal quantum number l takes the values 0, 1, 2, ..., n-1 for the principal quantum number n. For example, if n=1, l is only 0, if n=2, l takes two values, 0 and 1, and if n=2, l takes three values, 0, 1, and 2. In addition, the symbols s, p, d, f, g, ... are assigned to the values of l=0, 1, 2, 3, 4, ..., respectively. 1s represents n=1, l=0, 2s represents n=2, l=0, 2p represents n=2, l=1, and similarly 3d represents n=3, l=2. (The meanings of these symbols were determined from the observation of atomic spectra (*s*imple, *p*rinciple, *d*iffuse, *f*undamental, in alphabetical order from here on). Currently, their meanings are ignored.

There are three types of p orbitals, p_{-1}, p_0, and p_1, according to the magnetic quantum numbers -1, 0, and 1. If p_0 is assigned to the z-axis of a Cartesian coordinate system, p_{-1} and p_1 can be made to correspond to the y-axis and x-axis, respectively, so in organic chemistry they are written as p_z, p_y, and p_x. Additionally, there are five d orbitals, with magnetic quantum numbers -2, -1, 0, 1, and 2. When converted to the Cartesian coordinate system, m=0 is written as d_{z^2}, m=±1 as d_{xz}, and m=±2 as $d_{x^2-y^2}$, d_{xy}.

In short, a 2p_x atomic orbital is an atomic orbital with a principal quantum number of 2, an azimuthal quantum number of 1, and a magnetic quantum number of 1.