TRU Open Press

4 - Orbitals and Electronic Configuration

Quantum Choreography: Electron Orbits in Motion

Video 4 - Transcript

Hi everyone, welcome to video number 4. Today we are going to explore electronic configuration. And what we call orbitals, which are areas around the nucleus where there is a high probability of finding an electron. In the last video, we explored the structure of the atom. Today we're going to go a bit deeper by delving into the electronic configuration of these electrons, which surround the nucleus of an atom. Now we drew the oxygen atom. Like this, oxygen has atomic number 8. We have two electrons in the first shell and six electrons in the second shell. Now, electrons are negatively charged, as we know, and the nucleus is positively charged. The closer that the shell is to the nucleus, the greater is the electrostatic force of attraction between the negative electron and the positive nucleus. Therefore, these electrons are stabilized by that mutual attraction. The further away the shells are from the nucleus, the greater energy they will possess. Greater energy means lower stability and vice versa. Consequently, the shell that is closest to the nucleus is designated n =1. The second shell is designated n = 2. The third shell, n = 3, and so on. We can depict this like so. Within the shells or energy levels around the nucleus of an atom, there exists what we call orbitals. Now, an orbital we mentioned before is a region of space, a distinct region of space around the nucleus of an atom, where there is a high probability of finding an electron. Now, one orbital can house two electrons, a maximum of two electrons. There are a variety of shapes which orbitals can present. For example, s orbitals which are spherical. We have p orbitals, which are lobed shaped. There are many other different types of orbitals. In addition to the s and p we have d, f and g. But we're only going to be concerned with s and p orbitals. This is my s orbital. Don't let this circle confuse you. The s orbital is spherical. That's represented by the dot in the middle, we have three types of p orbitals. We have the py, the px and the pz x, y and z represent the three planes that exist in 3D space each. Remember, each orbital can hold two electrons. An s orbital holds 2, a py orbital holds 2. As well as px and pz. Where n is equal to one, Let's go back to our first shell, we can hold two electrons. Where n =2, we can hold 8 electrons, where n =3, We can also hold 8 electrons, where n =4, we can hold 2 electrons. This brings us to the 2, 8, 8, 2 system that I'm sure many of us are familiar with. That allows us to fill the first 20 elements of the periodic table. The determination of the electronic configuration of an atom gives us information about its physical and chemical properties. Including how it might bond with other atoms to form molecules. Now we're going to fill electrons from the lowest energy levels first, then move up to higher energy levels away from the nucleus. This makes sense, because electrons would rather occupy a low energy state where they're more stable, rather than a high energy state where they're less stable. If we take carbon, for example, carbon has atomic number 6. If we're going to fill carbon, the electrons in carbon, we can write it like this. 1s2, 2s2, 2p2 This is the electronic configuration of the electrons in a carbon atom. We're filling the first energy level, n is equal to one with two electrons. The second energy level can hold up to eight. Carbon only has four. In the second energy level, we have 2 in a s orbital and 2 in a p orbital. We can follow this system. We can write the electronic configuration for all of the first 20 elements. Very simply, hydrogen with atomic number 1 will simply be 1s1. If we want to try oxygen, atomic number 8 - oxygen is 1s2, 2s2, and 2p4. It is useful to note that when atoms bond, they do that in order to obtain a full outermost shell. When the outermost shells of atoms are filled like this, maximally 2 in the 1st, 8 in the 2nd, 8 in the 3rd and 2 in the 4th, atoms are considered to be stable. That's why you're not going to find a carbon atom existing all on its own. Carbon atoms are found bonded to other atoms, such as other carbon atoms in diamond or with other oxygen atoms in, for example, carbon dioxide. That's about all we're going to cover for electronic configuration. You guys can go through the first 20 elements of the periodic table and you can practice filling in the electrons in all of their shells. That's all for today. Thank you guys and I'll see you in the next video, where we're going to look at the electronic configurations of ions.