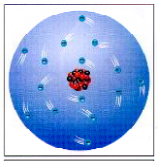
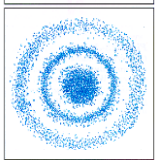
Electron Clouds





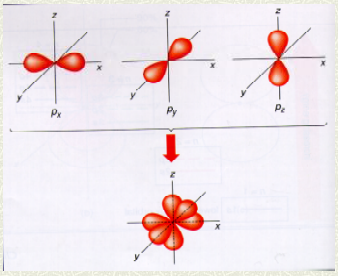
- **There are distinct probabilities where an electron can be found in an atom. It is in the form of an electron cloud around the nucleus.**
- **Within this electron cloud, there are regions in which electrons are found, called an orbital.**
- **An orbital is a region around the nucleus where an electron of given energy is found. Orbitals have characteristic shapes and sizes.**

Orbitals and Energy

- **Orbitals tell the region of where 90% of the electrons are going to be.**
- **There are four types of orbitals, designated s, p, d and f.**
- **S-orbitals hold 2 e- and are shaped as shown here**

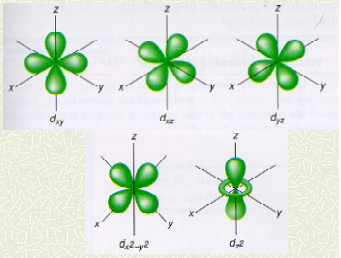
Orbitals and Energy

p-orbitals hold 6 electrons, with each sub-orbital holding 2 electrons each

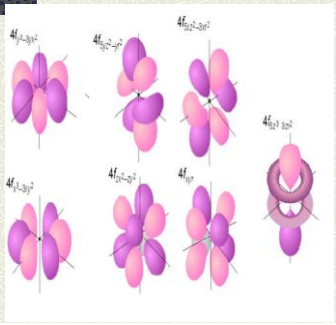


Orbitals and Energy

d-orbitals hold 10 electrons, with each of the 5 sub-orbitals holding 2 electrons each



Orbitals & Energy



f-orbitals hold 14 electrons, with each of the 7 sub-orbitals holding 2 electrons each

Orbital Diagrams

The distribution of electrons among the orbitals is called the orbital diagram of the atom.

These are determined by distributing the electrons in the orbital levels and sublevels based on a set of principles.

Principles of Orbital Diagrams

1) The Aufbau Principle - electrons are added one at a time to the lowest energy level possible. (Fill lowest energy level first, then move to next higher)

2) Pauli Exclusion Principle - an orbital can hold a maximum of 2 electrons. Electrons within an orbital must spin in opposite directions. (Electrons must move in opposite directions, one up, one down.)

Principles of Orbital Diagrams

3) Hund's Rule - electrons occupy equal energy levels so that a maximum number of unpaired electrons results.

(Electrons fill in all up in a p, d, or f orbital, then a second in each orbital)

Exceptions to the Aufbau Principle

When the Aufbau Principle is applied to all elements, certain elements do not agree experimentally with Aufbau.

Due to subtle electron interactions, a new configuration is formed which allows the atom to be more stable.

The exception is applied when the configuration ends in any of the following ways: d^4, d^9, f^6, or f^{13}

Shortcuts for Configurations

It is allowed (in order to save time) to abbreviate the configuration by listing the noble gas prior to the element [in parenthesis], then finishing off the configuration from there.

Ex. Nb - [Kr] $5s^2 4d^3$