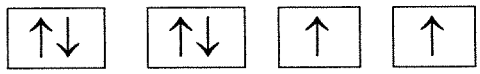
ELECTRON ARRANGEMENTS

In 1911, Rutherford proposed our present view of the nuclear atom. His model described the atom as having a very small nucleus containing most of the mass and all of the atom's positive charge. Bohr proposed that negatively charged electrons were distributed around the nucleus at great distances giving an atom a volume, which was mostly empty space.

Schrodinger developed a theory describing the most likely location of electrons around the atom. Using the results of this theory, a method was developed for writing electron configurations. Whole number, 1, 2, 3, and so on, are used to denote the main energy levels, and s, p, d, and f denote energy sublevels. Superscripts above the sublevel letter indicate the number of electrons in that sublevel. For example, sp^4 indicates 4 electrons in the p sublevel of the second energy level. The electron configuration for oxygen would be $1s^2 2s^2 2p^4$. The details on the order of filling and energy level capacities are given in your textbook.

Orbital filling diagrams also illustrate the distribution of electrons. For this method, only those electrons in the highest energy level need to be shown unless a "d" or "f" sublevel is partially filled, then that sublevel must be shown also. For oxygen, the orbital diagram is

Oxygen 

Note that electrons in the same energy sublevel do not pair until each orbital is occupied with one electron in accordance with Hund's rule.

A third method used to show electron arrangement is the electron dot diagram. This notation uses only those s and p electrons in the highest energy level. The s and p orbitals are arranged around the symbol for the element. The electron dot diagram for oxygen is

Each of these three methods for representing electron arrangements has merits, and they can be used to illustrate the concepts of bonding and molecular structure. In this exercise, you will practice each method of illustrating electron distribution.

Objectives

In this exercise, you will

- Write electron configurations,
- Write orbital filling diagrams, and
- Write electron-dot diagrams for ten elements.

EQUIPMENT

Paper and pencil

ANALYSIS

Organize the three types of electron arrangements in a table. Use the Electron Arrangements Table.

PROCEDURE

1. Prepare a data table as directed in the Analysis.
2. Write electron configurations, orbital filling diagrams (valence shell only), and electron dot diagrams for the following elements.

a. Boron	f. Iodine
b. Silicon	g. Rubidium
c. Sulfur	h. Chromium
d. Calcium	i. Gallium
e. Arsenic	j. Platinum

Electron Arrangements Table

Element (atomic number)	Electron Configuration	Orbital Filling Diagram (valence shell only)	Electron Dot Diagram	Noble Gas Abbreviation
Nitrogen (7)	$1s^2 2s^2 2p^3$	 2s 2p	N	$[He]2s^2 2p^3$
Boron				
Silicon				
Sulfur				
Calcium				
Arsenic				
Iodine				
Rubidium				
Chromium				
Gallium				
Platinum				

CONCLUSIONS

1. Why are the outer-most electrons the only ones included in the orbital filling diagram and the electron dot diagram?

2. The orbital filling diagram has arrows pointing in opposite directions when two electrons occupy the same orbital. What do these arrows indicate?

3. How many electrons do the elements in Group IIA (2) of the periodic table have in their electron dot diagrams?

4. Element X has an electron dot diagram

   X

   Name at least two elements that could be X.

5. Identify the element which has the following orbital diagram.