Electron Configuration
[PHYSICS & CHEMISTRY - INDEX] [Chemistry 2 INDEX]

Objectives
After completing this topic, students should be able to demonstrate the following skills:

- Given the number of electrons of an atom or ion, describe their distribution on orbits in the following ways: shorthand notation, box-diagram and Lewis structure.

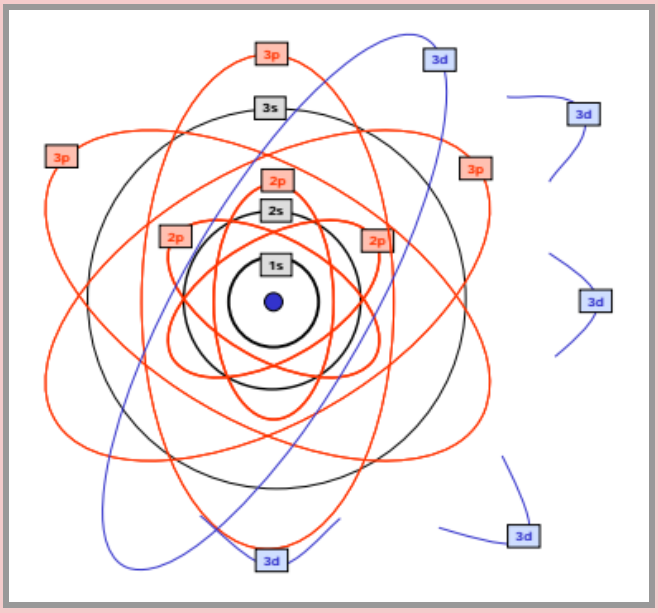
List of subtopics

Introduction
According to Bohr's model, electrons are located at orbits. This description of how electrons are located is called electron configuration.

Development
ATOMIC ORBITS [Electron configuration]
The orbits are the trajectories made by the electrons when they move around the nucleus. Those orbits can be classified in levels: 1st level (n=1) is the closest path around the nucleus; 2nd level is the second closer set of orbits... All levels have a circular orbit called "s" orbit. Therefore, there is a "1s" orbit (first level circular orbit), "2s" orbit, "3s" orbit...

Starting with the second level there are three equal orbits (their only difference is their orientation) called "p" orbitals (elliptical). So, there are three "2p" orbits, three "3p" orbits...

Starting with the third level, there are five equal (apart from their orientation) elliptical orbits called "d" orbits: five "3d" orbits, five "4d" orbits...

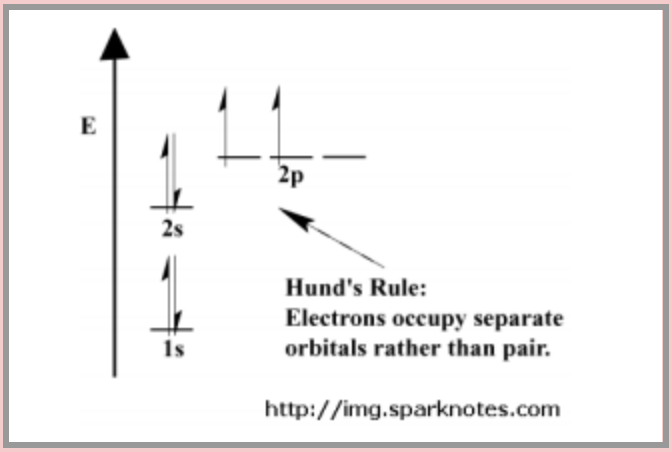


ELECTRON CONFIGURATION: RULES [Electron configuration]
In order to place electrons into orbits (to obtain the ground state electron configuration) we must follow some rules. Those rules are:

• The Aufbau (“to build up” in german) principle. This rule states that we must place an electron in the lowest energy orbital available.

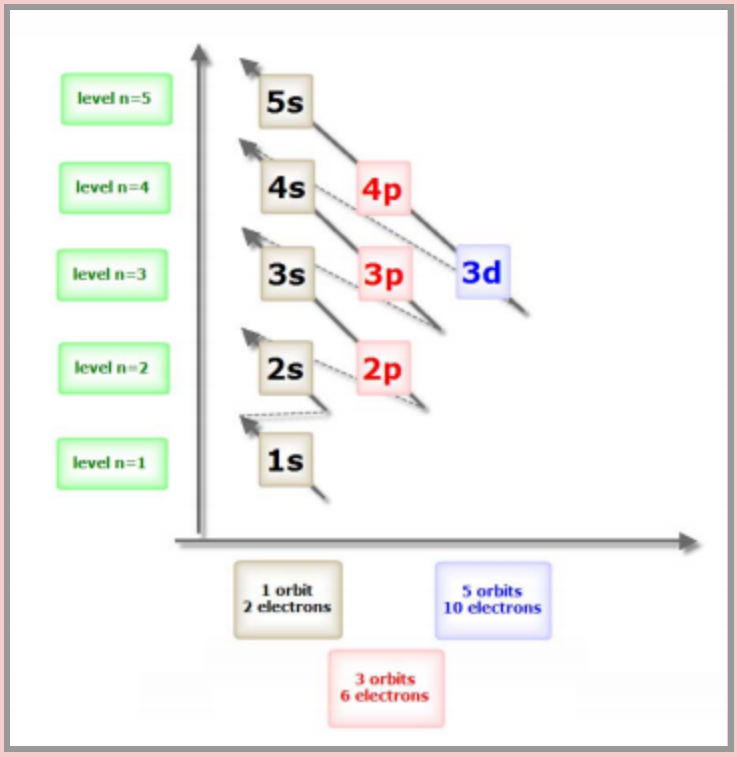
• Pauli exclusion principle. This principle tell us that an atomic orbit can hold a maximum of two electrons.

• Hund’s rule. When orbitals of equal energy are available, the electron configuration has the maximum number of unpaired electrons.



FILLING ORDER

The filling rules mentioned earlier (the three rules) can be graphically depicted, in order to easily remember how to fill the orbits. The filling order is indicated by the arrows starting with the one that goes through “1s” orbital. The filling order is the following: 1s – 2s – 2p – 3s – 3p - 4p – 5s ...

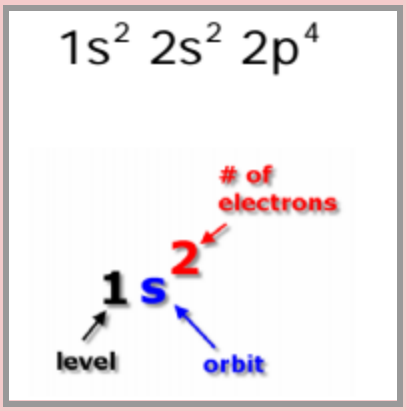


ELECTRON CONFIGURATION: NOTATION

Let’s determine the electron configuration of a oxygen atom (8 electrons). The electron configuration is: 2 electrons in “1s” orbit, 2 electrons in “2s” orbit and 4 electrons in “2p” orbits. The more common ways to show the electron configurations are:

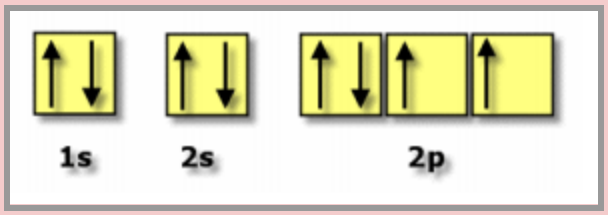
STANDARD (SHORTHAND NOTATION)

The general expression is:

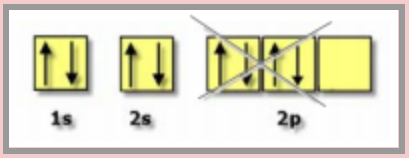


ORBITAL DIAGRAM

An orbital diagram consists of a box (or circle, or just a line) for each orbital available in a given energy level, grouped by sublevel, with arrows (first upwards and second downwards) indicating the presence of electrons. In our case:

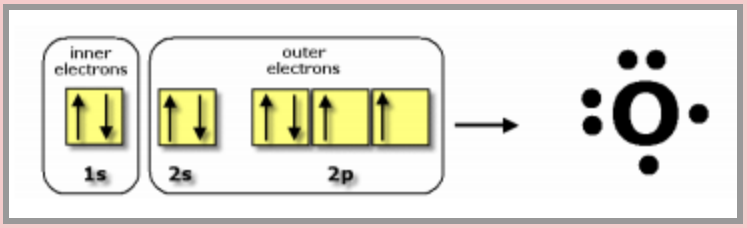


If we follow the rules, this possibility cannot be taken into consideration:



LEWIS ELECTRON-DOT SYMBOL

This notation consists of the symbol of the element and outer electrons represented by dots around the symbol (a pair of dots means represents an unpaired electron). In our case:



EXERCISES

MODEL EXERCISE

Worked example

Write the electron configuration of an atom of phosphorus $_{15}P$ using the following ways:

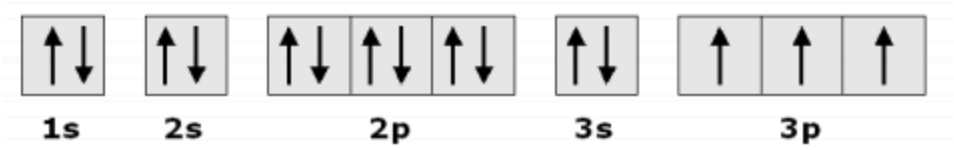
- **shorthand notation**
- **orbital diagram**
- **Lewis electron-dot symbol**

An atom of phosphorus has 15 electrons. Therefore, the electron configuration is:

SHORTHAND NOTATION

$$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$$

ORBITAL DIAGRAM



LEWIS ELECTRON-DOT SYMBOL

PROPOSED EXERCISES

Exercises 1 and Solutions

Exercises 2 and Solutions

List of resources

CONCEPTS AND EXERCISES

Electron configuration

Exercises 1 and Solutions

Exercises 2 and Solutions

Electron Configuration Flowchart

PROPOSED EXAMS

Physics & Chemistry Exams PAST EXAMS

Chemistry 2 PAST EXAMS