

<b>Topic:</b>	<b>ELECTRON CONFIGURATION</b>
<b>Objective:</b>	<b>FK_01_6</b>
<b>Given</b> the number of electrons of an atom / ion <b>the student must be capable of doing:</b>	
<ul style="list-style-type: none"> <li>• determine the electron configuration using the following notations <ul style="list-style-type: none"> <li>○ standard (shorthand notation)</li> <li>○ orbital diagram (a box for each orbital)</li> <li>○ Lewis electron-dot symbol</li> </ul> </li> </ul>	

**Introduction**

First, we are going to study the trajectories (or orbits) of the electrons around the nucleus.

Next, we will learn the order in which the electrons occupy those orbits, which are the rules we need to apply in order to correctly fill the orbits.

Finally, we will understand how to represent the electrons and its orbits in different ways.

**Atomic orbits**

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...

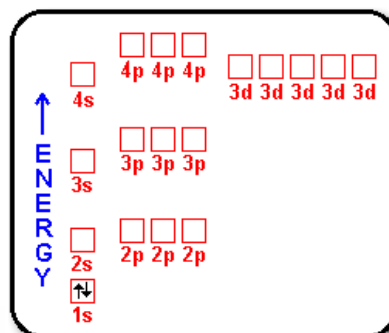
Starting with the second level there are three equal orbits (their only difference is their orientation) called "p" orbitals (elliptical). So, there are three "2p" orbits, three "3p" orbits...

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

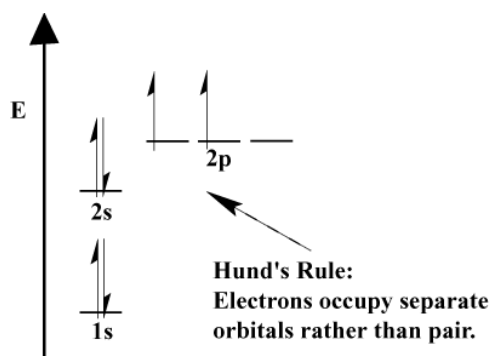
## Electron configuration: rules

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.



[www.physchem.co.za](http://www.physchem.co.za)



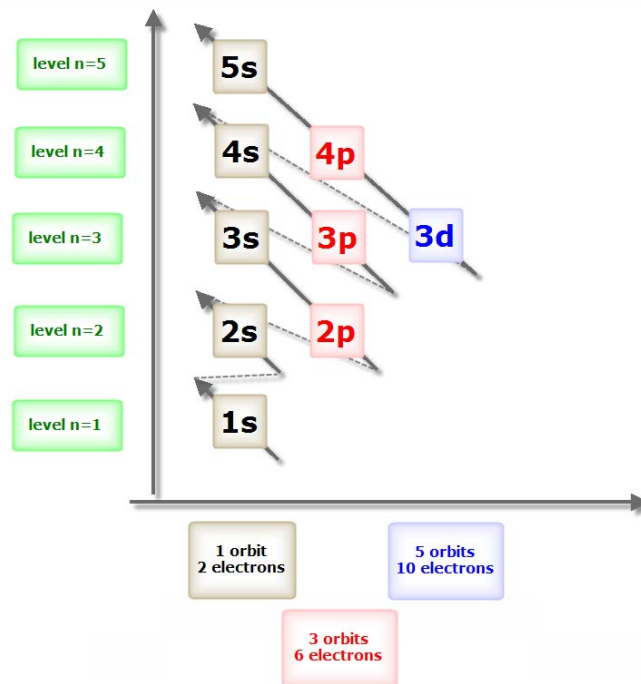
<http://img.sparknotes.com>

## Electron configuration: 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 – 4s – 3d – 4p – 5s ...

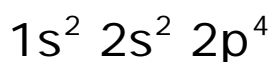


## Electron configuration: notations

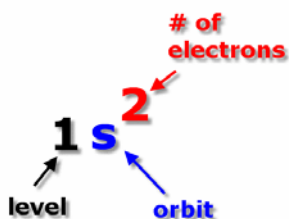
Let's determine the electron configuration of a oxygen atom (8 electrons). The electron configuration is: 2 electrons in "1s" orbit, 2 electrons in "2s" orbit and 4 electrons in "2p" orbits.

The more common ways to show the electron configurations are:

### STANDARD (SHORTHAND NOTATION)

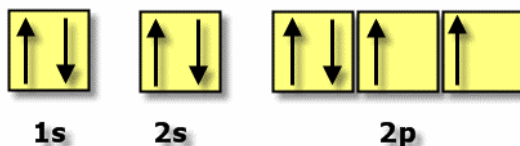


The general expression is:

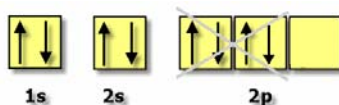


### ORBITAL DIAGRAM

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:

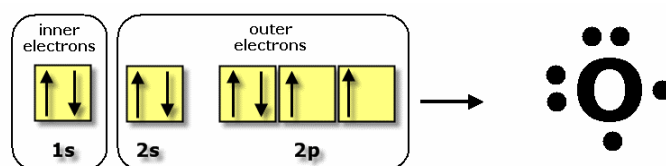


If we follow the rules, this possibility cannot be taken into consideration:



### 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 paired electrons and a dot alone represents an unpaired electron). In our case:



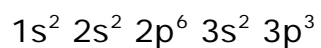
### Worked example

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

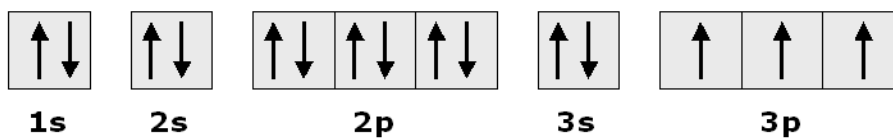
- shorthand notation
- orbital diagram
- Lewis electron-dot symbol

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

#### SHORTHAND NOTATION



#### ORBITAL DIAGRAM



#### LEWIS ELECTRON-DOT SYMBOL

