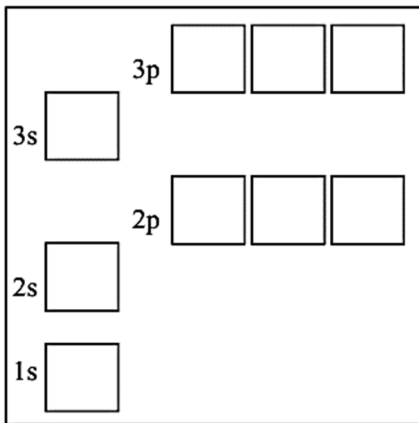


### Orbital Diagram Rules:

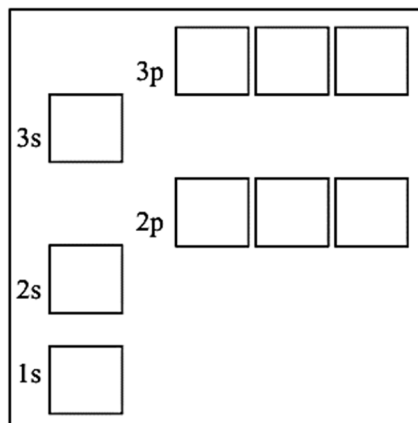
There are three rules that govern the arrangement of electrons in an atom's orbitals:

- 1. The Aufbau Principle:** Under normal condition, each electron occupies the **lowest energy levels possible**
- 2. The Pauli Exclusion Principle:** a maximum of **2 electrons** can occupy an orbital space, but only if they have **opposite spins**
- 3. Hund's Rule:** to minimize repulsion between electrons, **we put one electron in each orbital of the same energy level before we add the second electron.**

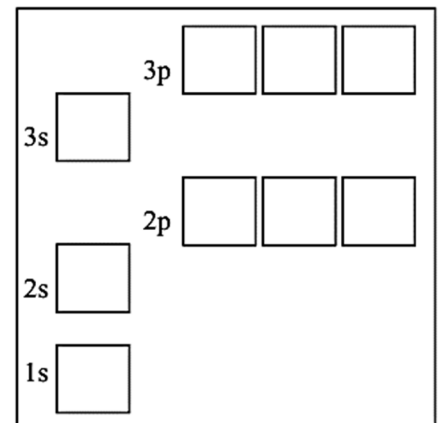
**Practice:** Draw in the orbital diagram and write the electron configuration for the following neutral atoms in the ground state



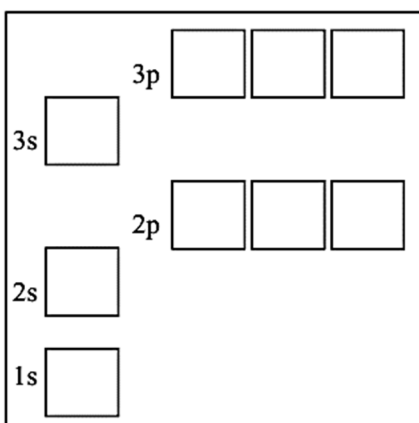
Magnesium  $1s \quad 2s \quad 2p \quad 3s$



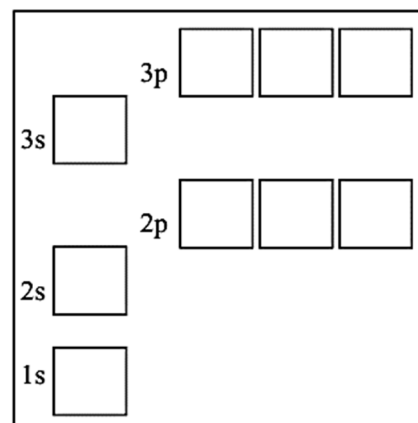
Silicon  $1s \quad 2s \quad 2p \quad 3s \quad 3p$



Sulfur  $1s \quad 2s \quad 2p \quad 3s \quad 3p$

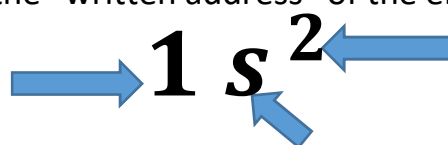


Lithium



Nitrogen

**Electron Configurations** are the "written address" of the electrons. There are 3 parts to the electron configuration:

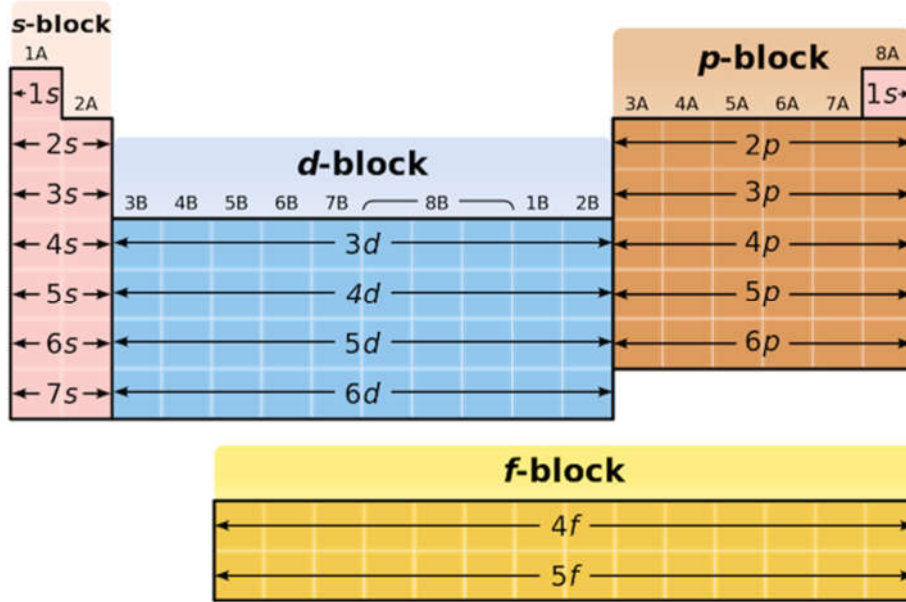


The Periodic Table gives you information regarding which orbitals are being filled:

**\*\*Note: The electron configuration for Helium is  $1s^2$**

### Determining the Electron Configuration Using the Periodic Table

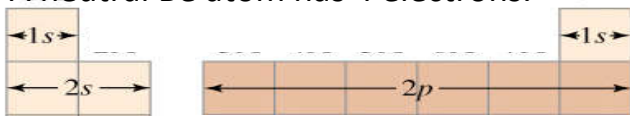
1. Determine the # of electrons in your atom
2. Go row by row and block by block on the Periodic Table until you reach the element or the # of electrons desired.



#### Ex 1: Beryllium

Be: atomic number = 4.

A neutral Be atom has 4 electrons.



|                               |                                 |                          |                             |                               |                             |                                 |                            |  |  |                              |
|-------------------------------|---------------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------|---------------------------------|----------------------------|--|--|------------------------------|
| 1.00794<br>H<br>1<br>Hydrogen |                                 |                          |                             |                               |                             |                                 |                            |  |  | 4.00260<br>He<br>2<br>Helium |
| 6.941<br>Li<br>3<br>Lithium   | 9.01218<br>Be<br>4<br>Beryllium | 10.81<br>B<br>5<br>Boron | 12.0111<br>C<br>6<br>Carbon | 14.0067<br>N<br>7<br>Nitrogen | 15.9994<br>O<br>8<br>Oxygen | 18.998403<br>F<br>9<br>Fluorine | 20.179<br>Ne<br>10<br>Neon |  |  |                              |

The entire 1s block must be filled, so Be has 2 electrons in the 1s orbital.

The entire 2s block must be filled, so Be also has 2 electrons in the 2s orbital.

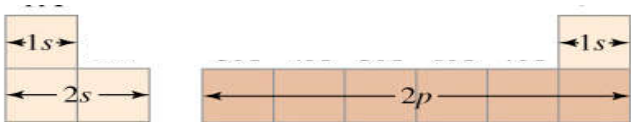
The full electron configuration for Be would be written as  $1s^2 2s^2$

The subscripts (2 and 2) add up to 4, which is the total number of electrons.

#### Ex 2: Oxygen

O: atomic number = 8.

A neutral O atom has 8 electrons.



|                               |                                 |                          |                             |                               |                             |                                 |                            |  |  |                              |
|-------------------------------|---------------------------------|--------------------------|-----------------------------|-------------------------------|-----------------------------|---------------------------------|----------------------------|--|--|------------------------------|
| 1.00794<br>H<br>1<br>Hydrogen |                                 |                          |                             |                               |                             |                                 |                            |  |  | 4.00260<br>He<br>2<br>Helium |
| 6.941<br>Li<br>3<br>Lithium   | 9.01218<br>Be<br>4<br>Beryllium | 10.81<br>B<br>5<br>Boron | 12.0111<br>C<br>6<br>Carbon | 14.0067<br>N<br>7<br>Nitrogen | 15.9994<br>O<br>8<br>Oxygen | 18.998403<br>F<br>9<br>Fluorine | 20.179<br>Ne<br>10<br>Neon |  |  |                              |

The entire 1s block must be filled, so O has 2 electrons in the 1s orbital.

The entire 2s block must be filled, so O also has 2 electrons in the 2s orbital.

To get to Oxygen, 4 electrons must be filled in the 2p orbital.

The full electron configuration for O would be written as  $1s^2 2s^2 2p^4$

The subscripts (2, 2, and 4) add up to 8, which is the total number of electrons.

## Writing Electron Configurations:


| Element                  | # of e <sup>-</sup>      | Long Form Electron Configuration   | Noble Gas Abbreviation   | # valence e <sup>-</sup> 's |                          |                          |                          |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
|--------------------------|--------------------------|--|--------------------------|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----|----|----|----|----|----|----|----|--|--|
| Be                       |                          | $1s^2 2s^2$ (see example)  |                          |                             |                          |                          |                          |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
| O                        |                          | $1s^2 2s^2 2p^4$ (see example)   |                          |                             |                          |                          |                          |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
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| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
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| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
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| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
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| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
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| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
| Cu                       |                          | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> <td style="text-align: center; width: 12.5%;"><input type="checkbox"/></td> </tr> <tr> <td style="text-align: center;">1s</td> <td style="text-align: center;">2s</td> <td style="text-align: center;">2p</td> <td style="text-align: center;">3s</td> <td style="text-align: center;">3p</td> <td style="text-align: center;">4s</td> <td style="text-align: center;">3d</td> <td style="text-align: center;">4p</td> </tr> </table> | <input type="checkbox"/> | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1s | 2s | 2p | 3s | 3p | 4s | 3d | 4p |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>   | <input type="checkbox"/> | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |
| 1s                       | 2s                       | 2p   | 3s                       | 3p                          | 4s                       | 3d                       | 4p                       |                          |                          |                          |    |    |    |    |    |    |    |    |  |  |

Electron configurations can get very long, as you can see in the table above! A shortened form of the electron configuration can be written for most elements. This shortened form is often referred to as the **Noble Gas** abbreviated electron configuration, or the short form.

## Valence Electrons

- Electrons in the \_\_\_\_\_
- The # of valence electrons = the total # electrons in the \_\_\_\_\_ sublevels (must be of the same energy level)

## Noble Gases: Group 18 (rightmost column on periodic table)

- Have \_\_\_\_\_ = \_\_\_\_\_
  - All elements want to be a noble gas (so freaking bad).  
In other words, all elements want to have a \_\_\_\_\_
  - Remember: “**8 IS GREAT!**” 
  - Exception to octet rule is \_\_\_\_\_: it only has \_\_\_\_\_ valence electrons ( $1s^2$ )

## Obtaining a Noble Gas Electron Configuration

- Elements can \_\_\_\_\_ or \_\_\_\_\_ electrons and become **ions** in order to get a noble gas' electron configuration. Depending on the element, sometimes it is “easier to lose electron(s)”, and sometimes it is “easier to gain electron(s)”
- Metals (on the left side of the staircase on the periodic table) tend to \_\_\_\_\_ electrons to obtain a noble gas electron configuration
- Nonmetals (on the right side of the staircase on the periodic table) tend to \_\_\_\_\_ electrons to obtain a noble gas electron configuration

## Complete the following table for the given ions

| Ion             | Lose or Gain e's? | # of e's | Long form | # Val e's |
|-----------------|-------------------|----------|-----------|-----------|
| Oxygen Ion      |                   |          |           |           |
| Potassium Ion   |                   |          |           |           |
| Phosphorous ion |                   |          |           |           |
| Chlorine Ion    |                   |          |           |           |
| Aluminum ion    |                   |          |           |           |