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HONORS - Unit 3, Section 4 - Orbital Diagrams and Electron Configuration

Orbital Diagrams:

An orbital diagram is a visual representation of where electrons are in an atom. Electrons in atoms will completely fill the lowest energy levels before filling higher energy levels. In an orbital diagram, the energy levels are represented with their corresponding number, the sublevel is represented with the letter (s, p, d, or f), and electrons are written as arrows.

* Boxes = orbitals

Examples:

e⁻

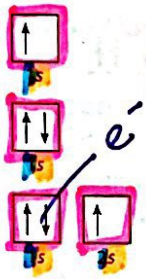
↑↓

↑↓

Hydrogen 1e⁻

Helium 2e⁻

Lithium 3e⁻

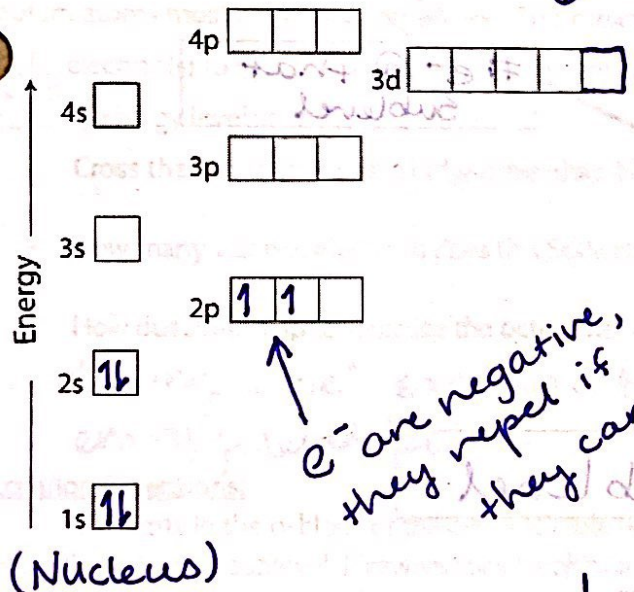


Rules:

1. Arrows (electrons) are placed so that they fill the lowest energy levels and lowest sublevels first.
2. Electrons are placed so that they are all pointing the same direction in different orbitals first, then go back and double up with the second electron pointing the opposite direction.

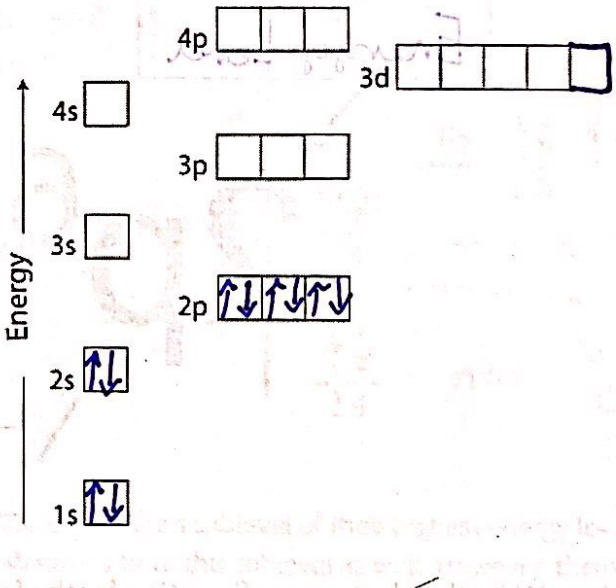
Practice:

a. Complete the orbital diagram for **Carbon** 6e⁻



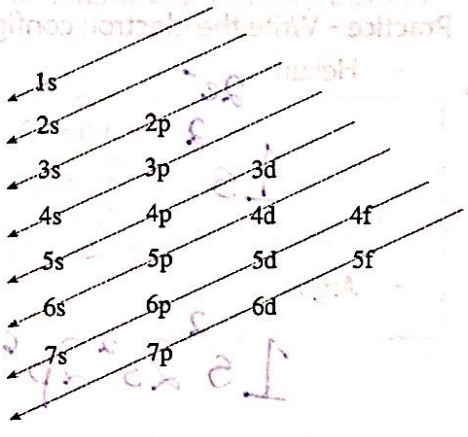
(Nucleus)

b. Complete the orbital diagram for **Neon** 10e⁻



The exceptions to the rules include the d and f sublevels. The shape of these sublevels can cause orbitals of these sublevels to extend beyond the s and p sublevels of the next energy level. For example, the **3d sublevel** is filled with electrons **AFTER** the **4s**, even though the **4s** is **TECHNICALLY** at a higher energy level.

To the right is a chart to follow to help with placing electrons, but the periodic table can also be used!



Write directions for using your periodic table below:

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Electron Configuration:

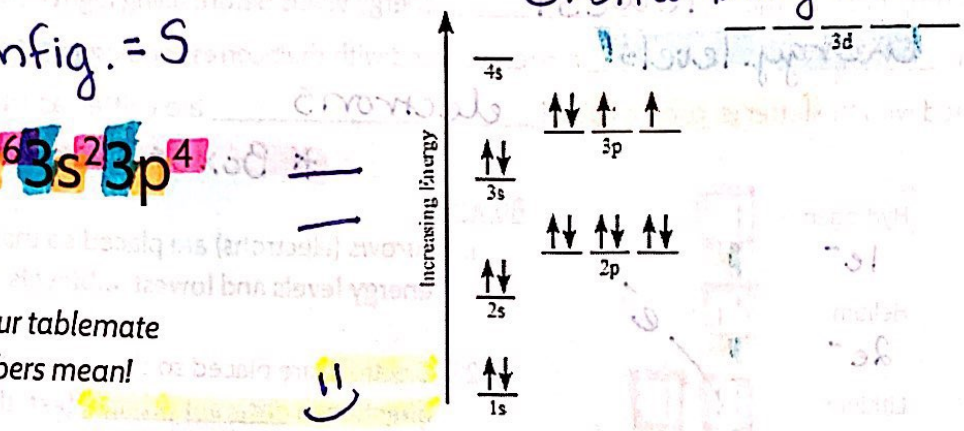
Electron configurations are a simpler way of showing where electrons are likely to be in the atom. It represents the same process as orbital diagrams, but just using the numbers and letters. Here is an example of the **electron configuration** for an atom of **Sulfur** along with its **orbital diagram:**

E⁻ Config. = S

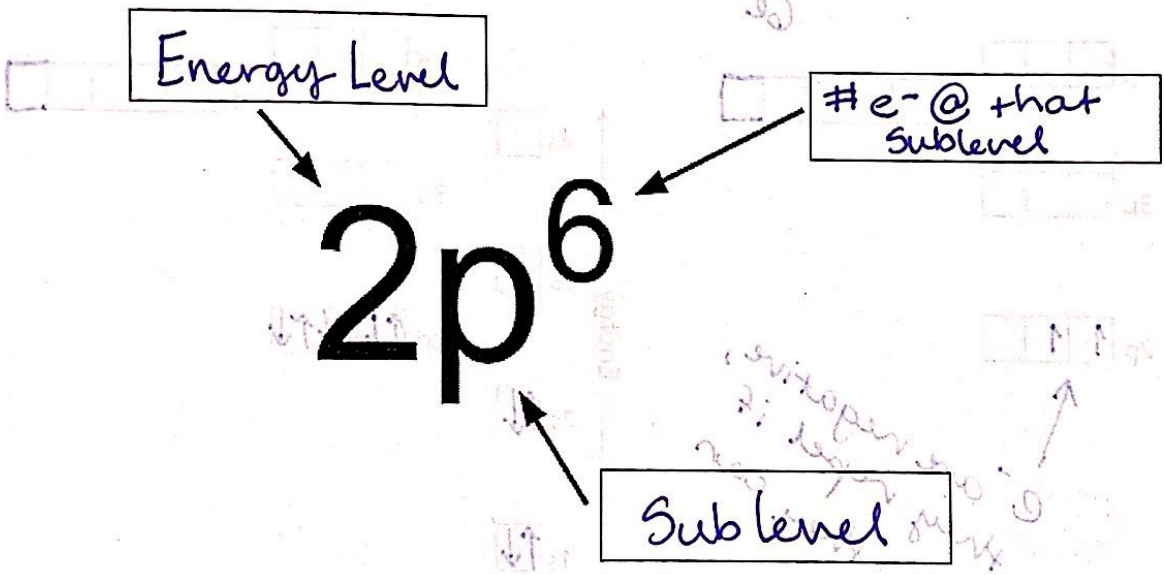
$1s^2 2s^2 2p^6 3s^2 3p^4$

Discuss with your tablemate what the numbers mean!

Orbital Diag = S



Now, let's label the diagram below!



Practice - Write the electron configuration for the following:

- Helium 2e⁻

  $1s^2$

- Oxygen

  $1s^2 2s^2 2p^4$

- Argon

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

- Calcium

  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$

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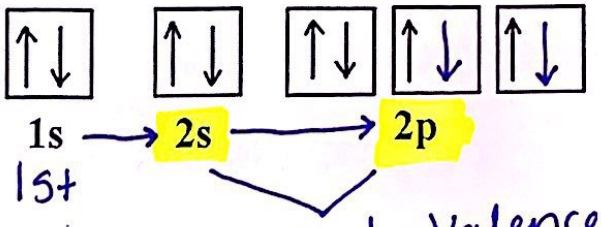
Ions in Orbital Diagrams and Electron Configuration:

When atoms gain and lose electrons, they are gained and lost from the highest energy level and therefore the outermost sublevel in that energy level.

Anions: (−)

Oxygen atoms most commonly for a 2- ion. This means it will (gain / lose) 2 electron(s) to form this ion. These will be placed in its 2nd energy level, in the p sublevel.

Oxygen + $2e^- = O^{2-}$



1st

2nd = Valence

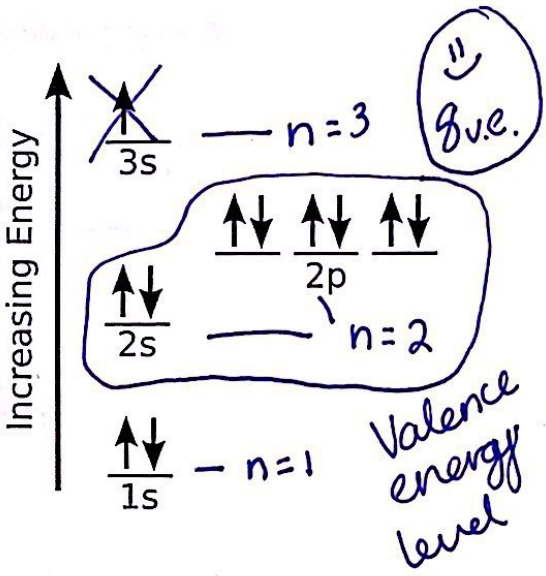
8 v.e⁻ = 🙂

- **Draw them in now with a color other than black!**
- How many valence electrons does this oxygen now have? 8
- How does this help to visualize the **octet rule?**

by gaining $2e^-$, Oxygen has fully filled its highest energy level (8 v.e⁻)

Cations: (+)

Sodium atoms most commonly for a 1+ ion. This means it will (gain / lose) 1 electron(s) to form this ion. These will be removed from its 3rd energy level, in the s sublevel.



- **Cross them out now with a color other than black!**
- How many valence electrons does this Sodium now have? 8
- How does this help to visualize the **octet rule?**

Losing 1 v.e⁻ exposes a full energy level below

Atom/Ion Exceptions:

Elements in the d-block of the periodic table will traditionally fill the s sublevel of their highest energy level before they fill the d sublevel. Likewise, they traditionally lose electrons from this sublevel as well. However, there are two exceptions. They are...

Copper:	Chromium:
Cu + Cr will prioritize "filling" the 3d (and therefore 3rd energy level) over filling the 4s sublevel	