Chemistry 11

Atomic Theory II

Name:
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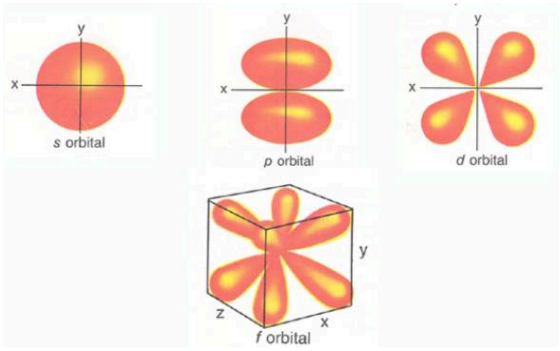
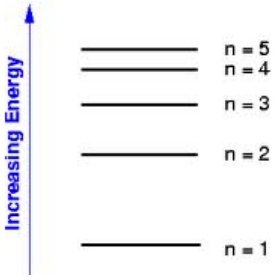
Block:

1. **Electronic Structure**
2. **Electron Configuration**
3. **Orbital Diagrams**

Electronic Structure

- Electrons are found in orbitals (areas of space) around the nucleus
- There are 4 different types of orbitals: s, p, d, f
- Each type of orbital has a different shape
- The orbital that an electron occupies depends on its energy level (called n)





Energy level

- a specific amount of energy which an electron in an atom possesses

Bohr's experiments with hydrogen atoms were fundamental to figuring out the electronic structure of the atom:

Bohr's Postulate #1:

- The hydrogen atom had only certain allowed energy levels or stationary states.
- The lowest (smallest) orbit was called the "ground state" and designated n = 1.
- The larger orbits were called "excited states" and designated as n = 2, n = 3, n = 4, etc.

Bohr's Postulate #2:

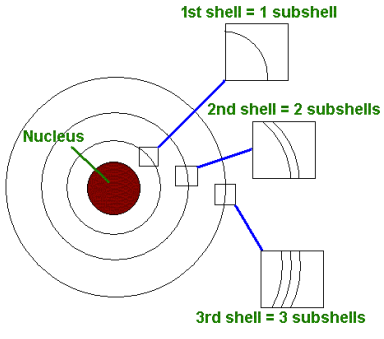
- As long as the electron moved within the same energy level, the electron did not radiate or absorb energy

Bohr's Postulate #3:

- The electron could only move from one allowed energy level to another if it absorbed or emitted an amount of energy equal to the energy different between the two energy levels.

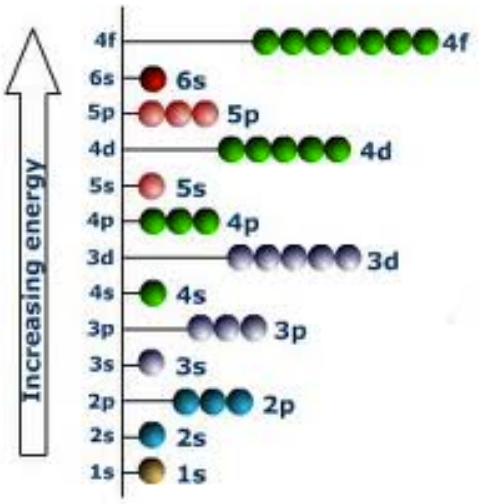
Expanding Bohr's Theory

- Each energy level (called shells) is split up into subshells and orbitals.
  - A shell matches the energy level of the electron
  - Each subshell contains a type of orbital (s, p, d, f)
  - An orbital is the region of space occupied by an electron



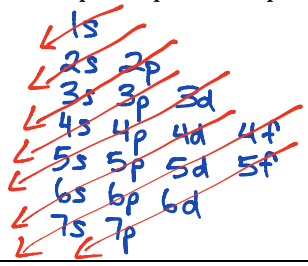
Atomic Orbitals

- There is __1__ s orbital (2 electrons)
- There are __3__ p orbitals (6 electrons)
- There are __5__ d orbitals (10 electrons)
- There are __7__ f orbitals (14 electrons)



Electrons fill orbitals from the lowest energy to the highest

- 1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f



Electron Configuration

- **Shows where the electrons are located within the orbitals**
- **There are three "rules" that we must remember:**

Rule #1: Aufbau Principle

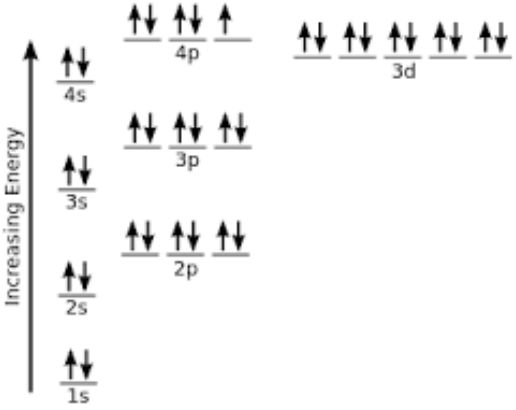
- Aufbau means "building up" in German
- When filling orbital, the lowest energy orbitals available are always filled first

Rule #2: Pauli Exclusion Principle

- Each orbital can hold a maximum of 2 electrons

Rule #3: Hund's Rule

- When orbitals of equal energy are being filled, electrons are most stable when each orbital is singly occupied before they are doubly occupied



Let's practice!

1. Lithium – 3 electrons $1s^2 2s^1$
   - Superscript indicate # of electrons
   - 2 electrons + 1 electron = 3 electrons
   - there are 2 electrons in the 1st subshell and 1 electron in the 2nd subshell
2. Beryllium – 4 electrons $1s^2 2s^2$

3. Boron 5 electrons

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

4. Carbon

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

5. Nitrogen

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

6. Oxygen

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

7. Fluorine

$1s^2 2s^2 2p^5$

8. Neon

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

More Practice:

1. F

$1s^2 2s^2 2p^5$

2. Ca

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

3. Cu

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$

4. Kr

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

5. Mo

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^4$

6. Ba^{2+} (54 electrons)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$

7. Xe

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$

8. I^- (54 electrons)

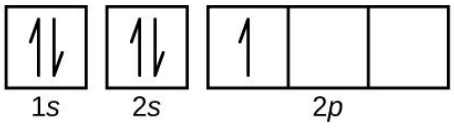
$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6$

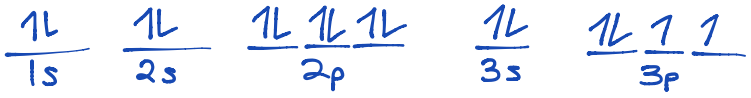
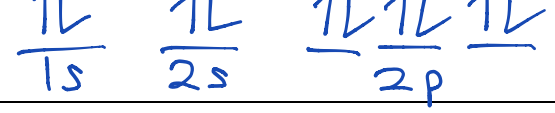
9. **How are Ba^{2+}, Xe, and I^- related?**

They all have the same number of electrons

Orbital Diagrams

B $1s^2 2s^2 2p^1$



Element	Electron Configuration	Orbital Diagram
Li	$1s^2 2s^1$	
S	$1s^2 2s^2 2p^6 3s^2 3p^4$	
Ne (10 e⁻)	$1s^2 2s^2 2p^6$	
V	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$