

Section 5.3

Electron Configurations

Electron Configurations

- Electron location when atom is in the ground state
- 3 rules or laws
 - The Aufbau principle
 - Pauli Exclusion principle
 - Hund's Law

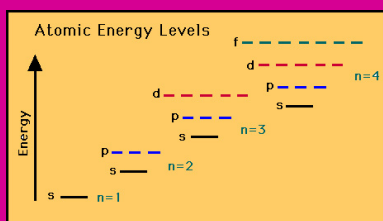
Aufbau Principle

- Electrons occupy lowest energy orbital available
 - All orbitals of a sublevel are equal energy
 - Sublevels within a principal energy level have different energies.
- Ex: 3p orbitals have higher energy than 2s orbital.

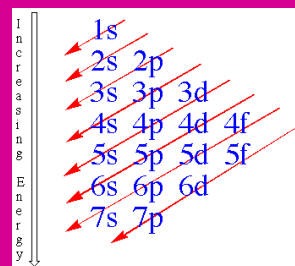
Aufbau (cont.)

- In order of increasing energy within a principal energy level is s, p, d, and f.
- Orbitals within one principal energy level can overlap orbitals of another
 - Ex: 4s orbitals are lower energy than 3d orbitals.

Electron Configurations

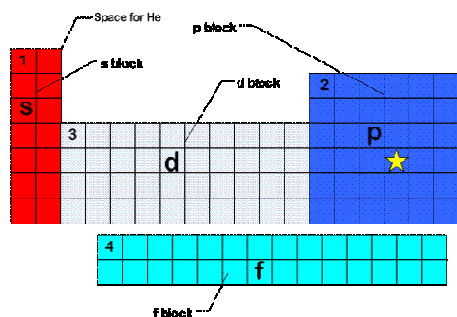


Electron Filling Order



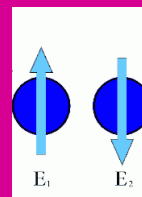
Which orbital will fill first, 4s or 3d?

Periodic Table Helps!



Pauli Exclusion Principle

- Maximum of 2 electrons in an orbital, but only if they have opposite spin.



Hund's rule

- Electrons with same spin must occupy each equal energy orbital before additional electrons with opposite spins can occupy the same orbital.

Summarizing the 3 Rules

• Orbital filling order:

1s 2s 2p 3s 3p 4s 3d 4p 5s 4d 5p 6s 4f 5d 6p 7s 5f 6d 7p

Remember...

- How many electrons each orbital can hold:
 - s = 2
 - p = 6
 - d = 10
 - f = 14

Electron Configurations

- Two methods
 1. Electron Configuration Notation
 2. Orbital Diagrams

Electron Configuration Notation

- Describes arrangement of electrons in atoms
- Designates principal energy level and sublevel associated with each orbital
- Superscript represents number of electrons in orbital

Electron Configuration Notation

- Ex: Write the electron configuration notation for Nitrogen.
 - Number of electrons?
- Start with the 1s orbital and fill it with 2 electrons, then the 2s orbital gets 2 electrons, then the 2p orbital gets the remaining 3 electrons
 - $1s^2 2s^2 2p^3$
 - The superscripts should add up the total number of electrons in the element.

Electron Configuration Notation

- You try ... Zinc

Electron Configuration Notation

- Answer:



Assignment

- Write the electron configuration notation for the following elements:
 - Boron (B), Neon (Ne), Sulfur (S), Magnesium (Mg), Vanadium (V), Arsenic (As), Silver (Ag), Bromine (Br), Promethium (Pm) and Gold (Au)
 - AND P.139 #18

Noble Gas Notation

- Shorthand configuration
 - Find the noble gas closest to the element (without going over).
 - Ex: For gold (79) that noble gas would be Xenon (54)
 - We write [Xe] and start counting from there
 - The first orbital after xenon is 6s so that's where we start

Noble Gas Notation

- [Xe]6s²4f⁴5d⁹
- Check: (Xe's atomic number) 54 + 2 + 14 + 9 = 79 (gold's Atomic number)!

Assignment

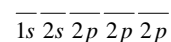
- P.139 #18-22
- P.147 #79, 80

Orbital Diagrams

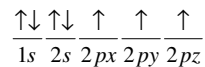
- Show the orbital distributions of electrons related to a sublevel
- Include a box for each orbital
 - \square = unoccupied orbital
 - \uparrow = orbital with 1 electron
 - $\uparrow\downarrow$ = orbital with 2 electrons
- Dashed lines can be substituted for boxes

Orbital Diagrams

- Nitrogen: 1s²2s²2p³
 - We start by writing the orbitals for Nitrogen



- Then we fill them with electrons using the Aufbau principle, Pauli exclusion principle, and Hund's law

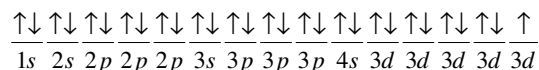


Orbital Diagrams

- You try another example: Cu – 29 electrons

Orbital Diagrams

- Answer



Assignment

- P.141 #24,25,27
- P.147 #78

Electron Dot Structures

- **Valence electrons:** electrons in outermost energy level.
 - Responsible for chemical and some physical properties
 - Number of electrons that still need to be filled after starting a noble gas notation.
 - Ex: S = [Ne] 3s²3p⁴ has 6 valence electrons

Electron Dot Structures

- Represents the valence electrons for that element
- Place 'dots' around the elements symbol
- 4 sides of the element are orbitals
- Fill these orbitals one at a time according to Hund's law

Electron Dot Structures

1	2	13	14	15	16	17	18
H·							He·
Li·	·Be·	·B·	·C·	·N·	·O·	·F·	·Ne·
Na·	·Mg·	·Al·	·Si·	·P·	·S·	·Cl·	·Ar·
K·	·Ca·				·Se·	·Br·	·Kr·
Rb·	·Sr·				·Te·	·I·	·Xe·
Cs·	·Ba·						

Assignment

- P.141 #23(yellow box), 26, 28
- P.147 #81