

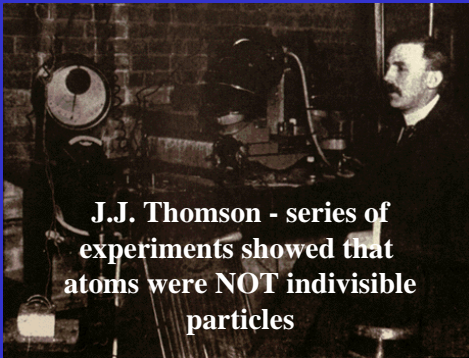
ATOMIC SYMBOLS - one or two letter symbol that represents a particular element



How many do you remember?

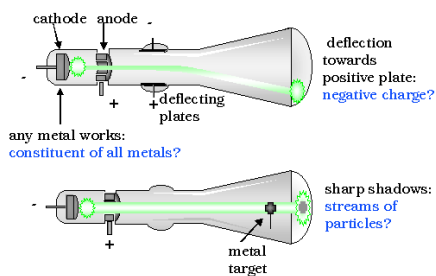
- Hydrogen
- Oxygen
- Chlorine
- Nickel
- Lead
- Mercury
- Neon
- Tin

The Structure of the Atom:



J.J. Thomson - series of experiments showed that atoms were NOT indivisible particles

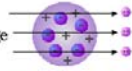
Probing Atomic Structure: Cathode Rays



The Nuclear Atom

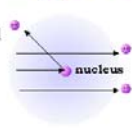
❖ Thomson's Atom

- diffuse mass and charge



❖ Rutherford's Atom

- concentrated mass and positive charge at the nucleus
- electrons roam empty space around the nucleus



Atoms have:

A nucleus: a central core that has a positive charge and contains most of the atom's mass

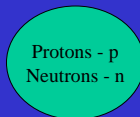
One or more Electrons: very light, negatively-charged particles that exist in around the positively-charged nucleus

The nucleus contains:

Protons: a nuclear particle having positive charge (equal to the electrons but having a mass 1800 times that of the electron)

Neutrons: a nuclear particle no electric charge and a mass about equal to that of the proton

Electrons - e



Check out Table 2.1 in your text for an equivalent table

Structure of the Nucleus

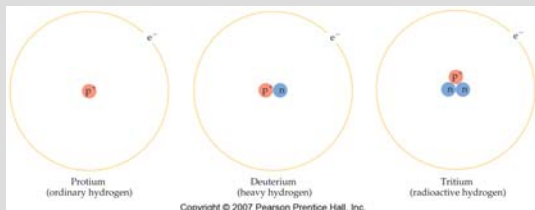
❖ nuclei are composed of "nucleons": protons and neutrons

	Symbol	Charge	Mass, kg	Mass, amu
electron	e^-	-1	9.10953×10^{-31}	0.000548
proton	p^+	+1	1.67265×10^{-27}	1.007276
neutron	n	0	1.67495×10^{-27}	1.008665



Isotopes

Isotopes have the same atomic number but different mass number (same number of protons but different number of neutrons).



Nuclear Symbol

A
 X
 Z

X = element symbol
 A = atomic number
 Z = mass number

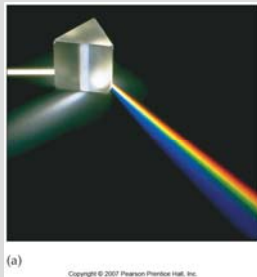
Electron Arrangement:
The Bohr Model

Flame Tests: Different elements give different colors to a flame.



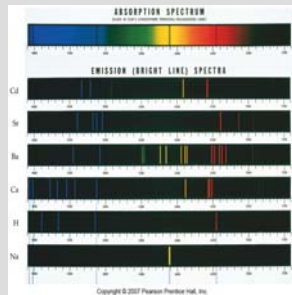
Electron Arrangement:
The Bohr Model

Continuous Spectra: When light emitted from a solid substance is passed through a prism, it produces a continuous spectrum of colors.



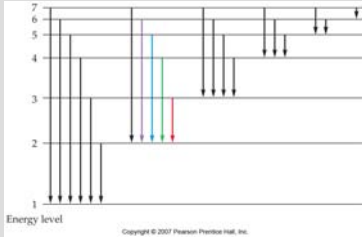
Electron Arrangement:
The Bohr Model

Line Spectra: When light from a gaseous substance is passed through a prism, it produces a line spectrum.



Electron Arrangement:
The Bohr Model

Quantum: tiny unit of energy produced or absorbed when an electron makes a transition from one energy level to another.

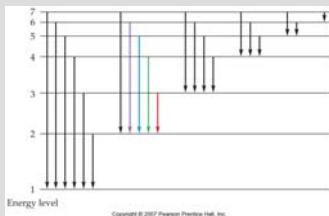


Electron Arrangement:
The Bohr Model

- When electrons are in the lowest energy state, they are said to be in the **ground state**.
- When a flame or other source of energy is absorbed by the electrons, they are promoted to a higher energy state (**excited state**).
- When an electron in an excited state returns to a lower energy state, it emits a **photon** of energy which may be observed as light.

Electron Arrangement

Energy states or levels are sometimes called **shells**.



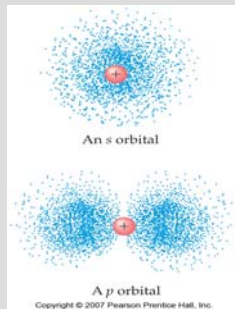
Electron Arrangement:
The Quantum Model

The **quantum model** of the atom is a probability-based model. It is composed of principle energy levels, sublevels, and orbitals.

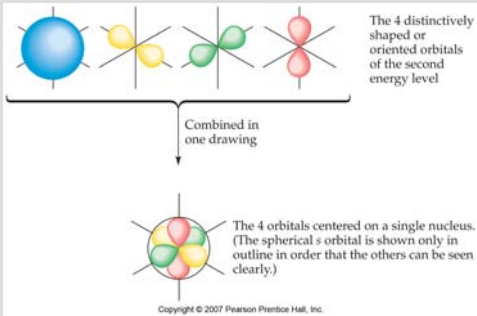
Electron Arrangement:
The Quantum Model

- **Principle Energy Levels (Shells):** roughly correlate to the distance that an electron is from an atom's nucleus.
- **Sublevels (subshells):** Each principle energy level (n) is divided into n sublevels.
- **Orbitals:** Orbitals are a region in space representing a high probability of locating an electron. Each sublevel has one or more orbitals.

Electron Arrangement:
The Quantum Model

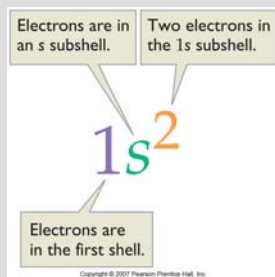


Electron Arrangement:
The Quantum Model



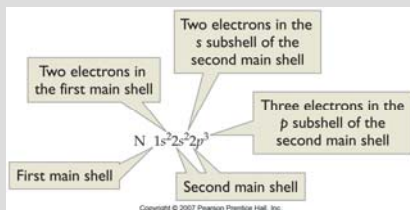
Electron Arrangement:
The Quantum Model

Electron Configurations: Allow us to represent the arrangement of the electrons in an atom.



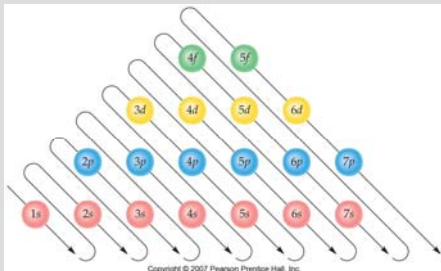
Electron Arrangement:
The Quantum Model

Electron Configurations: Allow us to represent the arrangement of the electrons in an atom.



Electron Arrangement:
The Quantum Model

The order-of-filling chart:



Electron Arrangement:
The Quantum Model

TABLE 3.3 Electron Structures for Atoms of the First 20 Elements

Name	Atomic Number	Electron Structure*
Hydrogen	1	1s ¹
Helium	2	1s ²
Lithium	3	1s ² 2s ¹
Beryllium	4	1s ² 2s ²
Boron	5	1s ² 2s ² 2p ¹
Carbon	6	1s ² 2s ² 2p ²
Nitrogen	7	1s ² 2s ² 2p ³
Oxygen	8	1s ² 2s ² 2p ⁴
Fluorine	9	1s ² 2s ² 2p ⁵
Neon	10	1s ² 2s ² 2p ⁶
Sodium	11	1s ² 2s ² 2p ⁶ 3s ¹
Magnesium	12	1s ² 2s ² 2p ⁶ 3s ²
Aluminum	13	1s ² 2s ² 2p ⁶ 3s ² 3p ¹
Silicon	14	1s ² 2s ² 2p ⁶ 3s ² 3p ²
Phosphorus	15	1s ² 2s ² 2p ⁶ 3s ² 3p ³
Sulfur	16	1s ² 2s ² 2p ⁶ 3s ² 3p ⁴
Chlorine	17	1s ² 2s ² 2p ⁶ 3s ² 3p ⁵
Argon	18	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶
Potassium	19	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ¹
Calcium	20	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ²

*Valence electrons are shown in red.
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Electron Configurations and the Periodic Table

- The **Periodic Table** is considered by many to be the most predictive tool in all of chemistry.
- It is composed vertical columns called **groups** or families and horizontal rows called **periods**.

Electron Configurations and the Periodic Table

- **Groups (families):** vertical column in the periodic table. Groups contain elements with similar chemical properties.
- **Periods:** horizontal rows of the periodic table. Elements in a period demonstrate a range of properties from metallic on the left to nonmetallic on the right.

Electron Configurations and the Periodic Table

- **Valence Electrons:**
 - Valence electrons are the electrons in the outermost principle energy level of an atom.
 - These are the electrons that are gained, lost, or shared in a chemical reaction.
 - Elements in a group or family have the same number of valence electrons.

Electron Configurations and the Periodic Table

- Some groups in the periodic table have special names:
- **Alkali Metals:** Group 1A
 - valence electron configuration: ns^1
- **Alkaline Earth Metals:** Group 2A
 - valence electron configuration: ns^2
- **Halogens:** Group 7A
 - valence electron configuration: ns^2np^5
- **Noble Gases:** Group 8A
 - valence electron configuration: ns^2np^6

Electron Configurations and the Periodic Table

• **Metals, Nonmetals, and Metalloids**

• **Metals:**

- metallic luster, conduct heat and electricity, malleable and ductile. Ex: sodium, copper

• **Nonmetals**

- dull luster, nonconductors, brittle
Ex: sulfur, bromine

• **Metalloids**

- Demonstrate properties of both metals and nonmetals.
Ex: silicon, arsenic

Electron Configurations and the Periodic Table

