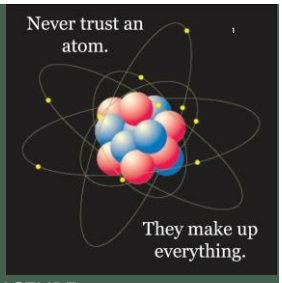


ATOMIC STRUCTURE
CHAPTER 2: ATOMS, MOLECULES AND IONS

AP Chemistry

Discovery of Atomic Structure

2

- Each of these scientists helped advance and explore the atom. The scientists are
  - Dalton
  - JJ Thomson
  - Millikan
  - Rutherford
  - Bohr

Dalton's Atomic Theory – Page 40

3

1. Elements are composed of extremely small particles called atoms
2. All atoms of a given element are identical to one another in size, mass and chemical properties. Atoms of one element are different from the atoms of all other elements
3. A chemical reaction involves only the separation, combination or rearrangement of atoms; it does not result in their creation or destruction
4. Compounds are formed when atoms of more than one element combine; a given compound always has the same relative number and kind of atoms

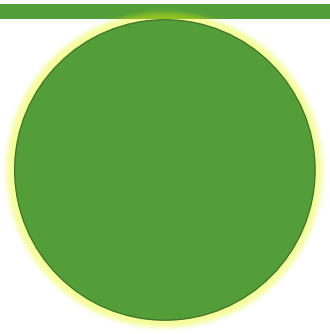
Extensions of Atomic Theory

4

- **Law of Definite Proportions –** In a given compound, the relative number and kinds of atoms are constant *(i.e. H_2O)*
- **Law of Conservation of Mass –** The total mass of material present after a chemical reaction is the same as the total mass present before the reaction. (Matter can be neither created nor destroyed)
- **Law of Multiple Proportions –** If two elements, A and B, combine to form more than one compound, the masses of B that can combine with a given mass of A are in the ratio of small whole numbers *(i.e. CO_2 and CO)*

Dalton's Model

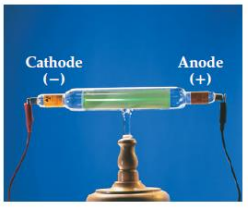
5

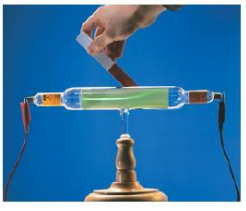


JJ Thomson's Model

6

- Discovered electrons using the **cathode ray tube**
- His model is known as the "plum pudding model"

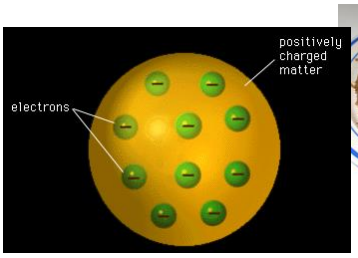




JJ Thomson's Model

7

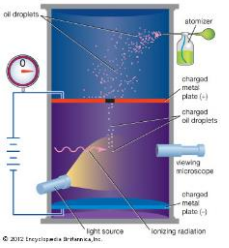
- Discovered electrons using the **cathode ray tube**
- His model is known as the "plum pudding model"



Robert Millikan

8

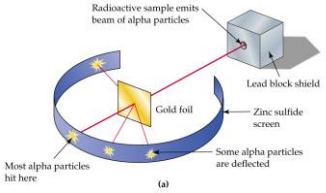
- Millikan explored the mass of the electron using the oil drop experiment
- He found the mass to be 9.109×10^{-31} kg
- He also confirmed that the electron carries a negative charge, 1.602×10^{-19} coulombs

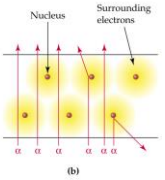


Rutherford Experiment

9

- Rutherford discovered α, β, and γ radiation
- Also discovered the nucleus using gold foil experiment
- Rutherford's model of the atom was like the solar system

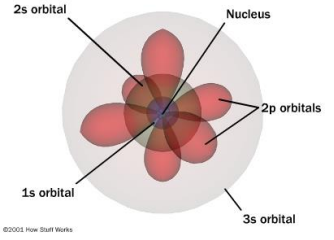




Bohr/Schrödinger

10

- Introduced the modern idea of the atom with a nucleus and an electron cloud
- We'll explore this more later



Subatomic Particles

11

- All atoms are composed of the same basic particles
  - Protons
  - Neutrons
  - Electrons
- The protons and neutrons are located in the nucleus
- Electrons are located in a cloud around the nucleus

Subatomic Particles

12

- The **ATOMIC NUMBER (Z)** of an element is the number of protons in the nucleus
- The **MASS NUMBER (A)** is the total number of protons and neutrons in the nucleus

$$\begin{matrix} A \\ Z \end{matrix} X$$

$$A - Z = Neutrons$$

$$Mass\ Number - Atomic\ Number = Number\ Neutrons$$

Subatomic Particles

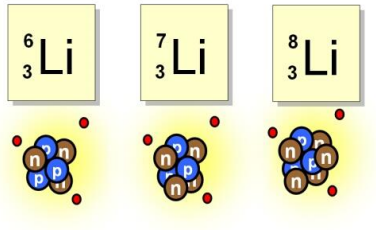
13

- Atoms have the same number of electrons as protons, so the charges overall charge of the atom is neutral
- For ions, the electrons can be different.
  - For positive ions – there is a loss of electrons
  - For negative ions – there is a gain of electrons

Subatomic Particles

14

- Isotopes are atoms of the same element that have different masses.
- Isotopes differ in the amount of neutrons



Practice!

15

For each of the following indicate the number of protons, neutrons and electrons

1. $^{17}_{8}O$
2. $^{63}_{29}Cu^{2+}$
3. $^{25}_{12}Mg$
4. $^{199}_{80}Hg$
5. $^{80}_{35}Br^{1-}$
6. $^{31}_{15}P^{-3}$
7. $^{238}_{92}U$
8. $^{235}_{92}U$
9. $^{226}_{88}Ra$
10. $^{195}_{78}Pt$

Average Atomic Mass

- The average atomic mass takes into account the relative amounts of each isotope of the element
- To find average atomic mass…

Average Atomic mass = (relative abundance X mass of 1st isotope) + (relative abundance X mass of 2nd isotope) + (relative abundance X mass of 3rd isotope) + (relative abundance X mass of nth isotope)

16

Practice

17

What is the average atomic mass for magnesium if there is 78.99% Magnesium-23.985, 10.00% Magnesium-24.986 and 11.01% Magnesium- 25.983?

Practice

18

Rubidium has two isotopes, ^{85}Rb and ^{87}Rb. ^{85}Rb has a mass of 84.912 amu and an abundance of 72.17%. Use the average atomic mass from the periodic table to determine the mass and abundance of ^{87}Rb.

Practice

19

The average atomic mass of copper is 63.55 amu. If the only two isotopes of copper have masses of 62.94 amu and 64.93 amu, what are the percentages of each?

Periodic Table- Can you find these?

21

- Periods
- Groups/Families
- Metals
- Metalloids
- Non Metals
- Alkali Metals
- Alkaline Earth Metals
- Chalcogens
- Halogens
- Nobel Gases
- Diatomic Atoms
- Transition Metals
- Lanthanides Series
- Actinides Series
- s Orbitals
- p Orbitals
- d Orbitals
- f Orbitals