Unit II. The Atom: Early Models

PDF for printing.

READING ASSIGNMENT 1 : Read Ch. 5 p107-112. Build a time line showing the scientists who contributed to our understanding of the atom and their contributions. You will add to this time line as the unit progresses.

I. A History of the Atomic Theory- "How Small is Small"

A. Democritus- Greek- "atomos" (means: indivisible) "All matter is composed of indivisible units."

Atoms of Salt, Water & Iron. The chemical
s were conserved in the structure of the atoms

B. John Dalton- English Ph[illegible]-1844) . See a section of Dalton's book as well as an excerpt of his writings. .

Dalton's Atomic Theory-

1. All elements are composed of atoms and the atom is the smallest piece of that element
2. All atoms of the same element are the same. These atoms then have the same mass.
3. Atoms of different elements combine in whole number ratios producing compounds.

Law of Definite Proportions (Law of Constant Composition) - All compounds are composed of specific ratios of elements.

-This was actually coined by Joseph Proust, which Dalton used to develop his theory.

4. Chemical reactions occur when atoms are separated, joined or rearranged.

ASSIGNMENT 1. Quiz over Dalton's Atomic Theory

II. Composition of the Atom & Historical Atomic Models

Simplified View of the Subatomic Particles.

A. Electron- negative particles, very small

1. William Crookes (1832-1919)- Cathode Ray Tube- (Crookes Tube)

-cathode rays-

1. travel from cathode to anode in straight lines
2. heated metals placed in path of rays
3. Deflected by electric & magnetic charges- shows rays are made of negative particles.

2. J.J. Thomson (1856-1940)- 1897 England- Using Crookes Tube

Thomson's experiment lead to identification of the electron.
-measured deflection of electrons in magnetic & electric fields-
-found the ratio of charge to mass (e/m)

-determined the ratio was constant regardless of the gas used.

Thomson's Original Paper

Thomson's presentation for the Nobel Prize, 1906

3. R.A. Millikan- 1909- using X-ray induced charged oil droplets

-found the charge and mass of electrons- mass = 0.00055 a.m.u (1/1837 amu)

B. Proton- positive particles- more massive than electrons

1. Eugen Goldstein- 1886- Using modified Crookes Tube.

-identified positive stream of charged particles emanating from anode.

2. Wilhelm Wien- 1889- found charge to mass ratio

-ratio is smaller than that of the electron but varied with kind of gas
-Hydrogen has smallest ratio- mass of proton = 1.0073a.m.u

C. Neutron- neutral in charge- mass is comparable to proton

1. James Chadwick- (1891-1974)- 1932, Chadwick's experiment

-bombarded beryllium atoms with high velocity alpha particles and emitted uncharged particles.
-unstable when not in atom- decay into proton and electron

D. Elementary Particles- particles that make up the subatomic particles

The Particle Adventure- a trip into defining elementary/fundamental particles.
MODEL: Structure of the Atom down to the Elementary Particles.

READING ASSIGNMENT 2: Read Ch. 5 pp.113-121. Answer questions p. 121: 18-26 and construct a concept map from the concepts on page 128.

III. Regions of Atom

A. Nucleus- central dense region containing proton/neutrons.

1. Ernst Rutherford Gold Foil Experiment (1871-1937)- 1911-

-Bombarded gold foil with high velocity alpha particles. Some particles were deflected, scattered, showing a dense region within atoms containing positive region.

An abstract introducing Rutherford's paper on α- particle scattering.

2. Henry Moseley- (1887-1915)- 1913-Moseley's Experiment

-Using an X-ray tube (modified cathode ray tube) to identify the number of protons in varying elements.

a. Atomic Number (Z)- The number of protons found in nucleus

b. Mass Number- The number of protons + neutrons in an atoms

-a.m.u.- atomic mass unit → $^{1}/_{12}$ of Carbon atom ~ 1.67×10^{-24} g

-written at upper left of chemical symbol.

c. Isotopes- elements with varying number of neutrons

RESOURCE: Isotopes of the Elements. Allows you to search for specific isotopes

-to determine # of neutrons = mass number – atomic number

Mass Spectrometers are tools used to identify isotope concentrations within an elemental sample.

d. Atomic Mass- the average of the known masses of all isotopes and their occurrences in nature.

Calculating Average Atomic Mass
$\text{Atomic Mass} = \sum (A_i * m_i)_n$
A_i = isotopes abundance m_i = isotopes mass n = number of isotopes to averaged.

ASSIGNMENT 2: Calculating Atomic Mass. Take the first quiz. Be sure to print off the results.

PRACTICE : Finding Subatomic Particles in atoms/isotopes

ASSIGNMENT 3: Finding Subatomic Particles. Problems 1-9. Write out the solution for each. You can proceed through the remaining for extra points on your homework grade. (#13 is incorrect)

ASSIGNMENT 4: Ch. 5 Review Questions. p 129: 36, 38, 41, 42, 46, 50, 53, 56, & 57.

Complete Review of The History of the Atomic Model and a preview of The Modern Atomic Model by Jim Walker

Highly recommended link for you to visit.

Timeline of Atomic Theory advancements