Atoms, molecules and ions

Dalton's Atomic Theory (1808)

- The elements are formed of extremely small particles called atoms. All the atoms of a given element are identical. The atoms of the elements are different than those of all other elements.
- Compounds are formed of more than one element. In all compounds, the ratio between the number of atoms of two elements is either an integer or a simple fraction .
- A chemical reaction is the separation, combination, or rearrangement of atoms; it causes neither the destruction nor the creation of atoms.
- N.B. Dalton did not know the structure of the atom (i.e., electron, proton, neutron, nucleus, etc.)
    - Dalton imagined an atom was small and indivisible
- Dalton's work explained some empirical observations
    - The law of definite proportions
    - The law of multiple proportions
    - The law of conservation of mass

The Structure of the Atom: the Electron

- With a cathode ray tube, the existence of a subatomic particle with a negative charge was discovered by Thomson…the electron.
- Thomson established the charge/mass ratio of the electron.
- Millikan established the charge of an electron in the early 1900's (-1.60 x 10-19 C)
- With the help of Thomson's work, Millikan deduced the mass of an electron

Radioactivity

- Radioactivity: the spontaneous emission of particles and/or radiation
- Three types of particle/rays are produced by the decay of radioactive substances :
    - α particles (helium nuclei)
    - β particles (electrons)
    - γ rays (rays of high energy, and no charge)

The Structure of the Atom: the Proton and the Nucleus

- Before 1910, Thompson's "plum pudding" model of the atom was the accepted model.
- In this model, the electrons are dispersed within a much bigger sphere of uniform and positive matter.
    - This is "logical" considering the small mass of the electron compared to the overall mass of the atom
- Rutherford bombarded thin sheets of gold with α particles
- According to the "plum pudding" model, α particles should pass through without their trajectories being greatly affected
- However, the trajectories of some particles are greatly perturbed
- In Rutherford's experiment, the deviations are the result of large repulsions

- Because α particles are positively charged, the positive charge in the atom must be concentrated in a very small and solid nucleus in the center of the atom (about 10-13 of the volume of the atom, but almost 100% of the mass)
- The positive charges that are located in the nucleus are the protons
- The charge of a proton is the same as the electron, but with the opposite sign (i.e., positive)
- The mass of the proton is 1.67252 x 10-24 g (about 1840 times that of the electron)