

ATOMIC STRUCTURE

Modern Atomic Theory:

- All matter is composed of atoms.
- Atoms cannot be subdivided, created, or destroyed in ordinary chemical reactions. However, these changes can occur in nuclear reactions.
- Atoms of an element have a characteristic average mass which is unique to that element.
- Atoms of any one element differ in properties from atoms of another element.

Discovery of the Electron:

- In 1897, J.J. Thomson used a cathode ray tube to deduce (arrive at) the presence of a negatively charged particle... Cathode ray tubes pass electricity through a gas that is contained at a very low pressure.

Conclusions from the Study of the Electron:

- Cathode rays have identical properties regardless of the element used to produce them. All elements must contain identically charged electrons.
- Atoms are neutral, so there must be positive particles in the atom to balance the negative charge of the electrons.
- Electrons have so little mass that atoms must contain other particles that account for most of the mass.

Thomson's Atomic Model:

- Thomson believed that the electrons were like plums embedded in a positively charged "pudding," thus it was called the "plum pudding" model.

Rutherford's Gold Foil Experiment:

- Alpha particles are helium nuclei.
- Particles were fired at a thin sheet of gold foil.
- Particle hits on the detecting screen (film) are recorded.

Rutherford's Findings:

- Most of the particles passed right through
- A few particles were deflected.
- VERY FEW were greatly deflected

Rutherford's Conclusions:

- The nucleus is small, dense, and positively charged

Atomic Particles:

Particle	Charge	Mass #	Location
Electron	-1	0	Electron cloud
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus

Atomic Number:

- The atomic number of an element is the number of protons in the nucleus of each atom of that nucleus.

Element	Number of Protons	Atomic Number
Carbon	6	6
Phosphorus	15	15
Gold	79	79f

Mass Number:

- Mass number is the number of protons and neutrons in the nucleus of an isotope.

$$\text{Mass \#} = p^{+} + n^{0}$$

Nuclide	p^{+}	n^{0}	e^{-}	Mass #
Oxygen - 18	8	10	8	18
Arsenic - 75	33	14	33	75
Phosphorus - 31	15	16	15	31

Isotopes:

- Isotopes are atoms of the same element having different masses due to varying numbers of neutrons.

Isotopes	Protons	Electrons	Neutrons
Hydrogen-1 (protium)	1	1	0
Hydrogen-2 (deuterium)	1	1	1
Hydrogen-3 (tritium)	1	1	2

Atomic Masses:

- Atomic mass is the average of all the naturally occurring isotopes of that element.

Isotope	Symbol	Composition of the nucleus	% in nature
Carbon-12	^{12}C	6 protons 6 neutrons	98.89%
Carbon-13	^{13}C	6 protons 7 neutrons	1.11%
Carbon-14	^{14}C	6 protons 8 neutrons	<0.01%

Carbon = 12.011