6 • Structure of the Atom
The Subatomic Particles
(1 of 8)

Name	Symbol	Mass	Charge	Location
protons	p^+	1 u	1+	part of the nucleus
neutron	n°	1 u	0	part of the nucleus
electron	e^-	$\frac{1}{1837}$ u	1–	normally at large distances from the nucleus

J.J. Thompson is given credit for discovering **electrons** using a Crookes tube and testing many different gases. Cathode rays were found to be beams of electrons.

Cavendish is given credit for the discovery of the **neutron**.

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6 • Structure of the Atom
Terms I-- Atomic Structure
(2 of 8)

atoms the smallest particle of an element . It consists of a central nucleus and electron clouds outside the nucleus.

nucleus the dense central portion of an atom.

subatomic smaller than an atom. The proton, neutron, and electron are subatomic particles.

net charge the difference in the positive charge due to protons and the negative charge due to electrons in an atom.

nucleons the particles that make up the nucleus.

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6 • Structure of the Atom
Terms II-- Atomic Structure
(3 of 8)

atomic number the number of protons in an atom. This number determines the identity of an element.

mass number the number of protons + neutrons

isotopes atoms with the same number of protons, but different numbers of neutrons. Atoms with the same atomic number, but different mass numbers.

isotopic notation shorthand notation for a nucleus that shows the mass #, atomic # and the symbol. U-238 would be $^{238}_{92}U$

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6 • Structure of the Atom
Calculating Atomic Mass
(4 of 8)

Any **real** sample of an element contains more than one naturally occuring **isotope**. For instance, **boron**

isotope		**abundance**	**mass #**	**isotopic mass**
boron-10	$^{10}_{5}B$	19.78%	10	mass = 10.013 u
boron-11	$^{11}_{5}B$	80.22%	11	mass = 11.009 u

The atomic mass is the weighted average of the isotopes.

at. mass = $\frac{(19.78\%)(10.013u) + (80.22\%)(11.0009u)}{100}$ or

at. mass = (0.1978)(10.013u) + (0.8022)(11.0009u) =10.81 u

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6 • Structure of the Atom
Determining Numbers of Protons, Neutrons, and Electrons from the Isotopic Notation
(5 of 8)

Consider the following symbol: $^{33}_{16}S^{2-}$

The 16 is the **atomic number** which is the number of **protons**.

The 33 is the **mass number** which is the mass of one of the isotopes. This mass is due to the **protons and neutrons**.

The number of **neutrons** is the **mass number - the atomic number**. 33 - 16 = 17 neutrons.

Since the charge is 2-, there are 2 **more electrons than neutrons.** In this case, there are 18 electrons.

6 • Structure of the Atom
Important People in the Development of the Atomic Theory
(6 of 8)

Democritus [atomos]
philosopher who decided that matter was discontinuous
John Dalton [billiard-ball model]
experiments with gases… different substances are different combinations of atoms
J.J. Thomson [plum-pudding model]
experiments with gas-discharge tubes… atoms have positive and negative parts… the negative electrons are the same from atom to atom
Ernest Rutherford [nuclear model]
most of the mass of the atom is concentrated in a tiny, positively-charged nucleus
Niels Bohr [solar-system model]

6 • Structure of the Atom
Early Experimental Observations That Would Later Be Explained By The Atomic Theory
(7 of 8)

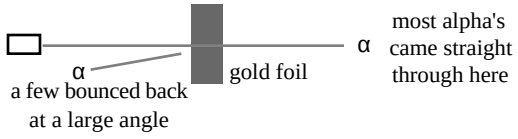
The Law of Conservation of Mass
the mass of all the reactant molecules = the mass of all the product molecules

The Law of Definite Composition
the percentage composition of any sample of a substance is the same

The Law of Multiple Proportions
when two compounds made of the same two elements (such as CO and CO_2) are broken down to give the same mass of ***one*** element… the masses of the ***other*** element will be in simple whole-number ratio.

6 • Structure of the Atom
Rutherford's Gold Foil Experiment
(8 of 8)

Ernest Rutherford's classic gold foil experiment led to the **nuclear model** of the atom.



- **the nucleus is tiny** - because most of the alpha's missed the nucleus and went straight through the foil
- **the nucleus is positively charged** - because the (+) charged alpha was repelled by the (+) charged nucleus
- **the nucleus is incredibly dense** - because the nucleus was able to bounce back at a very large angle