

The Periodic Table

Chapter 7

Chapter 7: The Periodic table and the atom

- A. Dalton's Atomic Theory
- B. Periodic table
- C. Models of the Atom
- D. Subatomic Particles
- E. Describing Individual Atoms
- F. Isotopes
- G. Bohr Model of Atom (Year: 1913)
- H. The electron as a wave

Dalton's Atomic Theory (1803)

- Elements are made up of atoms that are indivisible and indestructible.
- All atoms of an element have the same mass. No two different elements have the same mass.
- Compounds consist of small whole number ratios of elements.
- Elements are not changed during chemical reaction.

- Matter is composed of atoms. An atom is one of the 100+ elements.
- Each element has a name and a chemical symbol.
- The symbol is 1 to 2 letters. The first is capitalized, the second, is there is one, is lowercase. Example: F , Cl

11	Atomic number
Na	Element symbol
Sodium	Element name
22.99	Average atomic mass*

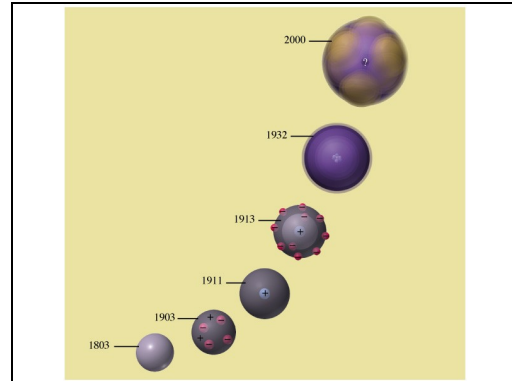
Periodic table

- Columns are called groups.
- Elements in the same group have similar properties.
- Rows are called periods.

H																	H	He
Li	Be											B	C	N	O	F	Ne	
Na	Mg											Al	Si	P	S	Cl	Ar	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe	
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn	
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub							

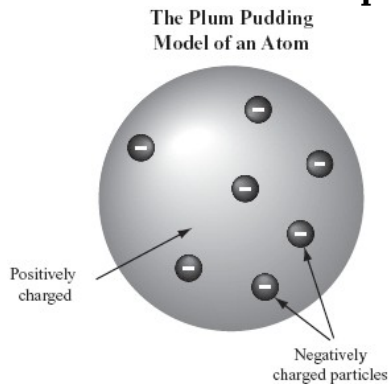
- Groups (vertical)

- 1A = alkali metals
 - 2A = alkaline earth metals
 - 7A = halogens
 - 8A = noble gases
- Element: A substance made of atoms of one element.
 - Compound: A substance made of atoms of 2 or more elements chemically bound together. Example: H₂O
 - Mixture: 2 or more elements and /or compounds not chemically bound together. Example: saline solution
 - Homogeneous
 - Heterogeneous

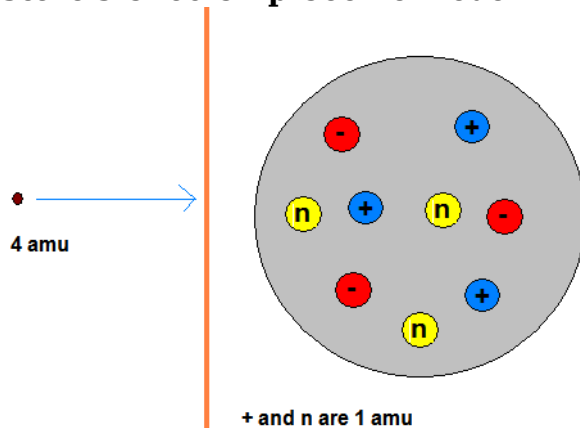


Models of the Atom

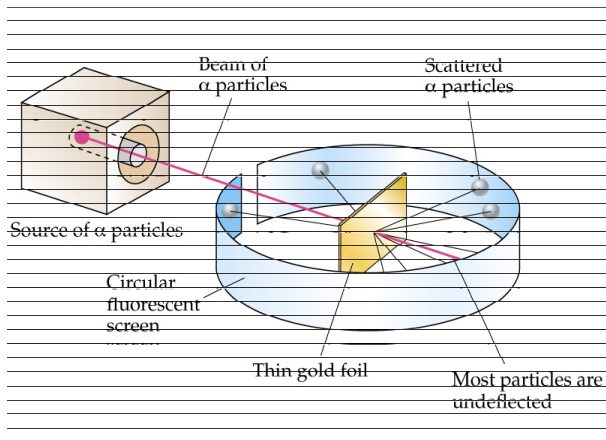
1903 Thomson - The plum pudding model



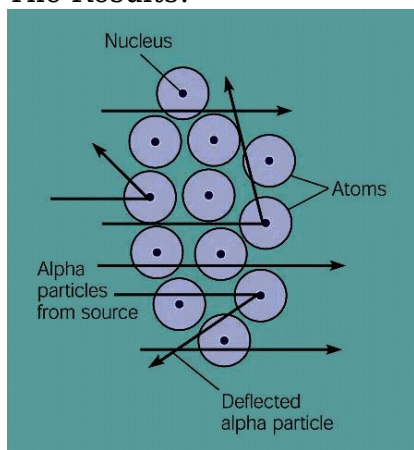
Steve's Choc Chip Cookie model



Rutherford's Alpha Scattering Experiment

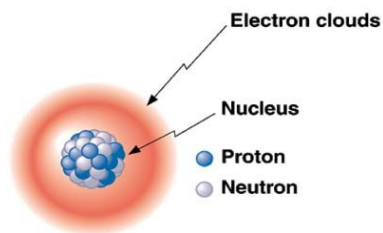


The Results!

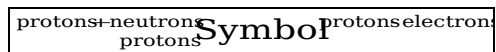
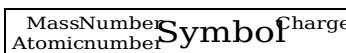


Subatomic Particles

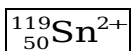
Particle	symbol	location	charge	mass
Electron	e ⁻	orbital	-1	1/1836
Proton	p ⁺	nucleus	+1	1
Neutron	n	nucleus	0	1



Describing Individual Atoms



Example



Fill in the blanks:

Symbol	neutrons	protons	electrons
^{60}Co	<u>33</u>	<u>27</u>	<u>27</u>
$^{81}\text{Br}^-$	<u>46</u>	<u>35</u>	<u>36</u>
<u>$^{65}\text{Cu}^{2+}$</u>	36	29	27

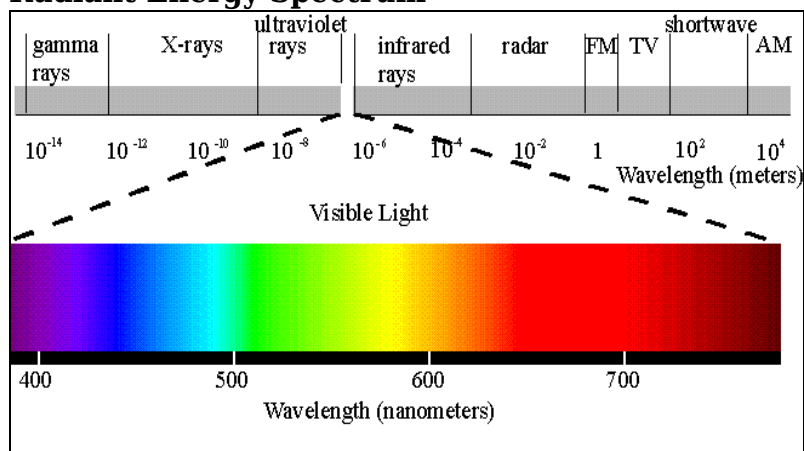
Isotopes

- Isotopes are atoms with the same number of protons but different numbers of neutrons.
- Same element, different mass.
- Some isotopes are stable, others are not.
- The masses on the periodic table are weighted averages.
- Isotopes of hydrogen and carbon.

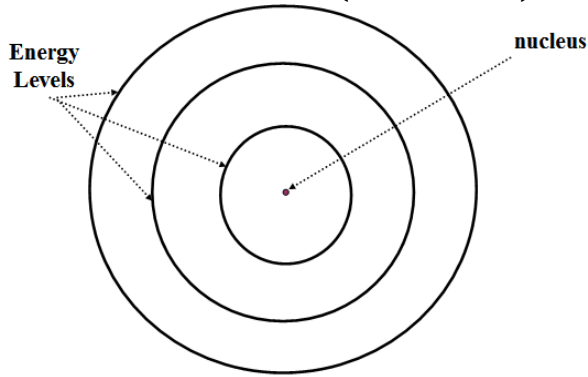
Chlorine

- Chlorine is 75% chlorine-35 and 25% chlorine-37. What is the average mass?

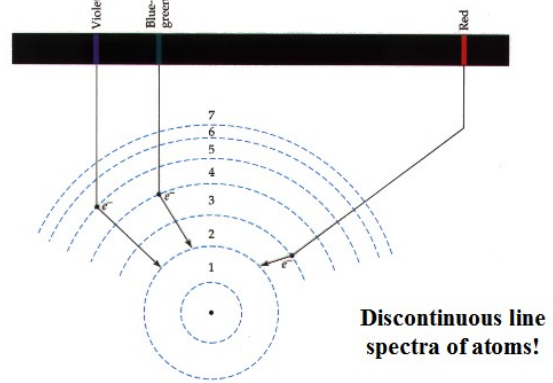
Radiant Energy Spectrum



Bohr Model of Atom (Year: 1913)



What was the evidence?



Discontinuous line spectra of atoms!

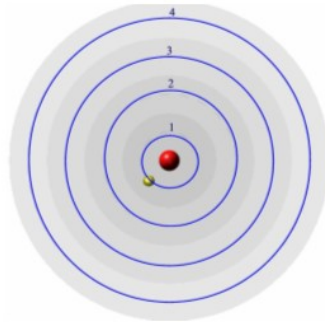
Final Statements on the Bohr model

Only certain orbits are allowed. Orbits closer to the nucleus are lower in energy.

1st orbit = 2 e⁻ max

2nd orbit = 8 e⁻ max

3rd orbit = 18 e⁻ max



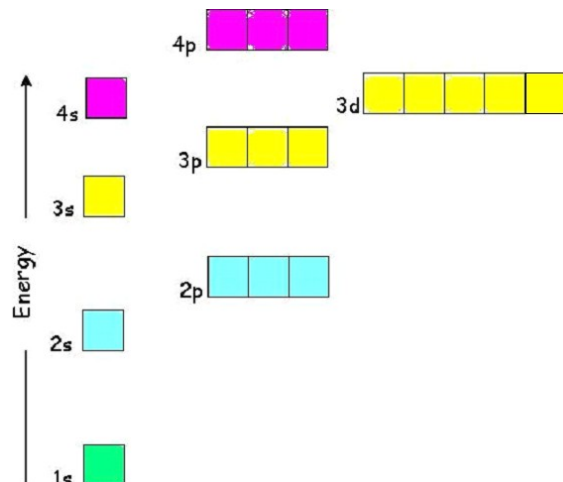
The electron as a wave

- Einstein, "Light, a wave, can have particle like properties"
- De Broglie, "particles, like electrons, can have wave-like properties"
- Schrödinger, "Came up with an equation that describes an electron"

The Players

The outcome

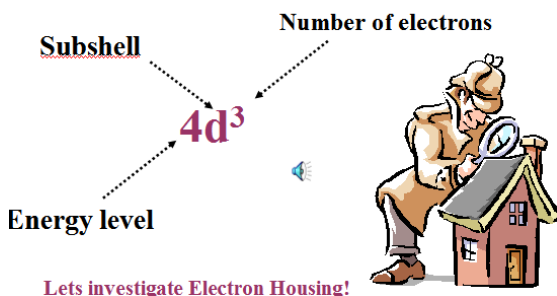
- n, principle quantum number. Correlates with shell of Bohr model
- l, subshell. Correlates with type of orbital, s p d or f.
- ml, orientation. p_x, p_y or p_z.
- s, spin. ↑ or ↓



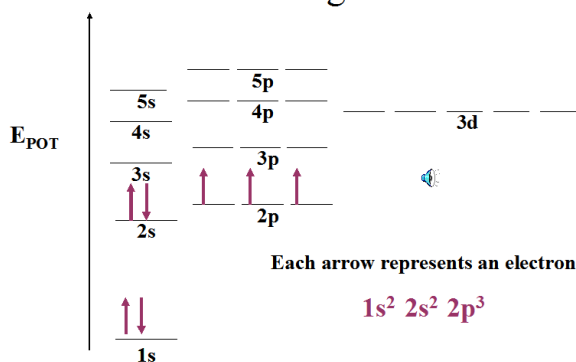
The first shell only has an s orbital
The second shell has s & p orbitals
The third shell has s, p d orbitals

Electron Configurations

(Shell-subshell notation)



Electron Configuration - N



Homework

- Which elementary particle(s) are in the nucleus?
(A) electron. (B) neutron. (C) proton. (D) protons and neutrons. (E) protons and electrons.
- Which elementary particle has a positive charge?
(A) electron. (B) neutron. (C) proton.
- The nucleus of a certain nitrogen atom contains 7 protons and 8 neutrons.
The atomic number of the nucleus is ____
- The nucleus of a certain nitrogen atom contains 7 protons and 8 neutrons.
The mass number of the above nucleus is ____.

5. The nucleus of an atom cannot be said to
(A) contain most of the atom's mass.
(B) be small in size.
(C) be electrically neutral.
(D) deflect alpha particles that come near it.
6. How many protons are in the nucleus of a chlorine-37 atom?
7. How many neutrons are in the nucleus of a chlorine-37 atom?
8. Sulfur contains two naturally occurring isotopes, sulfur-32 and sulfur-34. If the weighted average is 32.1 amu, which is there more of?

Answers: 1) D 2) C 3) 7 4) 15 5) C 6) 17 7) 20 8) The sulfur-32. The average is closer to 32.