

1. Atomic Theory

A. Democritus - 1st person to develop the idea that all substances are made of tiny, indivisible particles, called atoms.

B. John Dalton - developed the Atomic Theory, which states:

(1) All matter is made of tiny, indivisible particles, called atoms

(2) All atoms of a given element are identical.

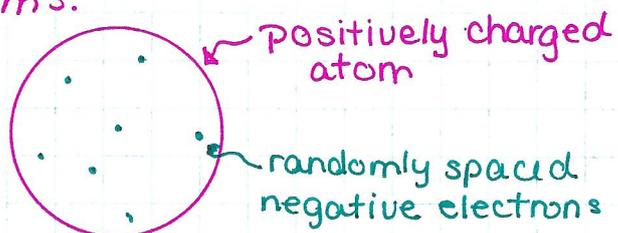
(3) Atoms of 1 element are different from atoms of another element

(4) Atoms combine in simple, whole number ratios to form compounds

(5) Atoms cannot be created or destroyed, only rearranged, in chemical reactions

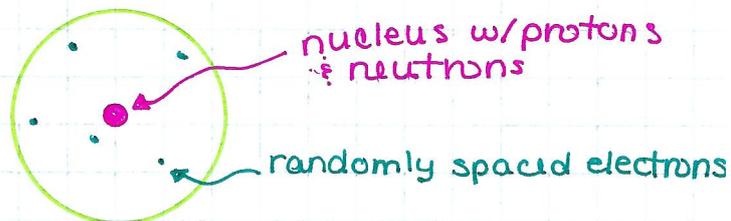
C. JJ Thomson - conducted the cathode-ray experiment to show that there are tiny, negative particles, called electrons inside the atoms.

Plum Pudding Model



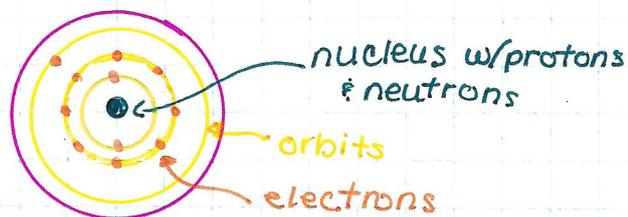
D. Ernest Rutherford - conducted the gold foil experiment and theorized that the positive charge in an atom is concentrated in the nucleus of the atom, in the center. He later discovered positive protons and neutral neutrons in the nucleus.

Rutherford's model



E. Neils Bohr - developed the planetary model of the atom where the electrons move around the nucleus in circular orbits. Each orbit represents a specific amount of energy the electron has.

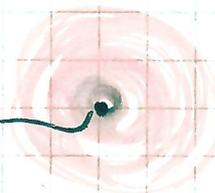
Bohr's Planetary Model



F Wave - Mechanical Model

2

nucleus
w/ protons &
neutrons



← e⁻ cloud
90% chance of
finding an electron
in it. Orbitals
exist w/i the
e⁻ cloud

2. Atomic Structure

- proton - p⁺, in the nucleus
neutron - n⁰, in the nucleus
electron - e⁻, in orbitals inside the e⁻ cloud
- atomic number - the # p⁺ in the nucleus (it's also the # e⁻ in the e⁻ cloud)
mass number - the # p⁺ and the # n⁰ in the nucleus
- isotope - atoms of the same element (same atomic number) but with different numbers of neutrons

D.

name	chemical symbol	atomic #	mass #	# p ⁺	# e ⁻	# n ⁰	isotopic symbol
beryllium	Be	4	9	4	4	9-4=5	⁹ ₄ Be
manganese	Mn	25	56	25	25	56-25=31	⁵⁶ ₂₅ Mn
cadmium	Cd	48	48+62=110	48	48	62	¹¹⁰ ₄₈ Cd
arsenic	As	33	75	33	33	75-33=42	⁷⁵ ₃₃ As

3. Electron Configurations

- O (has 8e⁻) 1s²2s²2p⁴ or [He]2s²2p⁴
- Mo (has 42e⁻) 1s²2s²2p⁶3s²3p⁶4s²3d¹⁰4p⁶5s²4d⁴ or [Kr]5s²4d⁴
- As (has 33e⁻) 1s²2s²2p⁶3s²3p⁴4s²3d¹⁰4p³ or [Ar]4s²3d¹⁰4p³
- I (has 53e⁻) 1s²2s²2p⁶3s²3p⁴4s²3d¹⁰4p⁶5s²4d¹⁰5p⁵ or [Kr]5s²4d¹⁰5p⁵

4. Electrons and Light

- Elements give off colored light when their electrons absorb energy and they jump to a higher orbital, they get excited. In order to go back down to their original, ground state, they release that energy as a light photon. That photon has a frequency in the visible light spectrum that humans can see

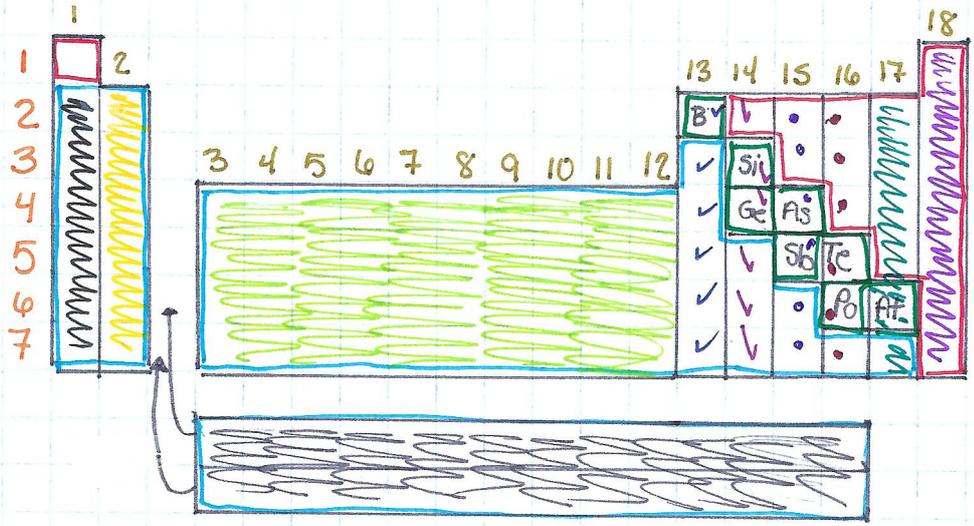


- (1) blue has a higher frequency than orange, so blue has a lower wavelength
- (2) infrared has a larger wavelength than red, therefore it has a lower frequency than red.
- (3) violet light has a higher frequency than indigo, therefore it has more energy

5. Nuclear Chemistry

A. All the elements heavier than hydrogen have been produced in stars by nuclear fusion - 2 smaller atoms join together to create a larger atom and a lot of energy.

6. The Periodic Table



6. Groups - vertical columns - all elements have same # valence
 7. Periods - horizontal rows - all elements in a period have the same # orbitals

8. metals metalloids nonmetals
- 9 a. transition metals boron family
 b. noble gases carbon family
 c. inner transition metals nitrogen family
 d. halogens oxygen family
 e. alkaline earth metals
 f. alkali metals

10. The Periodic Table is arranged in order of increasing atomic #

11. down a group
across a period

atomic radius	1 st ionization energy	electronegativity
increases	decreases	decreases
decreases	increases	increases

12. Atomic radius

down a group - as you move down a group on the table electrons are added to the atom in increasing number of orbitals. The valence electrons do not "feel" as much attraction to the protons in the nucleus because they are shielded by all the electrons in the inner orbitals, called core electrons. Therefore, the valence electrons are located farther and farther away from the nucleus.

across a period - as you move left to right across a period more protons are added to the nucleus and adding more electrons to the same orbital, so shielding doesn't change. But more protons and more electrons means more attraction and they move closer together, which makes the atom smaller and smaller

1st Ionization Energy

down a group - the bigger the atom is, the farther the valence electron is from the nucleus and the attraction to the protons. Therefore it takes less energy to remove that valence electron.

across a period - the smaller the atom gets, the closer the valence electron is to the nucleus and the greater its attraction to the protons. Therefore it will take more energy to remove the valence electron.

Electronegativity

down a group - the larger the atom is, the more the protons in the nucleus are shielded. Electrons from other atoms will "feel" less attraction to the protons and electronegativity decreases

across a period - the smaller an atom gets as more protons are added, the higher the attraction from electrons in another atom.

FIVE STAR. FIVE STAR. FIVE STAR. FIVE STAR. FIVE STAR.

13. a. Cr has a larger radius than Cu
b. W has a larger radius than Cr

(5)

c.

(i) Si (1) Fe (3) Pb (2)

(ii) Ag (2) Mo (3) Sb (1)

d.

(i) Si (1) Fe (3) Pb (2)

(ii) Ag (2) Mo (3) Sb (1)

e.

(i) Si (3) Fe (1) Pb (2)

(ii) Ag (2) Mo (1) Sb (3)

Periodic Table of the Elements

increasing radius

decreasing radius

increasing electronegativity

increasing 1st ion. energy

increasing electronegativity

smallest radius
largest 1st ion. energy
largest electronegativity

1+	Hydrogen 1 H 1.01	2+	Beryllium 4 Be 9.01
2	Lithium 3 Li 6.94		
3	Sodium 11 Na 22.99		Magnesium 12 Mg 24.31
4	Potassium 19 K 39.10		Calcium 20 Ca 40.08
5	Rubidium 37 Rb 85.47		Strontium 38 Sr 87.62
6	Cesium 55 Cs 132.91		Barium 56 Ba 137.33
7	Francium 87 Fr [223]		Radium 88 Ra [261]

Scandium 21 Sc 44.96	Titanium 22 Ti 47.88	Vanadium 23 V 50.94	Chromium 24 Cr 52.00	Manganese 25 Mn 54.94	Iron 26 Fe 55.85	Cobalt 27 Co 58.93	Nickel 28 Ni 58.69	Copper 29 Cu 63.55	Zinc 30 Zn 65.39	Gallium 31 Ga 69.72	Germanium 32 Ge 72.61	Arsenic 33 As 74.92	Selenium 34 Se 78.96	Bromine 35 Br 79.90	Krypton 36 Kr 83.80
Yttrium 39 Y 88.91	Zirconium 40 Zr 91.22	Niobium 41 Nb 92.91	Molybdenum 42 Mo 95.94	Technetium 43 Tc [98]	Ruthenium 44 Ru 101.07	Rhodium 45 Rh 102.91	Palladium 46 Pd 106.42	Silver 47 Ag 107.87	Cadmium 48 Cd 112.41	Indium 49 In 114.82	Tin 50 Sn 118.71	Antimony 51 Sb 121.76	Tellurium 52 Te 127.60	Iodine 53 I 126.90	Xenon 54 Xe 131.29
Lutetium 71 Lu 174.97	Hafnium 72 Hf 178.49	Tantalum 73 Ta 180.95	Tungsten 74 W 183.84	Rhenium 75 Re 186.21	Osmium 76 Os 190.23	Iridium 77 Ir 192.22	Platinum 78 Pt 195.08	Gold 79 Au 196.97	Mercury 80 Hg 200.59	Thallium 81 Tl 204.38	Lead 82 Pb 207.20	Bismuth 83 Bi 208.98	Polonium 84 Po [209]	Astatine 85 At [210]	Radon 86 Rn [222]
Lawrencium 103 Lr [262]	Rutherfordium 104 Rf [261]	Dubnium 105 Db [262]	Seaborgium 106 Sg [261]	Bohrium 107 Bh [264]	Hassium 108 Hs [269]	Mitlerium 109 Mt [268]	Darmstadtium 110 Ds [271]	Roentgenium 111 Rg [272]	Copernicium 112 Cn [277]	Nihonium 113 Nh [284]	Flerovium 114 Fl [289]	Moscovium 115 Mc [288]	Livermorium 116 Lv [293]	Tennesse 117 Ts [294]	Oganeson 118 Og [294]

Lanthanum 57 La 138.91	Cerium 58 Ce 140.12	Praseodymium 59 Pr 140.91	Neodymium 60 Nd 144.24	Promethium 61 Pm [145]	Samarium 62 Sm 150.36	Europium 63 Eu 151.97	Gadolinium 64 Gd 157.25	Terbium 65 Tb 158.93	Dysprosium 66 Dy 162.50	Holmium 67 Ho 164.93	Erbium 68 Er 167.26	Thulium 69 Tm 168.93	Ytterbium 70 Yb 173.04
Actinium 89 Ac [227]	Thorium 90 Th 232.04	Protactinium 91 Pa 231.04	Uranium 92 U 238.03	Neptunium 93 Np [237]	Plutonium 94 Pu [244]	Americium 95 Am [243]	Curium 96 Cm [247]	Berkelium 97 Bk [247]	Californium 98 Cf [251]	Einsteinium 99 Es [252]	Fermium 100 Fm [257]	Mendelevium 101 Md [258]	Nobelium 102 No [259]

-largest radius
-lowest 1st ion. energy
-lowest electronegativity