wkrp in cincinnati atomic structure

http://www.youtube.com/watch?v=hhbqIJZ8wCM

Mar 2-2:45 PM

New Unit: Atomic Structure

Text Book Chapter 4(skip 4.2)
Chapter 9 (9.1-9.5)

What is an Atom?

We learned that atoms were particles of elements, substances that could not be broken down further. In examining atomic structure though, we have to clarify this statement. An atom cannot be broken down further without changing the chemical nature of the substance. For example, if you have 1 ton, 1 gram or 1 atom of oxygen, all of these units have the same properties. We can break down the atom of oxygen into smaller particles, however, when we do the atom looses its chemical properties. For example, if you have 100 watches, or one watch, they all behave like watches and tell time. You can dismantle one of the watches: take the back off, take the batteries out, peer inside and pull things out. However, now the watch no longer behaves like a watch. So what does an atom look like inside?

What we are going to be studying in this unit is the Structure of an Atom, what makes up an Atom;

The Sub-Atomic Particles

Proton
Neutron
Electron

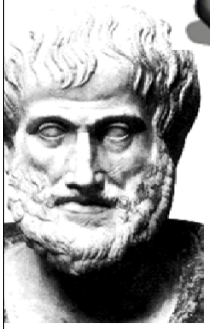
Nov 16-8:27 AM

History of Atomic Structure

Early Greek Theories

Democritus

- 400 B.C. - Democritus thought matter could not be divided indefinitely.
- This led to the idea of atoms in a void.



Aristotle

- 350 B.C - Aristotle modified an earlier theory that matter was made of four "elements": earth, fire, water, air.
- Aristotle was wrong. However, his theory persisted for 2000 years.

Nov 16-8:35 AM

John Dalton

- 1800 -Dalton proposed a modern atomic model based on experimentation not on pure reason.

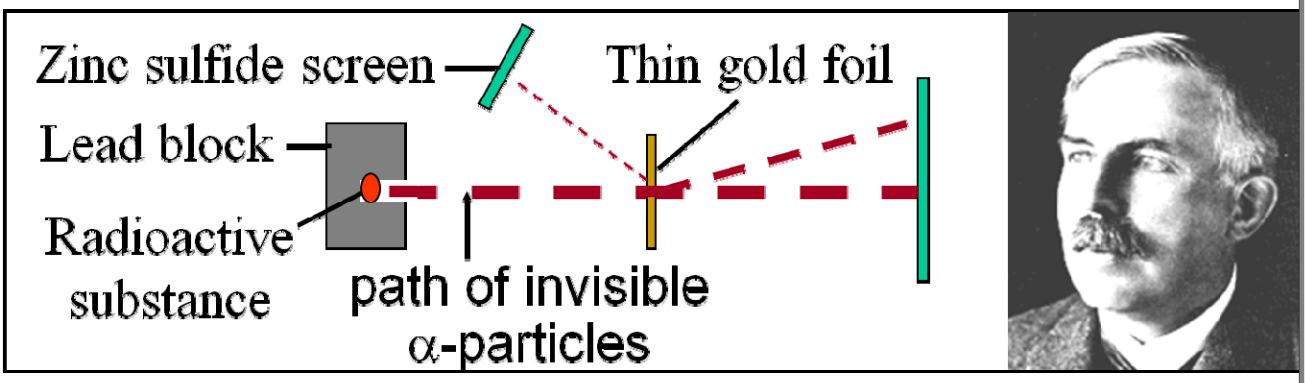
- All matter is made of atoms.
- Atoms of an element are identical.
- Each element has different atoms.
- Atoms of different elements combine in constant ratios to form compounds.
- Atoms are rearranged in reactions.

- His ideas account for the law of conservation of mass (atoms are neither created nor destroyed) and the law of constant composition (elements combine in fixed ratios).

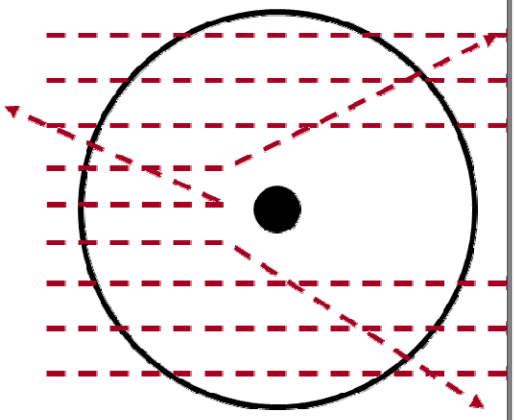
Nov 16-8:39 AM

Ernest Rutherford

- Rutherford shot alpha (α) particles at gold foil.



Most particles passed through.
So, atoms are mostly empty.
Some positive α-particles deflected or bounced back!
Thus, a "nucleus" is positive & holds most of an atom's mass.



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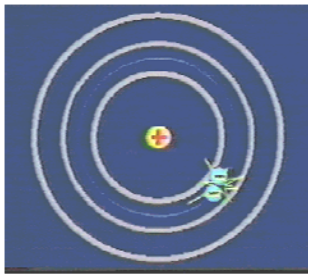
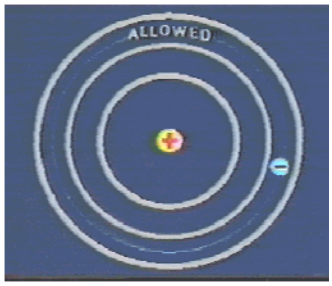
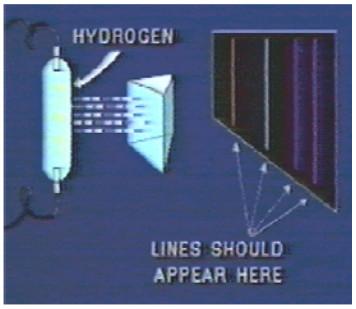
Bohr's model

- Electrons orbit the nucleus in "shells"
- Electrons can be bumped up to a higher shell if hit by an electron or a photon of light.







There are 2 types of spectra: continuous spectra & line spectra. It's when electrons fall back down that they release a photon. These jumps down from "shell" to "shell" account for the line spectra seen in gas discharge tubes (through spectroscopes).

Adding Electrons to the Model

Materials, when rubbed, can develop a charge difference. This electricity is called "cathode rays" when passed through an evacuated tube (demos). These rays have a small mass and are negative. Thompson noted that these negative subatomic particles were a fundamental part of all atoms.

1) Dalton's "Billiard ball" model (1800-1900)
Atoms are solid and indivisible.

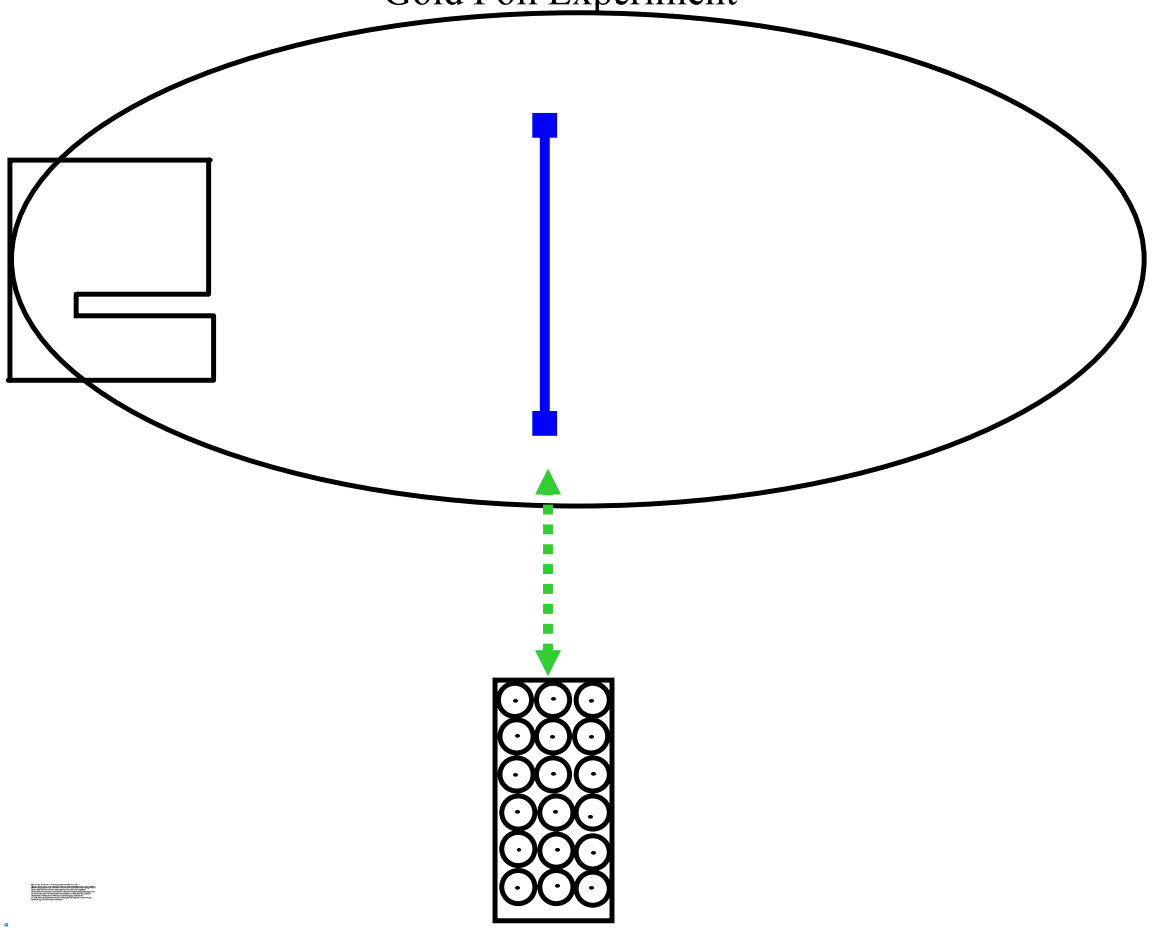
2) Thompson "Plum pudding" model (1900)
Negative electrons in a positive framework.

3) The Rutherford model (around 1910)
Atoms are mostly empty space.
Negative electrons orbit a positive nucleus.

Nov 17-10:05 AM

Ernest Rutherford

Gold Foil Experiment



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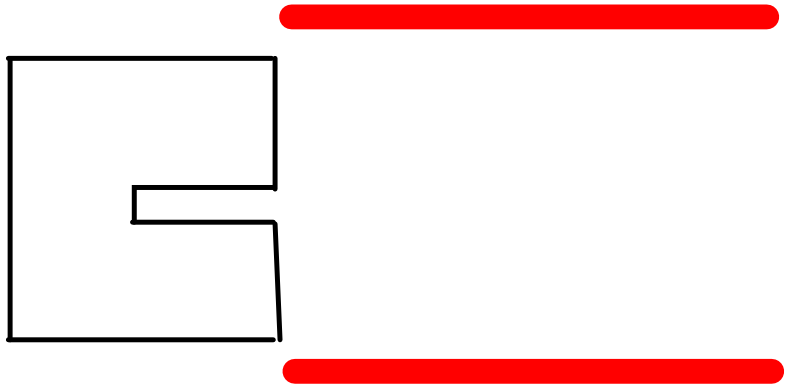
Sub-Atomic Particles



The Sub-Atomic Particles

Proton

Neutron

Nov 16-12:47 PM

Proton(Z)

Neutron

Electron

Nov 19-9:26 AM

Atom

All elements represented on the Periodic Table are **ATOMS**

Electrically Neutral

Number of Protons = Number of Electrons

Example: Zn

p=
e=

X

p=
e=25

Ion

Charged Particle #p ≠ #e

Cation - Positive Ion, when an atom loses electron(s) p>e

Anion -- Negative charge, when an atom gains electron(s) p<e

Example:

S^{2-}

p=
e=

Al^{3+}

p=
e=

Ca

p=
e=18

Nov 19-3:07 PM

Atomic Number, nuclear charge, or number of protons is the way an atom is identified, and can never change in an ordinary chemical reaction

Neutrons and Electrons can change!!

Isotopes

Same Element
Same Atomic Number
Same Nuclear Charge
Same Number of Protons

Different

Number of Neutrons
Mass Number

Example:

^{24}Na (Na-24)

p=
n=

^{22}Na (Na-22)

p=
n=

Ions

Charged Particle #p ≠ #e

Cation - Positive Ion, when an atom loses electron(s) p>e

Anion -- Negative charge, when an atom gains electron(s) p<e

Nov 19-12:07 PM

1. Determine the number of protons, neutrons, and electrons for the following

a. ^{28}Si p_____ n_____ e_____

b. ^{131}Xe p_____ n_____ e_____

c. $^{207}Pb^{+2}$ p_____ n_____ e_____

d. $^{127}I^{-1}$ p_____ n_____ e_____

Nov 20-2:55 PM

Fill in the Chart

Protons	Neutrons	Electrons	Atomic Number	Mass number	charge	Symbol
12						
			17	37		
		18			2-	
	35	30			0	
						Be
						P^{3-}
			92	235	2+	

ONLY USE YOUR PERIODIC TABLE AS A LAST RESORT

Always use the information given first!!

Nov 20-9:11 AM

Atomic Mass Vs. Mass Number

Mass Number = Protons + Neutrons

Atomic Mass = ?????

Average Atomic Mass (is what is on the Periodic Table)

Atomic Mass is an average of all known naturally occuring isotopes. It depends on **BOTH** the mass and relative abundance.

All elements on the Periodic Table whose masses are whole numbers () have no known naturally occurring isotopes

Calculation of Average Atomic Mass

If 75% of Carbon has a mass of 12 amu, and 25% of Carbon has a mass of 14 amu calculate the average atomic mass of Carbon

Nov 20-9:26 AM

Calculate the average atomic mass of iron if its abundance in nature is 15% iron-55 and 85% iron-56.

Boron has two naturally occurring isotopes: boron-10, boron-11. If the average atomic mass of boron is 10.81 amu, What is the relative abundance of each isotope?

Nov 20-2:44 PM

Calculate the average atomic mass of chromium

Isotope	Mass (amu)	Relative Abundance
Cromium 50	49.946	0.043500
Chromium 52	51.941	0.83800
Chromium 53	52.941	0.095000
Chromium 54	53.939	0.023500

The average atomic mass of copper is 63.55 amu. If the only two isotopes of copper have masses of 62.94 amu and 64.93 amu, what are the percentages of each?

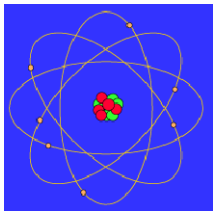
Nov 20-2:53 PM

Location of an Electron

Electrons are located outside of the nucleus, in regions called orbitals

We must be more specific as the location of an electron

The Bohr Model



The most important properties of atomic and molecular structure may be exemplified using a simplified picture of an atom that is called the *Bohr Model*. This model was proposed by Niels Bohr in 1915; it is not completely correct, but it has many features that are approximately correct and it is sufficient for much of our discussion. The correct theory of the atom is called *quantum mechanics*; the Bohr Model is an approximation to quantum mechanics that has the virtue of being much simpler.

The Bohr Model is probably familar as the "planetary model" of the atom illustrated above, for example, is used as a symbol for atomic energy (a bit of a misnomer, since the energy in "atomic energy" is actually the energy of the nucleus, rather than the entire atom). In the Bohr Model the neutrons and protons (symbolized by red and blue balls in the adjacent image) occupy a dense central region called the nucleus, and the electrons orbit the nucleus much like planets orbiting the Sun

Nov 23-12:30 PM

Erwin Schrödinger

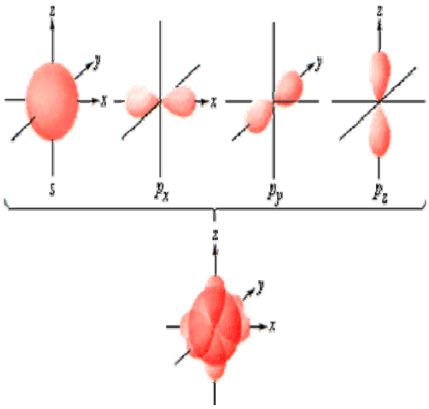
8/12/1887-1/4/1961

achieved fame for his contributions to quantum mechanics especially the Schrodinger Equation

The Detailed address of an electron is known as its electron configuration
The Electron configuration is the most probable location for an electron in an orbital, in fact an electron can be anywhere at any given time.

Nov 23-12:35 PM

PEL (Distance) (K-Q) (n)	Type of Sublevel (Distance) spdf	# Orbitals per type (Shape)	# Orbitals Per Level	Max # e- in PEL
1				
2				
3				
4				



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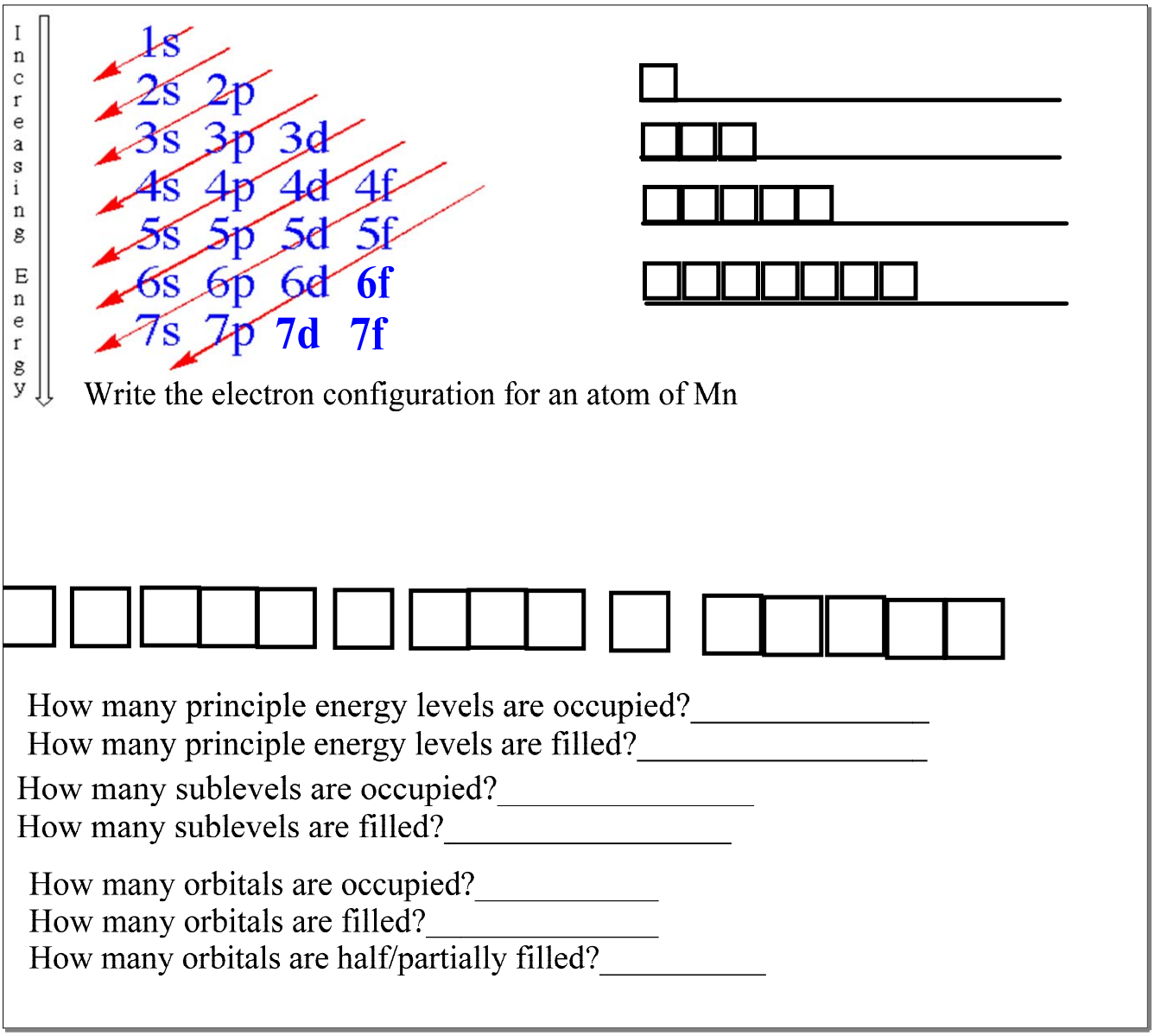

Increasing Energy
1s
2s 2p
3s 3p 3d
4s 4p 4d 4f
5s 5p 5d 5f
6s 6p 6d 6f
7s 7p 7d 7f
Write the electron configuration for an atom of Mn
How many principle energy levels are occupied?_____
How many principle energy levels are filled?_____
How many sublevels are occupied?_____
How many sublevels are filled?_____
How many orbitals are occupied?_____
How many orbitals are filled?_____
How many orbitals are half/partially filled?_____

Dec 3-11:50 AM

Write the electron configuration for an atom of Sulfur

Draw the orbital notation for Sulfur

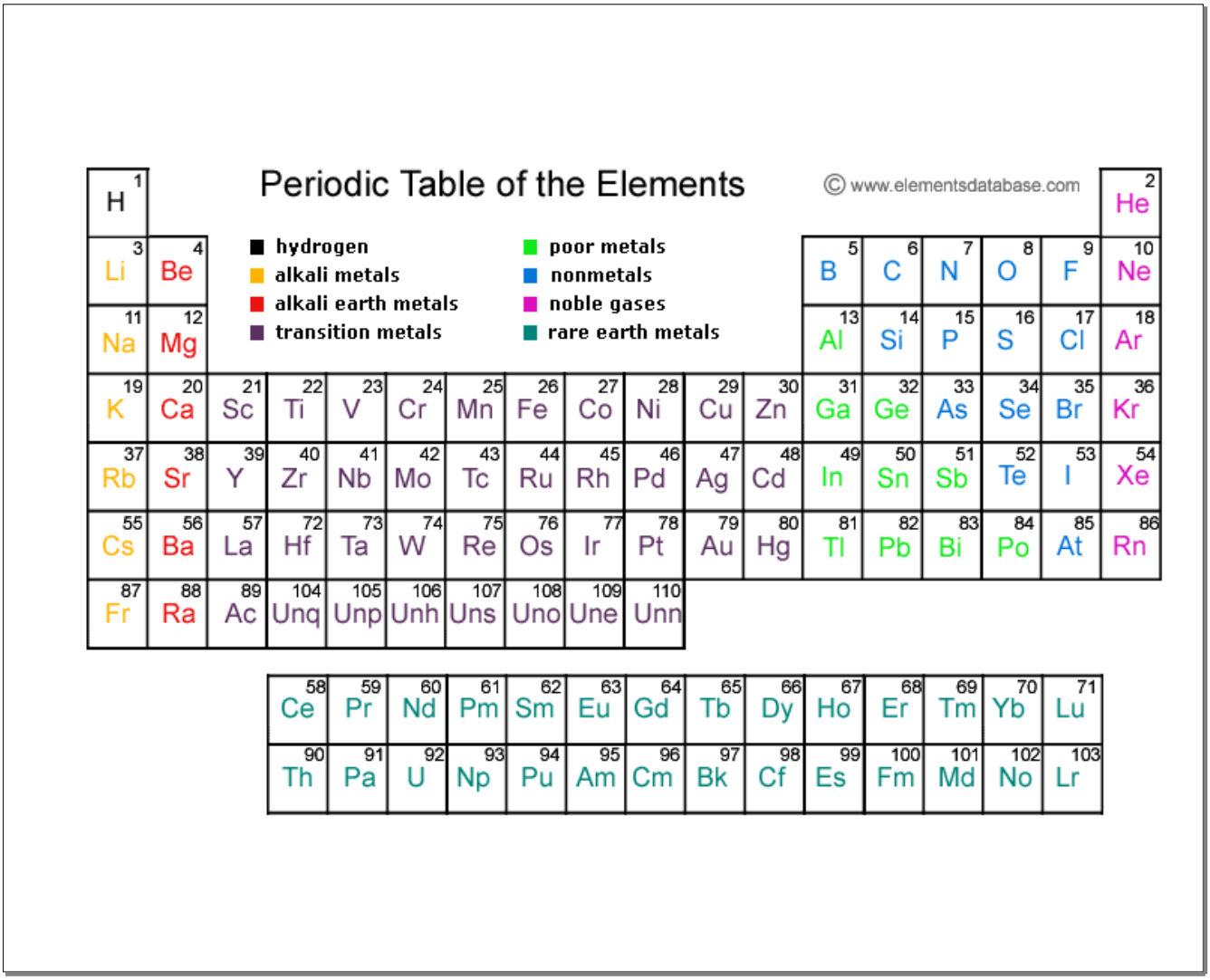
How many principle energy levels are occupied?_____
How many principle energy levels are filled?_____

How many sublevels are occupied?_____
How many sublevels are filled?_____

How many orbitals are occupied?_____
How many orbitals are filled?_____

How many orbitals are partially filled?_____

Dec 4-8:01 AM


Periodic Table of the Elements
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hydrogen
alkali metals
alkali earth metals
transition metals
poor metals
nonmetals
noble gases
rare earth metals
H 1
He 2
Li 3
Be 4
B 5
C 6
N 7
O 8
F 9
Ne 10
Na 11
Mg 12
Al 13
Si 14
P 15
S 16
Cl 17
Ar 18
K 19
Ca 20
Sc 21
Ti 22
V 23
Cr 24
Mn 25
Fe 26
Co 27
Ni 28
Cu 29
Zn 30
Ga 31
Ge 32
As 33
Se 34
Br 35
Kr 36
Rb 37
Sr 38
Y 39
Zr 40
Nb 41
Mo 42
Tc 43
Ru 44
Rh 45
Pd 46
Ag 47
Cd 48
In 49
Sn 50
Sb 51
Te 52
I 53
Xe 54
Cs 55
Ba 56
La 57
Hf 72
Ta 73
W 74
Re 75
Os 76
Ir 77
Pt 78
Au 79
Hg 80
Tl 81
Pb 82
Bi 83
Po 84
At 85
Rn 86
Fr 87
Ra 88
Ac 89
Unq 104
Unp 105
Unh 106
Uns 107
Uno 108
Une 109
Unn 110
Ce 58
Pr 59
Nd 60
Pm 61
Sm 62
Eu 63
Gd 64
Tb 65
Dy 66
Ho 67
Er 68
Tm 69
Yb 70
Lu 71
Th 90
Pa 91
U 92
Np 93
Pu 94
Am 95
Cm 96
Bk 97
Cf 98
Es 99
Fm 100
Md 101
No 102
Lr 103

Nov 28-8:24 AM

Valance Electrons

Electrons in the outer **most energy level**!!

Max of 8 VE Outer most s & p electrons

the valance electrons are the only electrons involved in a chemical reaction
elements with the same number of valance electrons will have similar chemical properties

All other electrons are called the kernel

How many VE are in Se?

Dec 7-8:24 AM

Lewis Dot-Diagrams

Use only the valance electrons

Mg ⟶ $\ddot{\text{M}}$g

2-8-2

N

2-5

Dec 7-8:26 AM

Paramagnetic vs Diamagnetic

**Must use orbital notation to figure out!!

Diamagnetic -- substance with no unpaired electrons in any orbital
Paramagnetic -- substance with at least 1 unpaired electron in any orbital

Mg

Al

Dec 4-8:03 AM

ODDS And ENDS

IF n = Principle Energy Level

and n =

THEN:

$n^2 =$

$2n^2 =$

Dec 4-7:58 AM

Ions

N^{3-}

K^{1+}

Dec 4-8:09 AM

Abbreviated electron config.

Mg

P

Ca

Br

Nov 29-8:27 AM

<u>Exceptions</u>: (Cr, Cu, Ag, Au)

Cu

Ag

Au

Cr

Nov 29-12:15 PM

Excited State vs Ground State electron Configuration:

Ground State Electron Configuration -- Electrons are at the lowest possible energy/sublevels. Stable Configuration (Normal Fill - Order)

Oxygen

Excited State Electron Configuration -- Electrons are not at the lowest possible energy/sublevels. Unstable Configuration (NOT the normal Fill - Order)

Oxygen

Dec 4-8:00 AM

Ground State
Low Energy
Stable

Excited State
High Energy
Unstable

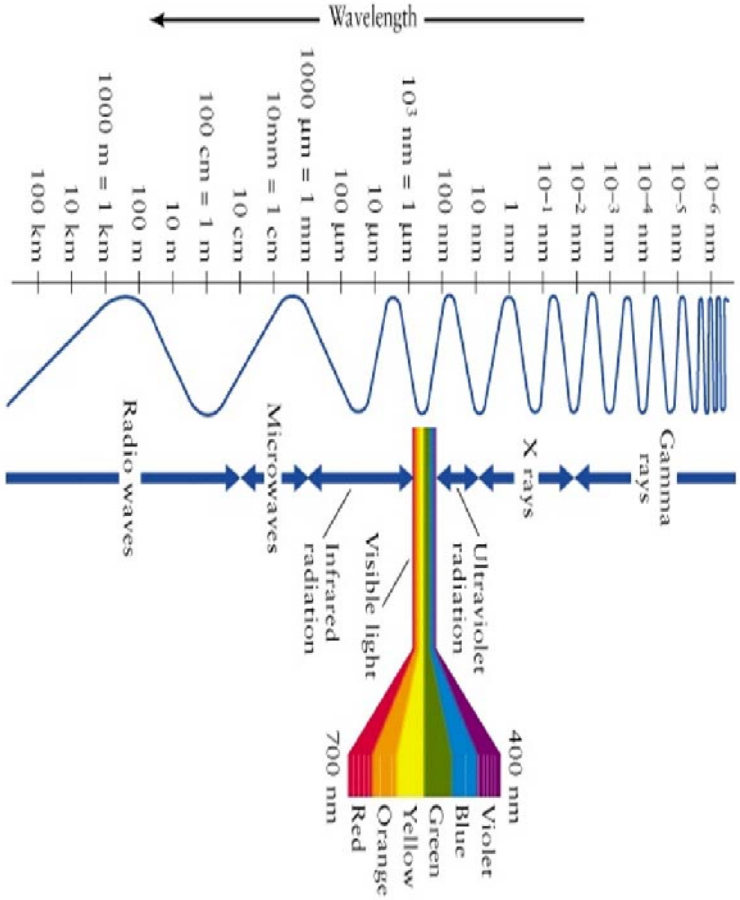
Excited State
High Energy
Unstable

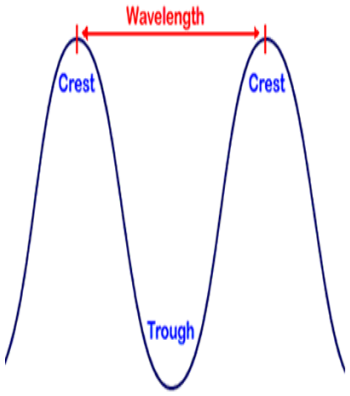
Ground State
Low Energy
Stable

Dec 8-11:13 AM

The Amount of Energy Released when an electron moves/returns from higher Excited state, back to lower Ground State is in the form of heat and LIGHT

Light travels in waves, the strength of this light, wave, is determined by the lights wavelength





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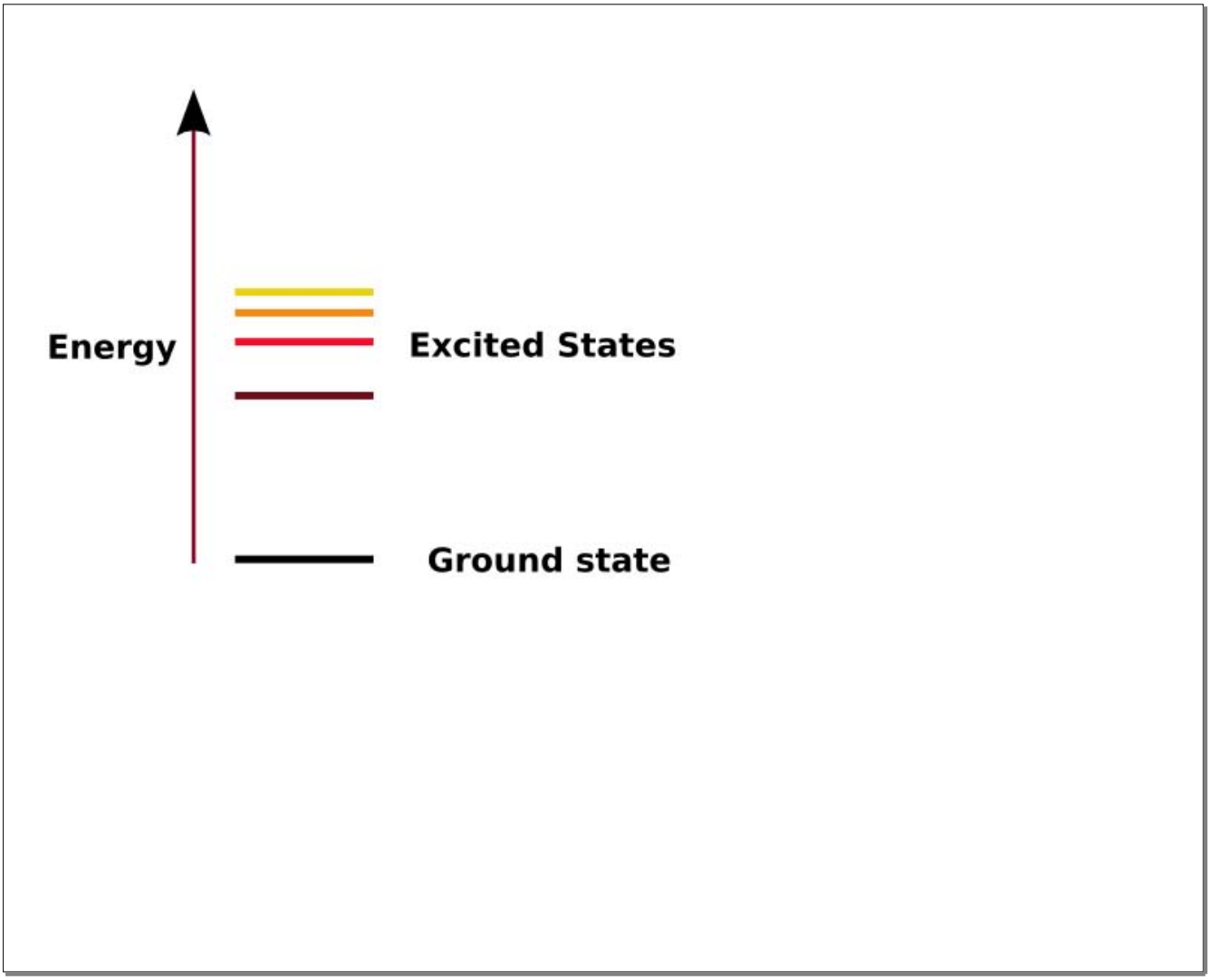

Dec 9-8:58 AM

The amount of energy in light can be solved using the following formula:

$$\lambda = \frac{hc}{E} \qquad E = h\nu = \frac{hc}{\lambda}$$

E is Energy
h is plank's constant
c = speed of light
v = frequency
λ = wavelength

$$h = 6.626 \times 10^{-34}\ J \bullet s$$

$c = 3.0 \times 10^{8}$ m/s

Dec 9-8:44 AM