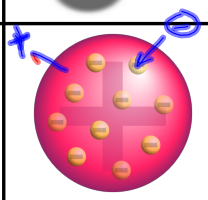
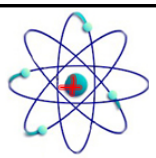
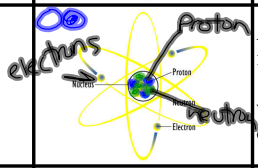
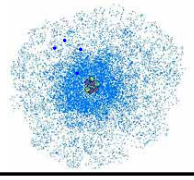
unit 3 atoms and isotopes

Scientist	Their Major Accomplishment (discovery)	Their Visual Model of the Atom	Explanation of Their Model
1. Dalton	1st Atomic theory		Solid spheres *-like marbles*
JJ. **2. Thompson**	Discovered the electron		Electrons floating in a sea of positive charge "plum pudding" or "blueberry muffin" model
3. Rutherford Chadwick = neutron	place a positive nucleus in the center.		Electrons "orbit" the positive nucleus Solar System
Neils **4. Bohr**	electrons have a fixed amt. of energy & travel in energy levels		Atoms travel in energy levels, with a fixed amt of energy
5. Quantum Mechanical Model	election location *not exact*, based on *probability*		'Electron "cloud" model

1. What was Dalton's atomic theory? –include all parts
   1. Atoms are indivisible, solid spheres NOT CORRECT
   2. All atoms of the same element are identical and different from those of any other atom not true (isotopes)
   3. Atoms combine in simple whole number ratios
   4. Atoms of one element can NEVER be changed into atoms of another element, they only can be rearranged during a chemical reaction. fission fusion
2. Who was the first person to theorize about the existence of the atom? When?

   Democritus, 400 BC
3. What particle did J.J. Thompson discover? About when?

   Electrons, EARLY 1900's
4. What did Robert Millikan discover? About when?

   Mass of an electron
5. complete the following:

Particle	Location	Charge	Relative Mass
Proton	nucleus	+1	1 amu
Neutron	nucleus	Ø	1 amu
Electron	around nucleus	-1	Ø = $\frac{1}{1840}$ amu

6. What is an isotope? Explain and give an example.

   Atoms of the same element that have different #'s of neutrons

   Carbon-12 (6neutrons); Carbon-14 (8neutrons)
7. What is an ion? Explain and give an example.

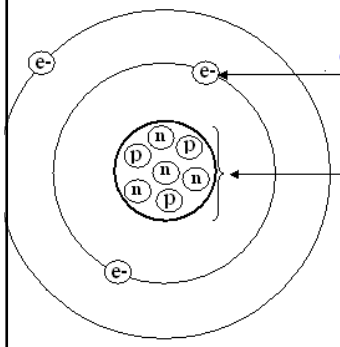
   an ion is an atom or group of atoms that carry a positive or negative charge

   Na^{1+}

Fill in the following chart with the correct information
IT DOES NOT REFER TO THE ATOM BELOW!!!!

particle	location	mass (amu)	Relative charge
proton	nucleus	1 amu	1+
neutron	nucleus	1 amu	0
electron	outside nucleus	0 amu	1-

Planetary model of the atom

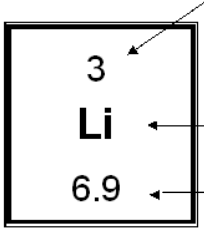


electrons

nucleus

protons

neutrons



atomic number

identifies the element

Same as # of # of protons

Chemical symbol

atomic mass

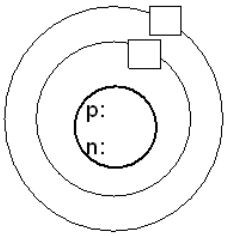
weighted average of all known isotopes of the element

# of electrons = the number of protons

energy level	max # electrons
1	2
2	8
3	18
4	32
5	32
6	18
7	8

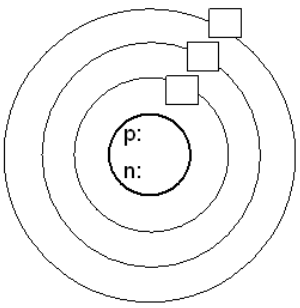
Carbon (C): mass# 12

#p_____ #n_____ #e_____



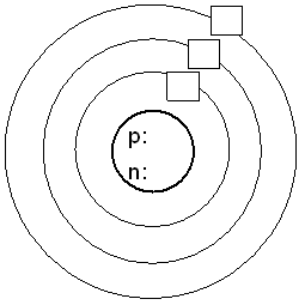
Sodium (Na): mass# 23

#p_____ #n_____ #e_____



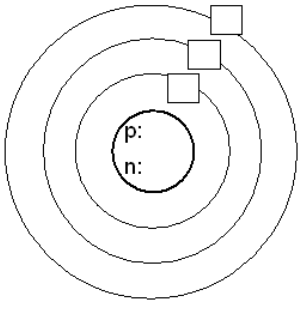
Sulfur (S): mass # 32

#p_____ #n_____ #e_____



Argon (Ar): mass# 40

#p_____ #n_____ #e_____



p-e=charge

name – m#

NOT AT

atomic #

0, p=e, p>e, e>p

	Symbol	Name notation	Mass Number	= Protons	+ Neutrons	Electrons	Charge
1	$^{17}_{8}O^{2-}$	Oxygen-17	17	8	9	10	2-
2	$^{131}_{54}Xe$	Xenon-131	131	54	77	54	0
3	$^{266}_{88}Ra$	Radium-266	266	88	178	88	0
4	$^{25}_{13}Al^{14}$	Aluminum-25	25	13	12	12	1+
5				38	50		0
6	$^{27}_{13}Al^{3+}$	Aluminum-27	27	13	14	10	3+
7	$^{32}_{16}S^{2-}$						
8				83	126		1-
			55			23	2+
		Tin^{4+} - 119	119				4+

ion – atom or group of atoms that carry a (+) or (–) charge.

Na^{1+}, Cl^{1-}

cation = positive ion Na^{1+}, $p^+ > e^-$

Ca(+)ion

anion = negative ion Cl^{1-}, $e^- > p^+$

they ONLY lose or gain electrons.

Na atom charge = 0, neutral

atoms/isotopes – p=e

can have different #'s of neutrons & electrons but protons must stay the same!

Symbol Notation

mass # → m, c ← charge

P, S ← symbol

protons: two isotopes

$^{15}_{8}O^{2-}$ $^{16}_{8}O$

must be the same for two isotopes

Sym	Name	At #	mass #	= p	+ n	e	Chg
$^{41}_{19}K^{1+}$	Potassium^{1+}-41	19	41	19	22	18	1+
$^{25}_{12}Mg^{2+}$	Magnesium^{2+}-25	12	25	12	13	10	2+
$^{12}_{6}C$	Carbon-12	6	12	6	6	6	∅
$^{107}_{53}I$	Iodine-107	53	107	53	54	53	∅
$^{62}_{29}Cu^{1+}$	Copper^{1+}-62	29	62	29	33	28	1+
$^{170}_{82}Pb^{2+}$	Lead^{2+}-170	82	170	82	88	80	2+

p-e

Sym	Name	at #	mass # = p⁺ + n°			e⁻	ch
$^{56}_{26}Fe^{3+}$	iron^{3+}-56	26	56	26	30	23	3+
$^{42}_{20}Ca^{2+}$	Calcium^{2+}-42	20	42	20	22	18	2+
$^{19}_{9}F^{1-}$	fluorine^{1-}-19	9	19	9	10	10	1−
$^{30}_{13}Al^{3+}$	Aluminum^{3+}-30	13	30	13	17	10	3+
$^{7}_{3}Li^{1+}$	Lithium^{1+}-7	3	7	3	4	2	1+
$^{140}_{56}Ba^{2+}$	Barium^{2+}-140	56	140	56	84	54	2+

p-e = ch

m# = p + n

+, p>e
−, e>p
0, p=e

Block_____

Unit 1 Worksheet 2

Fill in the missing information on the following table

	Symbol			Protons	Neutrons	Electrons	Charge
1							
2	$^{41}_{19}K^{1+}$						
3	Mg				13		2+
4						6	
5						53	
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Substance	*Symbol*	*Atomic Number*	*Mass #*	*# of Protons*	*# of Neutrons*	*# of Electrons*
Helium	He	2	4			
Magnesium	Mg	12			12	
Zinc	Zn	30	65			
Bromine	Br		80			35
Aluminum	Al				14	
Uranium	U				146	92
Sodium	Na	11			12	
Krypton	Kr				48	36
Calcium	Ca		40	20		
Silver	Ag			47	61	

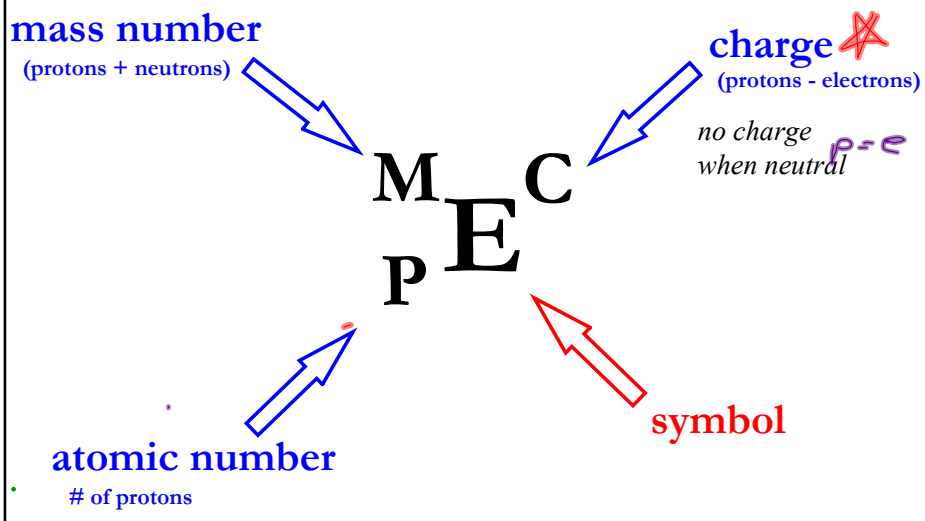
	Symbol	Name	Mass Number =	Protons +	Neutrons	Electrons	Charge
1	$^{75}_{33}As^{3-}$	Arsenic $^{3-}$ -75	75	33	42	36	3-
2	$^{15}_{7}N^{3-}$	Nitrogen-15	15	7	8	10	3-
3	$^{65}_{29}Cu$	Copper-65	65	29	36	29	0
4	$^{209}_{83}Bi$	Bismuth-209	209	83	126	84	1-
5	$^{190}_{80}Hg$		190	80			
6				47	61		1+
7		Titanium $^{2+}$ -48					
8				24	28		3+
9					14	7	0
10	$^{28}_{13}Al$						3+

mass number (= protons + neutrons)

* the sum of **protons** and **neutrons** in the nucleus of an atom

NOT ON PERIODIC TABLE

Symbol Notation

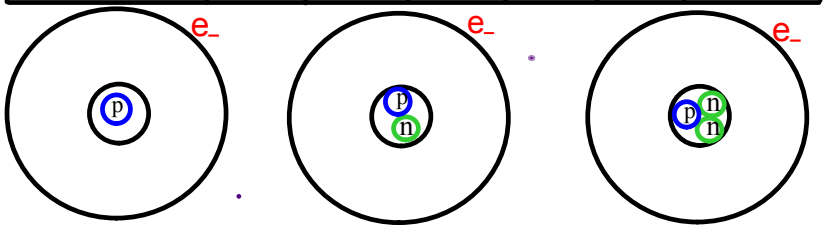


element$^{C}_{-}$ M#

Carbon-12

isotope: Atoms of the same element that differ in the number of neutrons.

Isotope	mass	P	N	E	At#	Symbol
protium hydrogen-1						
deuterium hydrogen-2						
tritium hydrogen-3						



Hydrogen-1 "Protium"

Hydrogen-__ "deuterium"

Hydrogen-__ tritium"

If carbon-12 has a mass of 12 amu, why does the periodic table list carbon as 12.011 amu?

Formula to Calculate Average Atomic Mass

isotope 1 (mass of isotope) x (% abundance) = fractional abundance

\+

isotope 2 (mass of isotope) x (% abundance) = fractional abundance

""

""

total them all from each isotope and this is your atomic mass in **amu**'s.

Boron-10 x **20%** = 2.0

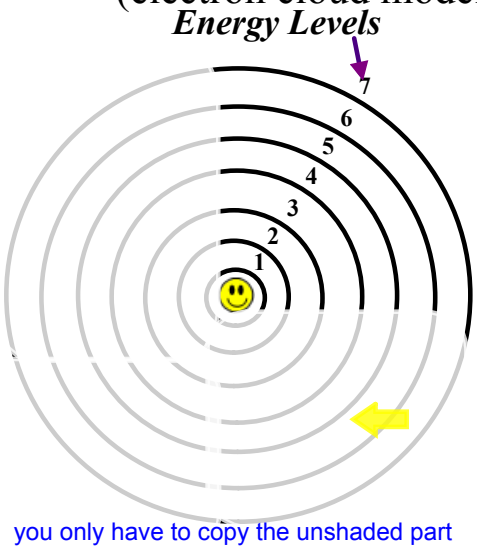
\+

Boron-11 x **80%** = 8.8

Boron = 10.8 amu

Current Atomic Model / Electron Theory

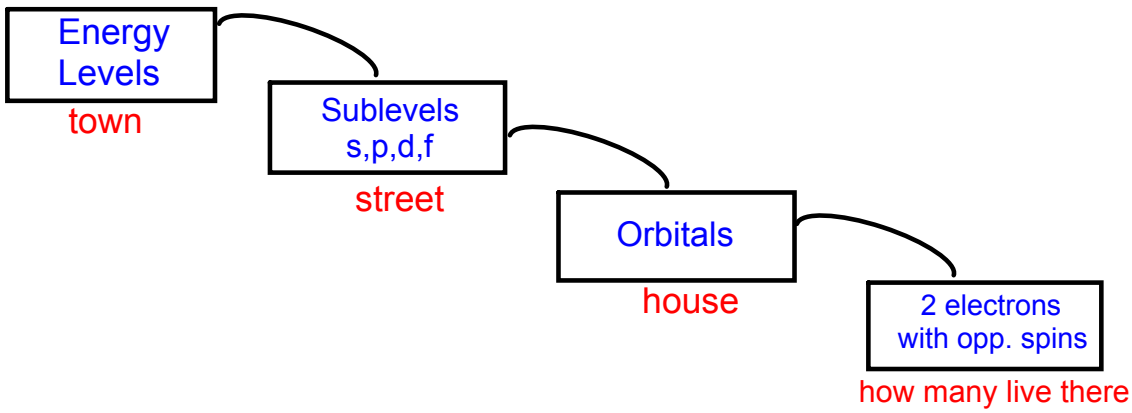
Quantum Mechanical Model -Electrons are not found in a specific area, but have a PROBABILITY of where they may be located.
(electron cloud model)



you only have to copy the unshaded part

1-7 Principle Energy levels

- Also known as shells
- Areas around the nucleus that contains electrons
- These energy levels are divided into **SUBLEVELS** which can sometimes overlap depending on their shape



Sublevel	Max # orbitals	Max # Electrons
s	1	2
p	3	6
d	5	10
f	7	14

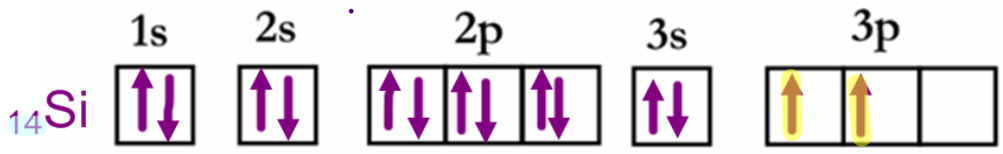
Electron Configuration Rules

1. **Aufbau Principle**
   Electrons enter the lowest energy level and sublevel available. (Start @ 1s)
2. **Pauli Exclusion Principle**
   If two electrons occupy the same orbital, they have opposite spins.
3. **Hund's Rule (Bus Seat Rule)**
   All orbitals of a sublevel will get one electron with the same spin before it receives a second electron of opposite spin.
   (ex:3 orbitals of p will get 1 e- before a 2nd is added)

Orbital (Box) Notation, electron configurations

Each box represents an orbital within that particular sublevel, each orbital may only hold two electrons(arrows) which must have opposite spins (direction of arrows)

you must fill up each set of (boxes) before moving to the next set.



Silicon will need 14 electrons, so it will have 14 arrows.

When you get to a set that you will not fill PUT ONE IN EACH BOX IN THE SAME DIRECTION BEFORE DOUBLING THEM UP

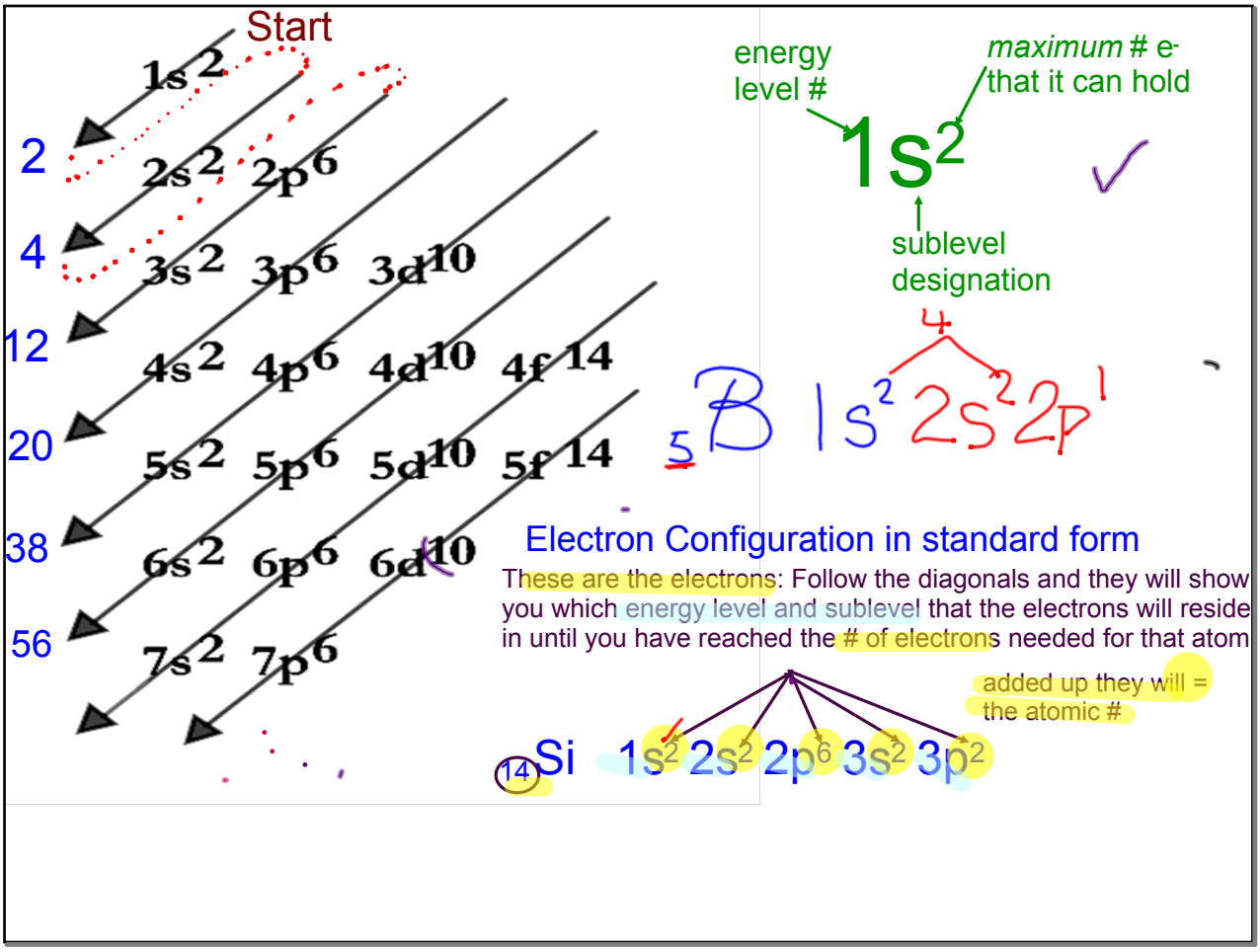
Bus Seat Rule

- any element can have multiple different mass numbers

$^{14}_{7}N$ — 7 neut. $^{15}_{7}N$ — 8 neut.

- When 2 of the same atom have different mass numbers, they are called ***isotopes***

(same # of protons, but different # of neutrons)



Valence Shell- (VS)

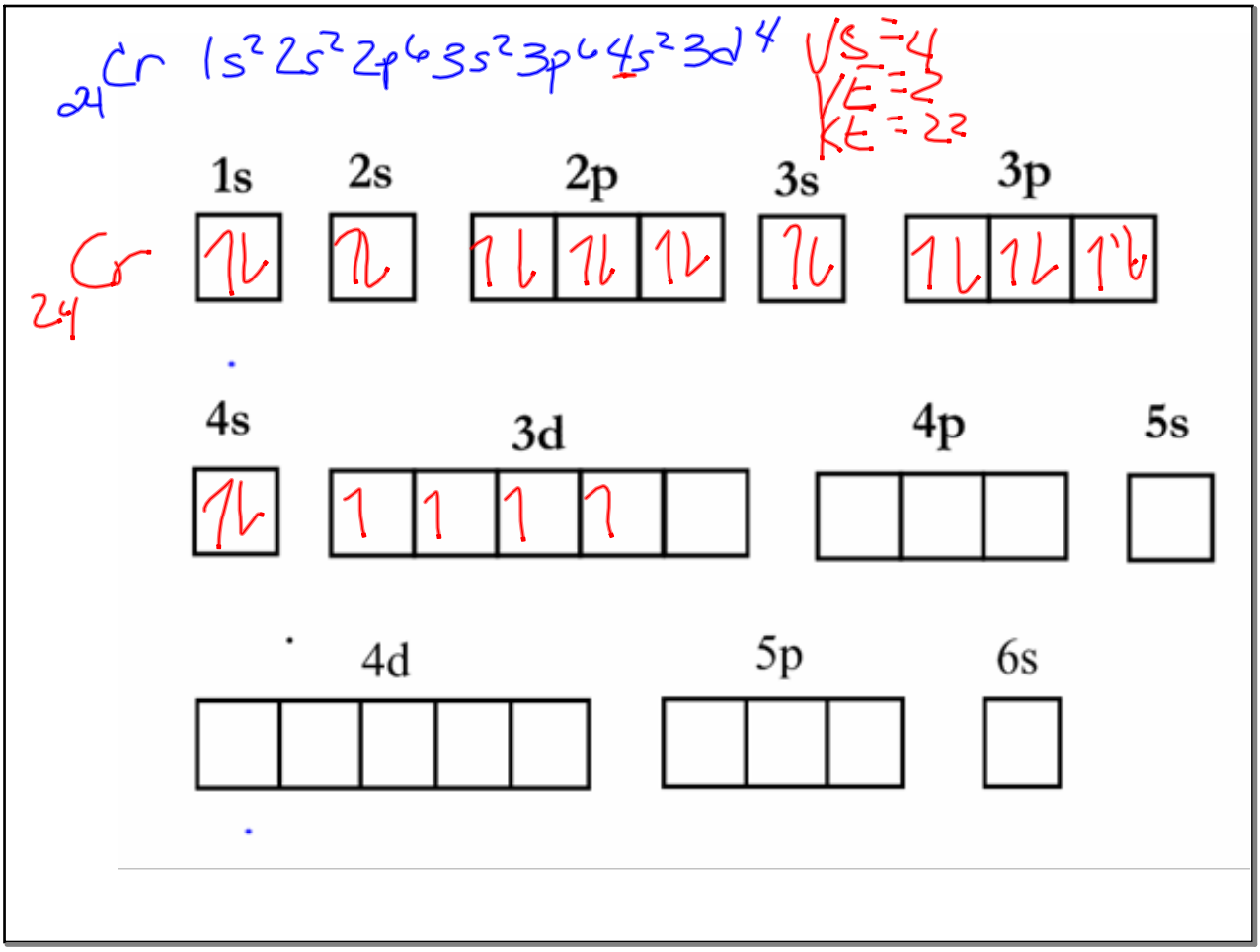
The highest occupied energy level.

Valence Electrons- (VE)

Electrons in the valence shell.

Kernel Electrons- (KE) TE - VE = KE

Electrons not in the valence shell.



☆ *Use the periodic table to do* ☆ *electron configurations*

The period number indicated the energy level of the valence shell.

The group heading indicates the number of valence electrons.