Atoms: Building Blocks of Matter

1) Matter - anything that has mass and volume.

2) Atoms - the basic building blocks of matter.

3) Atomic Models

1) Greek Model - matter could not be divided into smaller and smaller pieces forever.

2) Dalton's Model - 1) All elements are composed of atoms.
2) Atoms of the same element are exactly alike.
3) Atoms of different elements are different.
4) Compounds are formed by the joining of atoms of two or more elements.

3) Rutherford's Model - showed the atom with a positively charged nucleus and space in between the nucleus of the different atoms.

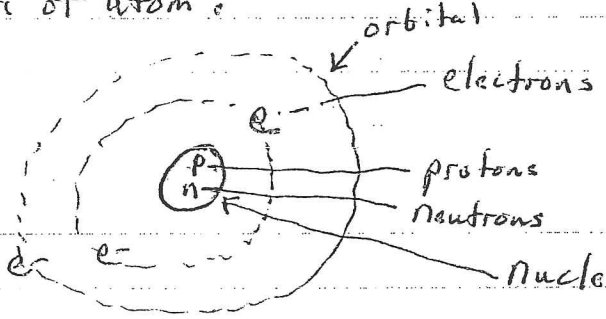
4) Bohr Model - showed the electrons moving in definite orbitals around the nucleus.

4) Parts of atoms (subatomic particles)

Part	Charge	location	rel. Mass
Proton	Positive	Nucleus	1 AMU
Neutron	zero	Nucleus	1 AMU
electron	Negative	orbitals	very little

Note: AMU - Atomic Mass Unit

5) Structure of atom:



6) Atomic Number - Number of protons in an atom.

7) Number of electrons = number of protons in a neutral atom.

8) Mass number - Sum of the protons and neutrons in an atom.

9) Isotope - atom of the same element that have the same number of protons but a different number of neutrons.

10) Examples: Mass # → $^{1}_{1}H$ (Atomic Number) 1 Proton 0 Neutrons Hydrogen 1

$^{2}_{1}H$ 1 Proton 1 neutron Hydrogen 2

$^{3}_{1}H$ 1 Proton 2 neutron Hydrogen 3

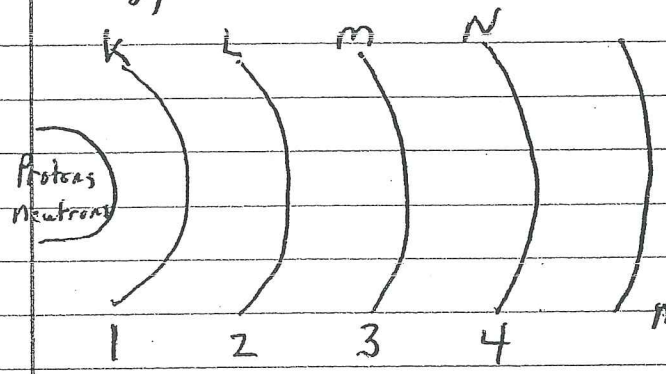
11) Average Atomic Mass - average of the weighted masses of the isotopes that exist naturally.

12) Chart of Elements

Name	Symbol	Atomic #	Mass #	# Protons	# electrons	# neutrons
Hydrogen	H	1	1	1	1	0
Helium	He	2	4	2	2	2
Lithium	Li	3	7	3	3	4
Beryllium	Be	4	9	4	4	5
Boron	B					

13) Electron Cloud - space in which electrons are found orbiting around the nucleus. It gives the atom it's volume.

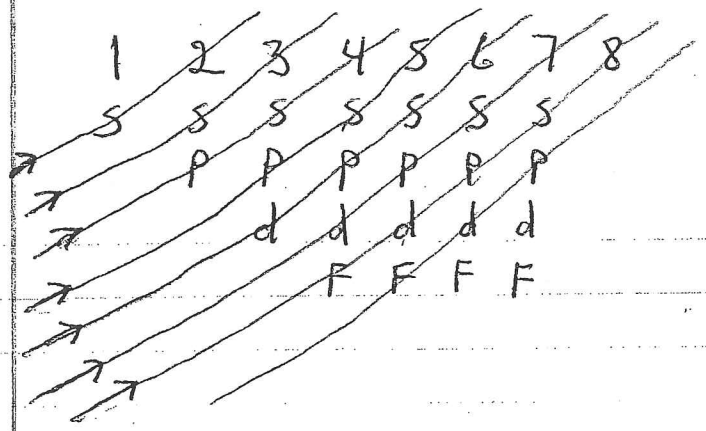
14) Energy levels or shells - Indicates closeness to the nucleus.



15) Orbital

Type	Number of orbitals	Max # electrons	Shape
S	1	2	Spherical
P	3	6	Fig. 8 in 3 dim.
d	5	10	Complex
F	7	14	Complex

16) Order of energy level orbitals



1s 2s 2P 3s 3P 4s 3d 4P 5s 4d 5P 6s 4F 5d 6P 7s

17) Electron Configuration – Arrangement of electrons in a atom in the order of lowest energy level orbital to the higher ones.

18) Rules For Configuration – 1) Must fill lower energy level orbital First.

2) Orbital type pairs up only if it has to.

3) When an orbital is full the electrons have opposite spin.

19) Example of Electron Configuration:

H - 1 - $1s^1$
(1)

He - 2 - $1s^2$
14

Li - 3 - $1s^2$ $2s^1$
14 (1)

(4) (100)

20) Possible Oxidation state - This is what is possible in a chemical change with the outer electrons and orbitals of an atom.

21) Rules for possible oxidation states:

1) The outer orbitals of an atom like to be either filled or empty in a chemical reaction.
2) Atom is electrically neutral when it has the same number of protons and electrons.
3) When an atom's outer orbital gains electrons it becomes negative. When an atom's outer orbital loses electrons it becomes positive.
4) Atoms will not lose electrons between the nucleus and the outermost s type orbital. (Note: too close to nucleus.)
5) Atoms will not lose electrons out of filled p, d, or f type orbitals. (Note: too stable.)

22) Examples:

	Gained	loss
H - 1 - $1s^1$ (1)	-1	+1
He - 2 - $1s^2$ (2)		+2
Li - 3 - $1s^2$ (2) $2s^1$ (1)	-1	+1
Be - 4 - $1s^2$ (2) $2s^2$ (2)		+2

22) Continue:

B - 5 - $1s^2\ 2s^2\ 2p^1$ — $-5, +1, +3$

C - 6 - $1s^2\ 2s^2\ 2p^2$ — $-4, +2, +4$

N - 7 - $1s^2\ 2s^2\ 2p^3$ — $-3, +3, +5$

23) Dot structure - Symbolic way of showing the valence electrons.

24) Rules for dot structure:
1) Use the orbitals and electrons used in the possible ox. state.
2) Noble gases show the octet arrangement.

25) Examples:

H - 1 - $1s^1$ — $-1, +1$ — H·

He - 2 - $1s^2$ — $+2$ — He:

Li - 3 - $1s^2\ 2s^1$ — $-1, +1$ — Li·

Be - 4 - $1s^2\ 2s^2$ — $+2$ — Be:

B - 5 - $1s^2\ 2s^2\ 2p^1$ — $-5, +1, +3$ — B·

(4) (102)

26) Forces within the atom:

1) Electromagnetic Force - attraction of unlike charges and repulsion of like charges.

2) Strong Force - attraction from masses in the protons and neutrons.

3) Weak Force - radioactive decay of a neutron into a proton and electron.

4) Gravity - force of attraction based on masses.

27) Valence electron - Outer electrons found from the outer s type orbital out.

28) Kernel - electrons from the nucleus to the outer s type orbital.

29) Electron Arrangement using shells

K - shell $1s^2$
L - shell $2s^2\ 2p^6$
M - shell $3s^2\ 3p^6\ 3d^{10}$
N - shell $4s^2\ 4p^6\ 4d^{10}\ 4F^{14}$

Example: Na 11 - $1s^2\ 2s^2\ 2p^6\ 3s^1$