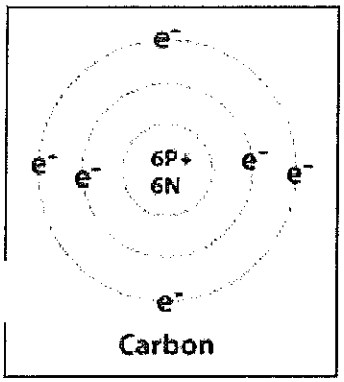
Elements are the simplest pure substances, and cannot be broken down into any other substance.

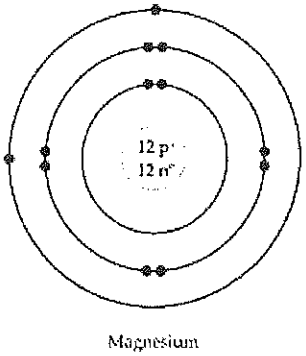
An atom is smallest particle of an element.

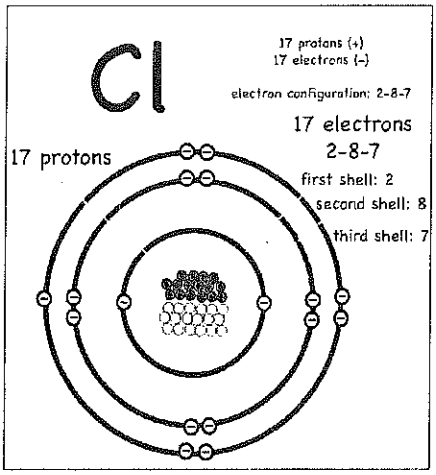
Parts of an atom:
The ***nucleus*** contains PROTONS (positive charge) and NEUTRONS (no charge). The nucleus makes up the ***atomic mass*** (found at the bottom of the element square). The ***atomic number*** (found at the top of the element square) equals the number of protons.

The ***electron cloud*** contains the ELECTRONS (negative charge) arranged in ***energy levels.*** The ***periods*** on a Periodic Table correlate to the number of energy levels. The first energy level can only hold 2 electrons (Period 1 contains Hydrogen and Helium). The last energy level can hold 8 electrons (this is the ***Octet Rule***).

Draw and Label an Atom (include the number of protons, neutrons, electrons, and valence electrons)

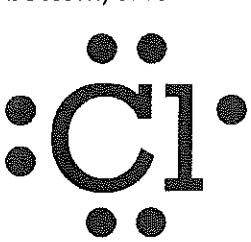


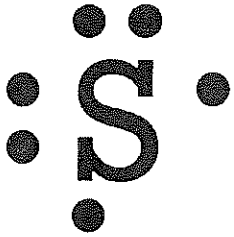


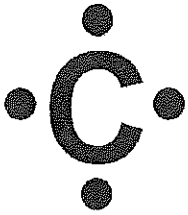


**Study your sheets where you filled in all of this information.

Lewis Dot Diagram
Also known as the *electron-dot diagram*, this diagram shows the valence electrons in each element (in the form of dots). Write the symbol for the element in the middle and then begin completing the outermost energy level by adding electron-dots in a counter-clockwise fashion. (Ex: top, side, bottom, side, top, side, bottom, side - until you've recorded all valence electrons FOR THAT ELEMENT!)







Cl = 7 valence electrons S = 6 valence electrons C = 4 valence electrons

Draw your own Dot Diagrams on the yellow sheets!

Ions are atoms that keep the same number of protons, but NOT the electrons. The number of electrons change. Because electrons have a negative charge, the overall charge becomes unbalanced. If electrons are LOST, you have a positive charged atom called a ***cation.*** (There are more protons than electrons – so the positive charges "win".) If electrons are GAINED, you have a negative charged atom called an ***anion.*** (There are more electrons than protons – so the negative charges "win".)

Na^{1+} - it is 1+ because it is easier to lose the one valence electron than to gain 7 (OCTET RULE)
Cl^{1-} - it is 1- because it is easier to gain one electron than it is to lose 7 (OCTET RULE)

The ***oxidation number*** is the number and sign that shows how many electrons are gained or lost!
What do you think Group 2 would be? What about Group 16?

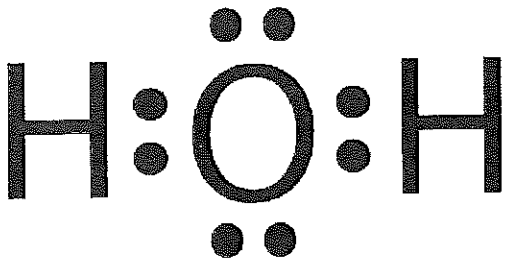
Group 2 would be a 2+ because it is easier to lose two electrons (therefore it would have 2 more protons)
Group 16 would be a 2- because it is easier to gain two electrons (therefore it would have 2 more electrons)

Look back at your yellow sheets and write down the ionization number for those 16 elements.

A ***chemical formula*** is an easy way to describe a chemical compound. It shows the elements that were combined and how many atoms are present.

A ***molecule*** is formed when two or more atoms join together chemically (O_2 – this is a ***chemical formula***). A ***compound*** is a molecule that contains at least two different elements (H_2O – this is a ***chemical formula***). *All compounds are molecules, but NOT ALL molecules are compounds! Once the elements chemically bond together, the properties of the compound are different than the properties of the individual elements. Remember Sir Dalton taught us that elements in a compound have a fixed ratio for the atoms. For example, H_2O has two hydrogen atoms (the ***subscript*** tells us how many atoms are present for that element) and one oxygen atom. That means there will always be two hydrogen atoms combined with one oxygen atom (it doesn't matter if you have 1 water molecule or 50).

Types of Chemical Bonds
Ionic Bond – between a Metal and a Non-Metal (M + NM) *refer back to your ions
Covalent Bond – between a Non-Metal and a Non-Metal (NM + NM)
Metallic Bond – between a Metal and a Metal (M + M)
**Use your periodic table and Lewis Dot Diagrams to determine the type of bond.



Hydrogen and Oxygen are both non-metals, so this is a covalent bond. The chemical formula is H_2O.

To practice bonding and writing chemical formulas, use your yellow sheets from class.

Some Vocabulary you need to know:

What is the difference between a compound, a mixture, and a solution?

Compound:

- Consists of atoms of two or more different elements *bound together*.
- Can be broken down into a simpler type of matter by chemical means.
- Has properties that are different from its original elements.
- Always contains the same ratio of atoms.

Mixture:

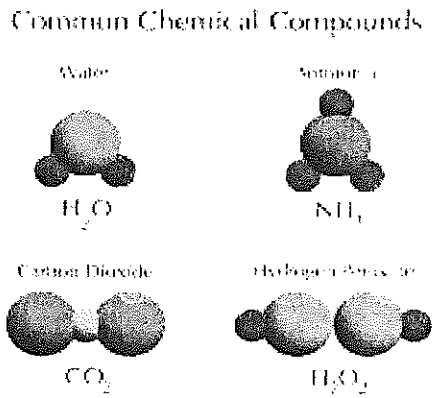
- Consists of atoms of two or more different elements and/or compounds physically intermingled.
- Can be separated into its original elements/compounds by physical means.
- Often retains many of the properties of its original elements.

Solution:

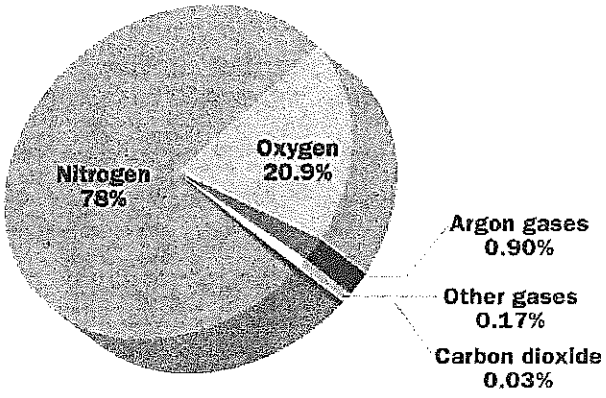
- A mixture that looks like a single substance.
- Has the same properties throughout.
- Contains a solute (substance that dissolves) and a solvent (substance into which the solute dissolves).

Examples:

Compound:



Mixtures: Air around you!

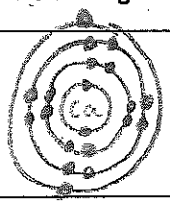
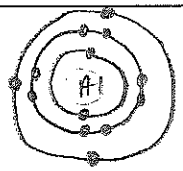


Remember ***Isotopes*** are atoms that keep the same number of protons, but NOT the neutrons. The number of neutrons change. Because neutrons do not have a charge, the overall charge is still balanced. The atomic mass does change though. Ex: Carbon-12 has 6 protons and 6 neutrons, Carbon-13 has 6 protons and 7 neutrons, and Carbon-14 has 6 protons and 8 neutrons.

Chemical Bonds – Ionic Bonds

1. **Identify the *Number of Valance Electrons* and *Draw the Lewis Dot Structure***

   Notes: Scientists use *Lewis Dot Structures* to show the valance electrons of an element as dots. Since bonding involves the valance shell electrons only, it is only necessary to illustrate those outer electrons.

Element	Lewis Dot Diagram	Group Number (PT)	# of Valance Electrons	Bohr Diagram
Calcium	·Ca·	2	2	
Carbon	·C·	14	4	
Hydrogen	·H	1	1	
Helium	·He	18	2	
Oxygen	·Ö·	16	6	
Fluorine	:F·	17	7	
Neon	:Ne:	18	8	
Sodium	·Na	1	1	
Aluminum	·Al	13	3	

Making Ions – Ionic Bonds are made of Ions. A strong understanding of Ions is needed.

Notes: Remember that Metals tend to lose their electrons, falling back to their inner octet, becoming smaller, forming positive "cations". Nonmetals tend to gain electrons, filling up their current energy levels, becoming larger, forming negative "anions". *Complete the chart below.*

Element	Lewis Dot	# of Valance e-	Gain/Lose ___ e-
Na	Na	1	L 1
Be	Be	2	L 2 - cation
Cl	Cl	7	G 1 - anion
S	S	6	G 2 - anion
Al	Al	3	L 3 - cation
Ne	Ne	8	Neither - already stable
K	K	1	L 1 - cation
N	N	5	G 3 - anion
O	O	6	G 2 - anion
Ca	Ca	2	L 2 - cation
P	P	5	G 3 - anion
B	B	3	L 3 - cation
Mg	Mg	2	L 2 - cation

• Covalent - between non-metal & non-metal; weak bond; ex. H_2O - water; shares electrons

• ionic - between metal & non-metal; strong bond; between cation & anion; gains/loses electrons

Section B: Ionic Bonds

What is an ionic bond?

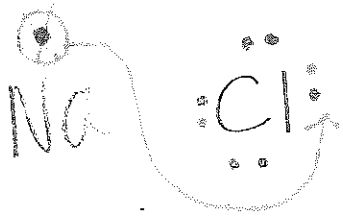
- Atoms will transfer one or more electrons to another to form the bond.
- Each atom is left with a full outer shell.
- An ionic bond forms between a cat ion with a positive charge and a an ion with a negative charge.

• cation - lost electrons → becomes more positive

• anion - gains electrons → becomes more negative

Example B1: Sodium + Chlorine

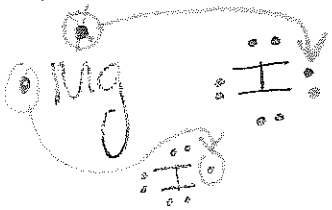
metal + non-metal



Name - NaCl

Example B2: Magnesium + Iodine

metal + non-metal

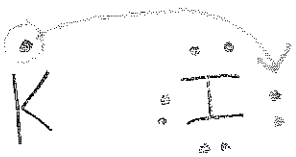


Name - MgI_2

• Regardless of the bond, all atoms want to have a full outer shell → octet rule

Example B3: Potassium + Iodine

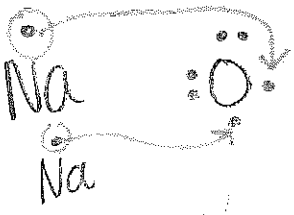
metal + non-metal



Name - KI

Example B4: Sodium + Oxygen

metal + non-metal

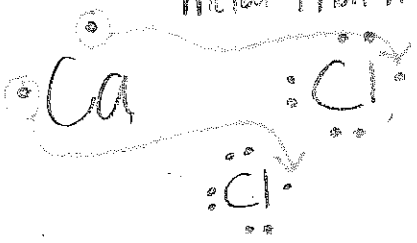


Name - Na_2O

• Compound name = metal + non-metal

Example B5: Calcium + Chlorine

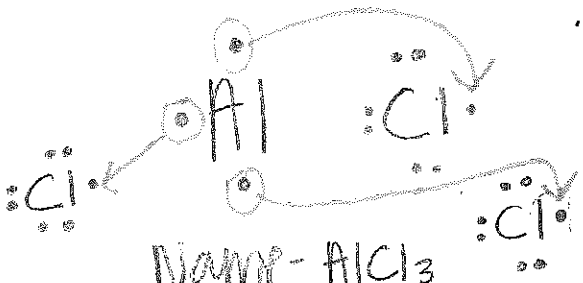
metal + non-metal



Name - $CaCl_2$

Example B6: Aluminum + Chlorine

metal + non-metal



Name - $AlCl_3$

Challenge: What are some other ionic bonds that can be formed by the elements you see? Remember that you need a metal and a nonmetal to make an ionic bond. Write the chemical formula for the compound and its name.

Last

Name: _____ Date: _____

Ionic Bonding Practice Worksheet

Directions: Draw the Lewis dot structures for each element. Then draw arrows to show where the valence electrons will go during a chemical reaction. Then draw the resulting compound. Be sure to include which ion loses/gains an electron.

1. Lithium + Chlorine

Name: LiCl
Lithium - L1 = cation
Chlorine - G1 = anion

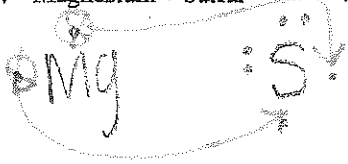
2. Calcium + Oxygen

Name = CaO
Calcium - L2 = cation
Oxygen - G2 = anion

3. Beryllium + Flourine

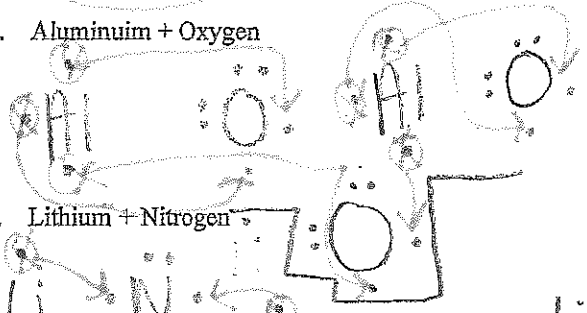
Name = BeF_2
Beryllium - L2 = cation
Flourine - G1 = anion

4. Magnesium + Sulfur



Name = MgS
Magnesium - L2 = cation
Sulfur - G2 = anion

5. Aluminuim + Oxygen

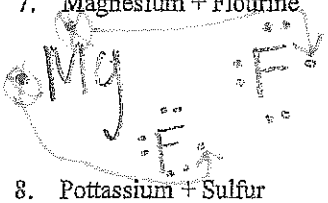


Name = Al_2O_3
Aluminum - L_3 = cation
Oxygen - G2 = anion

6. Lithium + Nitrogen

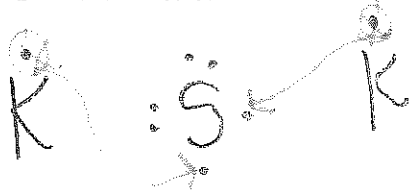
Name = Li_3N
Lithium - L1 = cation
Nitrogen - G3 = anion

7. Magnesium + Flourine



Name = MgF_2
Magnesium - L_2 = cation
Flourine - G1 = anion

8. Pottassium + Sulfur



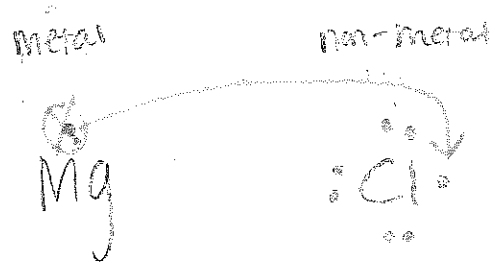
Name = K_2S
Potassium - L1 = cation
Sulfur - G2 = anion

Lewis Dot, Formula Unit & Naming Practice Sheet

Notes:

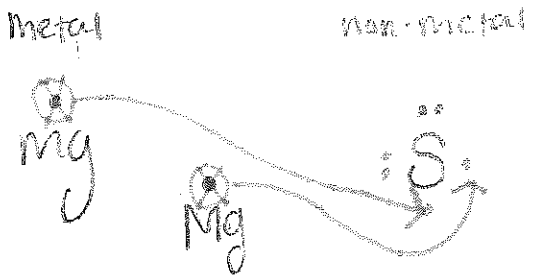
1. An **ionic bond** is an attraction of a *cation* for an *anion* resulting from the transfer of electrons. Remember, the smaller nonmetals are more electronegative and pull the electrons close, away from the larger, less electronegative metals.
2. When wiring the compound form, make sure you include the ratio of elements in the compound. Ex. Ca_3N_2

1. Draw the Lewis Structure for Mg & Cl



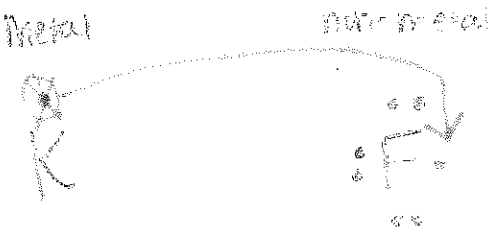
Compound Formed: $MgCl_2$

2. Draw the Lewis Structure for Mg & S



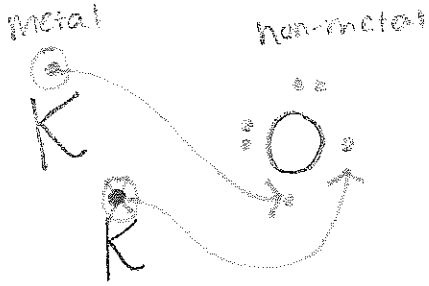
Compound Formed: Mg_2S

3. Draw the Lewis Structure for K & F



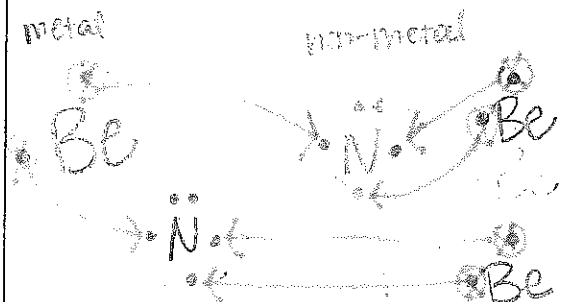
Compound Formed: KF

4. Draw the Lewis Structure for K & O



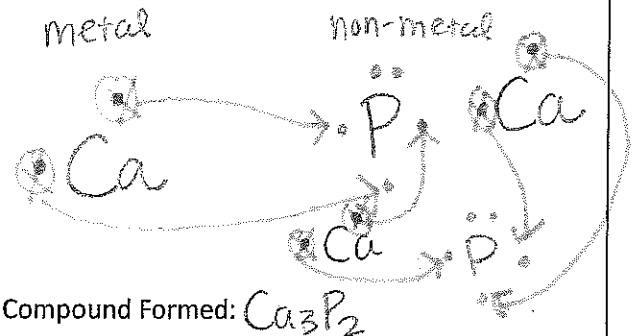
Compound Formed: K_2O

5. Draw the Lewis Structure for Be & N



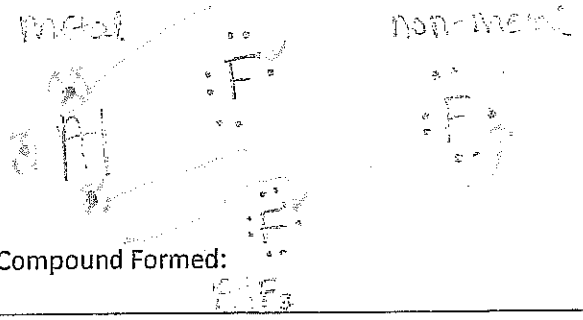
Compound Formed: Be_3N_2

6. Draw the Lewis Structure for Ca & P



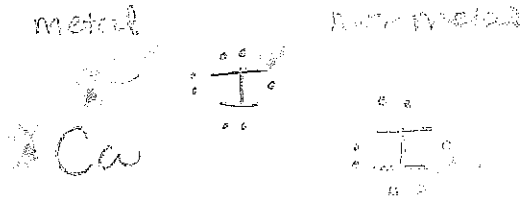
Compound Formed: Ca_3P_2

7. Draw the Lewis Structure for Al & F



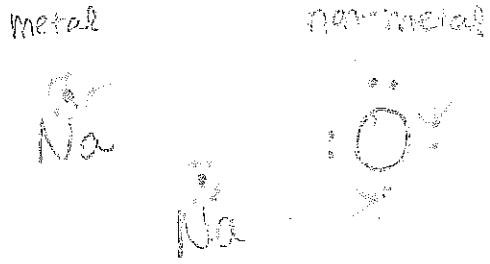
Compound Formed: AlF_3

8. Draw the Lewis Structure for Ca & I



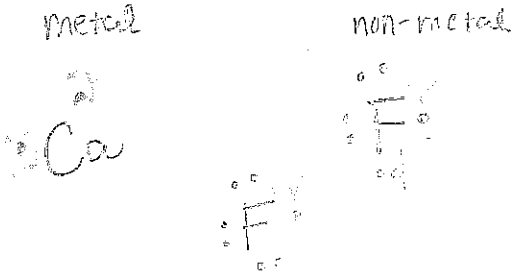
Compound Formed: CaI_2

9. Draw the Lewis Structure for Na & O



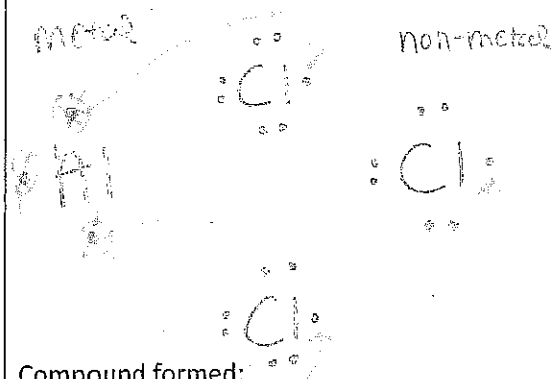
Compound Formed: Na_2O

10. Draw the Lewis Structure for Ca & F



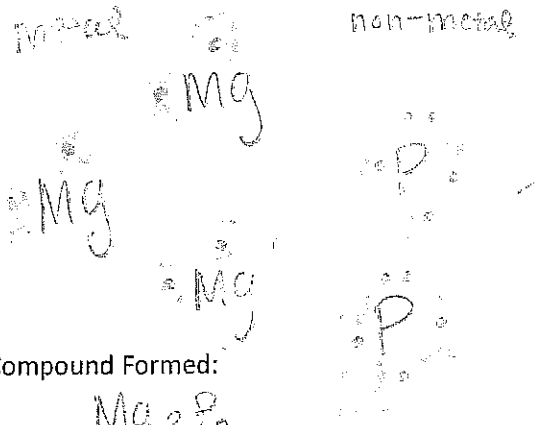
Compound Formed: CaF_2

11. Draw the Lewis Structure for Al & Cl



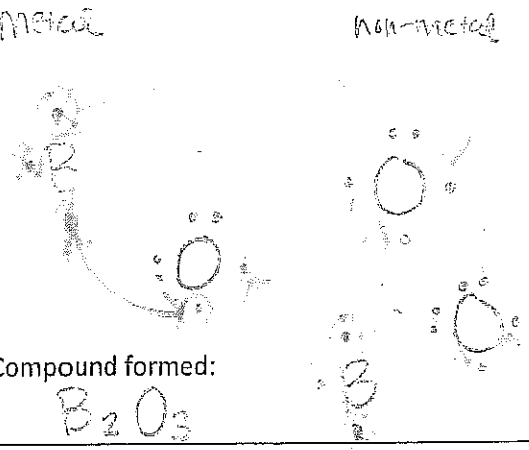
Compound formed: $AlCl_3$

12. Draw the Lewis Structure for Mg & P



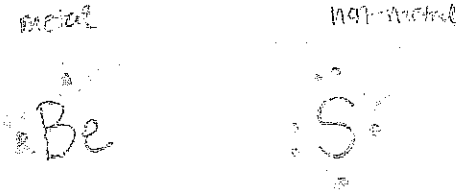
Compound Formed: Mg_3P_2

13. Draw the Lewis Structure for B & O



Compound formed: B_2O_3

14. Draw the Lewis Structure for Be & S



Compound formed: BeS

Bonding Basics Review Name _____

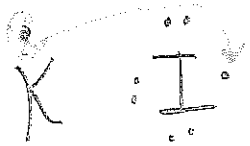
1. Complete the chart using your knowledge of atoms.

Element	Atomic Symbol	Total # of Electrons	# of Valence Electrons	# of Electrons Gained or Lost	Oxidation Number
Bromine	Br	17	7	G1 - anion	
Lithium	Li	3	1	L1 - cation	
Calcium	Ca	20	2	L2 - cation	
Sulfur	S	16	6	G2 - anion	
Boron	B	5	3	L3 - cation	
Silicon	Si	14	4	G/L4 - cation/anion	
Phosphorus	P	15	5	G3 - anion	

2. Ionic Bonds - Draw the Lewis structures for each atom, draw arrows to show the transfer of electrons, ~~write the charge for each ion~~, and then write the chemical formula.

(A) Potassium + Iodine

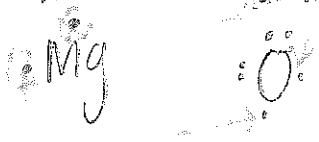
metal non-metal



Name - KI
Potassium - L1 = cation
Iodine - G1 = anion

(B) Magnesium + Oxygen

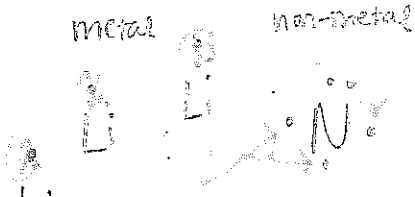
metal non-metal



Name - MgO
Magnesium - L1 = cation
Oxygen - G2 = anion

(C) Lithium + Nitrogen

metal non-metal



Name - Li_3N
Lithium - L1 = cation
Nitrogen - G3 = anion

3. Covalent Bonds – Draw the Lewis structures for each atom, draw circles to show the electrons that are shared, and then write the bond structure and chemical formula.

(A) Fluorine + Fluorine

(B) 3 Hydrogen + 1 Phosphorus

(C) 2 Hydrogen + 1 Sulfur

Chemical Bonding Worksheet

Ionic Bond	between a Metal and Non-Metal	(M + NM)
Covalent Bond	between a Non-Metal and Non-Metal	(NM + NM)
Metallic Bond	between a Metal and Metal	(M+ M)

Determine if the elements in the following compounds are metals or non-metals. Describe the type of bonding that occurs in the compound.

Compound	Element 1 (metal or non-metal?)	Element 2 (metal or non-metal?)	Bond Type
NO_2	N = non-metal	O = non-metal	covalent
NaCl	Na = metal	Cl = non-metal	ionic
SO_2	S = non-metal	O = non-metal	covalent
PO_4^{3-}	P = non-metal	O = non-metal	covalent
$MgBr_2$	Mg = metal	Br = non-metal	ionic
CaO	Ca = metal	O = non-metal	ionic
H_2O	H = non-metal	O = non-metal	covalent
K_2O	K = metal	O = non-metal	ionic
Cu-Zn alloy	Cu = metal	Zn = metal	metallic
O_2	O = non-metal	O = non-metal	covalent
$CuCl_2$	Cu = metal	Cl = non-metal	ionic
NO_2^-	N = non-metal	O = non-metal	covalent
TiO_2	Ti = metal	O = non-metal	ionic
HF	H = non-metal	F = non-metal	covalent
Rb_2S	Rb = metal	S = non-metal	ionic
Au-Ag mixture	Au = metal	Ag = metal	metallic
Fe_2O_3	Fe = metal	O = non-metal	ionic
$C_6H_{12}O_{22}$	C = non-metal	H = non-metal	covalent