1 class periodic – complete all of this

19-2 Chemical Formulas NAME _____

Question: Why do atoms combine in certain ratios?

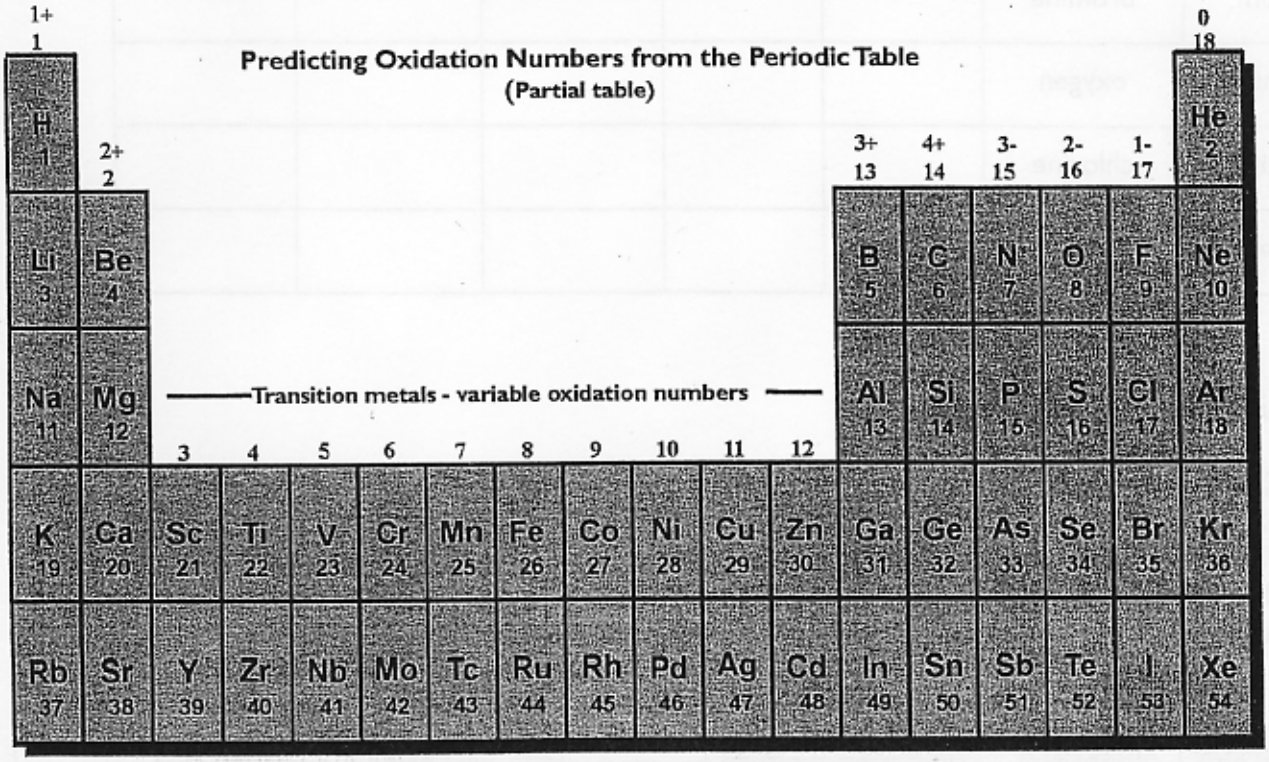
- Chemists have long noticed that groups of elements behave similarly.
- The periodic table is an arrangement of the elements grouped according to similar behavior.

In this investigation, you will:

- Discover the relationship between elements, their placement on the periodic table, and chemical formulas.
- Build models of compounds using the periodic table tiles and write their chemical formulas
- Discover how the arrangement of electrons in atoms is related to groups on the periodic table
- Learn why atoms form chemical bonds with other atoms in certain ratios

1. Oxidation numbers and Ions

- An elements ***oxidation number*** indicates how many electrons are lost or gained when chemical bonding occurs
- The oxidation number is equal to the charge an atom has when it **ionizes**, that is, gains or loses electrons to become an **ion**
- The partial periodic table below shows the most common oxidation numbers of the elements
- The oxidation numbers are written above the group number above each column on the table
- Groups 1, 2, and 13 through 18 are called the **main group elements**



a. How are elements grouped according to the number of valence electrons in their outermost levels

b. Why do elements in group 2 have an oxidation number of 2+?

c. Why do elements in group 17 have an oxidation number of 1-?

d. Why do the oxidation numbers in the first two groups tend to be positive?

2. Predicting Chemical Formulas

Compounds that are formed from ions are called **ionic compounds**. Predict the chemical formulas for ionic compounds that are made up of the pairs of elements in the table below. Use the following steps:

1. Using the periodic table on the previous page, determine the ion formed by each element.
2. Figure out how many periodic table tiles of each element will be needed to make the compound electrically neutral.
3. Form the compound with your tiles and write the chemical formula for each compound based on the number of tiles of each element

element 1	element 2	ion 1	ion 2	number of tiles of element 1	number of tiles of element 2	chemical formula
hydrogen	fluorine					
magnesium	sulfur					
calcium	bromine					
aluminum	oxygen					
potassium	chlorine					
lithium	argon					

3. Naming Ionic Compounds

Naming ionic compounds is very simple if you follow these rules:

1. Write the name of the element with a positive oxidation number first.
2. Write the root name of the element with a negative oxidation number second. For example, chlor- is the root name of chlorine. Subtract the –ine ending.
3. Add the ending –ide to the root name. Chlor- becomes chloride.

Element 1	Element 2	Chemical Formula	Name of the Ionic Compound
hydrogen	fluorine		
magnesium	sulfur		
calcium	bromine		
aluminum	oxygen		
potassium	chlorine		
lithium	argon		

BONDING NAME_____

1. Listed below are 5 minerals/compounds and their chemical formulas.
2. To the right of each individual element, fill the electron shells.
3. To the left of each symbol, put the oxidation # or ionization #.
4. Next, study the outside electron shell numbers and try to figure out the bonding.
5. Use arrows and numbers to show the bonding and octet rule.
6.

→ THE FIRST ONE IS COMPLETED AS AN EXAMPLE

COMPOUND	Electron Shells by # to right of symbol	# of elements	# of atoms
HALITE $NaCl$	$+1\ Na\ 2,8,1$ $\quad -1\ Cl\ 2,8,7$	elements 2	atoms 2
CALCITE $CaCO_3$	Ca O O C O		
FLUORITE CaF_2	Ca F F		
QUARTZ SiO_2	Si O O		
OLIVINE Mg_2SiO_4	Mg O Mg O O Si O		

over →

Chemical formula	# of elements	# of atoms	# of compound	# of molecules
NaCl				
$CaCO_3$				
CaF_2				
SiO_2				
Mg_2SiO_4				
Al_2O_3				
$KAl_3Si_3O_{10}(OH)_2$				

In the table above, figure out how many elements, atoms, compounds, and molecules are in each chemical formula.

3. Practice writing chemical formulas for ionic compounds

Use the periodic table to find the oxidation numbers of each element. Then write the correct chemical formula for the compound formed by the following elements:

Element	Oxidation Number	Element	Oxidation Number	Chemical Formula for Compound
Potassium (K)		**Chlorine (Cl)**		
Calcium (Ca)		**Chlorine (Cl)**		
Sodium (Na)		**Oxygen (O)**		
Boron (B)		**Phosphorus (P)**		
Lithium (Li)		**Sulfur (S)**		
Aluminum (Al)		**Oxygen (O)**		
Beryllium (Be)		**Iodine (I)**		
Calcium (Ca)		**Nitrogen (N)**		
Sodium (Na)		**Bromine (Br)**		

4. Polyatomic ions

Have you ever heard of sodium nitrate? It's a preservative used in foods like hot dogs. The chemical formula for sodium nitrate is $NaNO_3$. How many types of atoms does this compound contain? You are right if you said three: sodium, nitrogen, and oxygen. The nitrogen and oxygen atoms have a shared-electron bond. They act as one unit (called nitrate) with an oxidation number of 1-. Ions that have more than one type of atom (like nitrate) are called *polyatomic ions.*

To write the chemical formula for a compound containing one or more polyatomic ions, consult a reference table or guide to determine the ion's oxidation number. Then, use the same procedure for writing chemical formulas that you practiced in section 3. The oxidation numbers for the polyatomic ions you will need for the problems in the skill sheet are shown in the following table:

Polyatomic Ion	Oxidation Number	Polyatomic Ion	Oxidation Number
Phosphate (PO_4)	3-	Nitrate (NO_3)	1-
Carbonate (CO_3)	2-	Sulfate (SO_4)	2-
Ammonium (NH_4)	1+	Acetate ($C_2H_3O_2$)	1-
Hydroxide (OH)	1-	Hydronium (H_3O)	1+

Example 3:

Calcium and the hydroxide ion (-OH) combine to form a compound. Write the chemical formula for this compound.

From the periodic table, we see that the oxidation number for calcium is 2+. From the table above, you will see that the oxidation number for the hydroxide ion is 1-. To make a molecule of calcium hydroxide, therefore, we need one calcium atom and two hydroxide ions:

$$(2+) + 2(1-) = 0$$

The correct chemical formula for this compound would be $Ca(OH)_2$. Note that we enclose the members of the polyatomic ion in parentheses. The subscript for this ion is placed outside of the parentheses. This shows that we need two complete polyatomic hydroxide ions to form the compound.

5. Writing chemical formulas for compound containing polyatomic ions

Use the table on the previous page and the periodic table to find the oxidation numbers of each ion. Then write the correct chemical formula for the compounds formed by these ions.

Element	Oxidation Number	Polyatomic Ion	Oxidation Number	Chemical Formula for Compound
Sodium (Na)		**Phosphate (PO_4)**		
Calcium (Ca)		**Nitrate (NO_3)**		
Fluorine (F)		**Ammonium (NH_4)**		
Boron (B)		**Sulfate (SO_4)**		
Lithium (Li)		**Hydroxide (OH)**		
Beryllium (Be)		**Carbonate (CO_3)**		
Nitrogen (N)		**Hydronium (H_3O)**		