Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_

**“Chemical Bonding”**

1. What is a chemical bond? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Why do bonds form? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What are the three main types of chemical bonds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Graphic Organizer:

**Chemical Bonds**

Type

General Rule

Formation

Smallest Unit

Properties

**I. Ionic Bonds** are formed by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The metal atom will become a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ion ( ), while the nonmetal atom will become a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion ( ). An ionic bond forms when the positive ions and negative ions \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ each other (electrostatic attraction). Note: Even though we say a transfer of the valence electrons from metal atom to nonmetal atom, there’s still some sharing. An ionic compound is made of ionic bonds between ions in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

1. **Formation of Binary Ionic Compounds from main body elements - IA, IIA, IIIA, VA, VIA, VIIA** (not using transition metals yet, B group)
2. **Monatomic ion** – an ion consisting of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_atom.

Examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Binary ionic compound** – is composed of two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ types of atoms. The first being a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion and the second a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion.

Examples: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Lewis Dot Diagram of the formation of a binary ionic compound**

**Example 1: From groups IA and VIIA.**

**metal** **nonmetal**

lithium and chlorine

**Lewis Dot Diagram:**

**Show Transfer:**

**Formula: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* metal ion first
* subscripts tell how many of each ion
* nonmetal ion nect
* subscripts tell how many of each ion

**Naming the Ionic Compound: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* name metal ion first (just the metal’s name)
* Change ending on nonmetal **from -ine, -orus, -ygen etc.** (atom) to **–ide** (ion)

**Example 2: From groups IA and VIIA.**

**metal** **nonmetal**

sodium and bromine

**Lewis Dot Diagram:**

**Show Transfer:**

**Formula: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* metal ion first
* subscripts tell how many of each ion
* nonmetal ion nect
* subscripts tell how many of each ion

**Naming the Ionic Compound: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* name metal ion first (just the metal’s name)
* Change ending on nonmetal **from -ine, -orus, -ygen etc.** (atom) to **–ide** (ion)

**Example 3: From groups IA and VIIA.**

**metal** **nonmetal**

potassium and fluorine

**You Do! (Draw Lewis Diagram, Show Transfer, Write Formula, Name Compound)**

**Example 4: From groups IIA and VIIA.**

**metal** **nonmetal**

calcium and fluorine

**Lewis Dot Diagram:**

**Show Transfer:**

**Formula: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Naming the Ionic Compound: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**You Do! (Draw Lewis Diagram, Show Transfer, Write Formula, Name Compound)**

**Example 5: From groups IIA and VIIA.**

**metal** **nonmetal**

magnesium and bromine

**Example 6: From groups IIA and VIIA.**

**metal** **nonmetal**

beryllium and iodine

**Example 7: From groups IIIA and VIA.**

**metal** **nonmetal**

aluminum and fluorine

**Lewis Dot Diagram:**

**Show Transfer:**

**Formula: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Naming the Ionic Compound: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**You Do! (Draw Lewis Diagram, Show Transfer, Write Formula, Name Compound)**

**Example 8: From groups IIIA and VIA.**

**metal** **nonmetal**

magnesium and oxygen

1. **Writing Ionic Formulas (Simplified)**
2. Here’s a simpler way to write ionic formulas -------just **crisscross** **down** the **charge number** to get **how many of each ion. The charge becomes the subscript!**

**Example 1**: barium and chlorine

**YOU DO!**

**Example 2:** sodium and oxygen

**Example 3:** aluminum and sulfur

**Example 4:** calcium and sulfur

**What do you notice about the overall charge (net charge) on an ionic compound? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

1. **Group B Metals in Ionic Bonding**
2. Now, what about using transition metals (B group or 3-12) in a binary ionic compound? Remember any metal ion beyond group IIA are positive and have multiple charges (with a few exceptions – a few you will be responsible for memorizing – Ag+, Zn2+, Al3+).
3. A Roman numeral in the name will tell you the charge of the metal ion that’s beyond group IIA (Roman numerals are not used for the exceptions – Ag, Zn, Al).

Example: The copper ion can come as Cu+ or Cu2+

copper(II) chloride is using Cu2+

1. You can now write the formula for binary ionic compounds containing metals from beyond group IIA.

You Do! **Write the formula from the name. Remember to crisscross and reduce if applicable.**

* 1. iron(III) oxide (also known as rust)
  2. iron(II) oxide
  3. manganese(III) phosphide
  4. zinc chloride (no Roman numeral in name, because it doesn’t have multiple charges).

1. You just wrote a formula from a name- let’s go the other way now.

Write the name from the formula

Example: SnO2

The net charge on an ionic compound is \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

You need to do some math to figure out what charge is on Sn (it’s a metal beyond IIA so we need to figure which charge was used).

Example: CuO (don’t crisscross back up to get the charge on Cu, because the subscripts were reduced).

1. **Polyatomic Ions**
2. Ternary ionic compounds contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ different elements instead of binary ionic compounds, which contains \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Ternary ionic compounds contain a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion and a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ion.
4. You must memorize the formulas and names of the common polyatomic ions we’ll be using in class. Quiz \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. A polyatomic ion is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of atoms (covalently bonded together) that has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, unlike a monatomic ion, which is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_atom with a charge. Polyatomic ions can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ like the monoatomic ions.
6. Polyatomic ions act like a \_\_\_\_\_\_\_\_\_unit with a charge.
7. **Writing formula from ionic compounds containing polyatomic ions.**

* Use parentheses around the polyatomic ion if you have more than one.
* Remember polyatomic ions act as a single unit with a charge.
* Determine charges, crisscross down, reduce if needed.

Example 1: calcium nitrate

Example 2: strontium carbonate

You Do!

* 1. ammonium nitrate
  2. ammonium sulfide
  3. copper(I) sulfate
  4. lead(IV) carbonate
  5. zinc sulfate
  6. mercury(I) oxide
  7. silver nitrate
  8. aluminum bicarbonate or aluminum hydrogen carbonate

1. **Naming ionic compounds from a formula containing a polyatomic ion.**

* Don’t change the name of a polyatomic ion in a compound’s name – just use its name.
* Identify the polyatomic ion in the formula – circle it.
* Name the cation (just name it) and anion (polyatomic –don’t change name just name the polyatomic ion).

Example 1: NaNO3

Example 2: **Ca(NO3)2**

You Do!

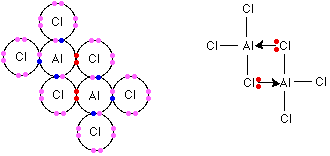
* 1. NH4Cl
  2. (NH4)2S
  3. NH4 NO3

**Don’t forget to ask the question: Is the metal ion beyond IIA? If yes-use a Roman numeral in name. Use math to figure-out the charge for the Roman numeral.**

* 1. Cu(NO3)2
  2. Sn(CO3)2
  3. Pb(HCO3)2

**II. Covalent Bonds** are formed when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Covalent bonds are between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Each atom in the bond wants \_\_\_\_\_\_\_\_\_ valence electrons - Octet Rule (exception: 2 valence electrons in 1st energy level). A covalent bond contains a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of valence electrons. A single bond contains \_\_\_\_\_\_\_\_\_\_\_\_ pair of valence electrons. A double bond contains \_\_\_\_\_\_\_\_\_\_\_\_\_ pairs of valence electrons (total of 4 electrons) being shared between two atoms. A triple bond is \_\_\_\_\_\_\_\_\_\_\_\_\_ pairs of valence electrons (total of 6 electrons) being shared between two atoms. Covalent bonds make up molecular compounds. The smallest unit (representative unit) of a molecular compound is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, unlike the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for ionic compounds.

**Picture of representative units in an ionic compound verses a molecular compound.**

****

1. **Lewis Dot Diagram of the Formation of a Single Bond.**

**Example 1: nonmetal** **nonmetal**

hydrogen and hydrogen

**Show Sharing with Lewis Dot Diagram:**

**Structural Formula: (use lines to represent bonds)**

* **single bond (2 electrons)**
* **double bond (4 electrons)**
* **triple bond (6 electrons)**

**(Molecular) Formula:**

**Subscripts tell how many of each atom are in the molecule** \_\_\_\_\_\_\_\_\_\_\_ is a diatomic molecule that you memorized earlier in the year.

**Lewis Dot Diagram of the Formation of a Double Bond.**

**Example 2: nonmetal** **nonmetal**

oxygen and oxygen

**Lewis Dot Diagram of the Formation of a Triple Bond.**

**Example 3: nonmetal** **nonmetal**

nitrogen and nitrogen

**Lewis Dot for molecules that have two or more different elements in the molecule.**

**Example 4: nonmetal** **nonmetal**

carbon and chlorine

**Show sharing with a Lewis Dot Diagram between carbon and chlorine:**

**Structural Formula:**

**Molecular Formula:**

* **Carbon, or the least electronegative element is first in formula**
* **subscripts tell how many of each atom are in the molecule**

**Naming (Nomenclature) of molecular compounds (except for the diatomic molecules).**

* **Use prefixes in the name to indicate the number of atoms in the molecule.**
* **Don’t use mono in the beginning of a name.**
* **You need to memorize the following prefixes:**

**Name the molecule in #4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**