**Honors Chemistry - Unit 5 Bonding and Nomenclature**

**Ionic Naming Quiz: Thursday, Oct. 11 Vocab Quiz: Friday, Oct. 12 Covalent Naming Quiz: Tuesday, Oct 16 Mixed Naming Quiz: Wednesday, Oct. 17 Test: Friday, Oct. 19 Warm-Ups/PS due: Friday, Oct. 19**

**Bonding Project Due: Wednesday, Oct. 17**

**VOCABULARY:**

monatomic ion cation anion binary compound

ionic compound transition metal polyatomic ion nomenclature

molecular compound molecular formula hydrate London Dispersion

covalent bonds molecule polar covalent nonpolar covalent

VSEPR dipole-dipole

resonance structure intermolecular forces Van der Waals forces

**FORMULAS/CONSTANTS/INFO TO BE MEMORIZED:**

Charges from periodic table Numerical prefixes

**OBJECTIVES:**

* Understand how to find oxidation numbers from the periodic table and be able to use them in writing formulas.
* Memorize the common polyatomic ions.
* Be able to write and name ionic and molecular formulas.
* Be able to name transition compounds.
* Be able to identify the location of the metals and nonmetals on the periodic table.
* Know the names of the families on the periodic table
* Be able to describe and identify the three types of bonds: ionic, molecular, and metallic.
* Be able to describe characteristics of ionic, molecular and metallic compounds.
* Be able to describe the difference between polar and nonpolar molecular bonds.
* Be able to determine bond type using the periodic table or electronegativity difference
* Be able to identify VSEPR model for covalent molecules
* Be able to differentiate between IMF

**Common Polyatomic Ions (many are in the reference packet)**

**\*Acetate C2H3O2 1-** \***Ammonium NH4 1+**

Cyanide CN 1- Hydroxide OH 1-

**\*Carbonate CO32-**  \***Nitrate NO31-**

Chromate CrO42- Nitrite NO21-

Perchlorate ClO41- Peroxide O22-

**\*Phosphate PO43-** \***Sulfate SO42-**

Sulfite SO32- Chlorate ClO31-

Bicarbonate HCO31-

**Common Acids - Need to be memorized!!!**

Hydrochloric Acid HCl Nitric Acid HNO3

Acetic Acid HC2H3O2 Sulfuric Acid H2SO4

Carbonic Acid H2CO3 Phosphoric Acid H3PO4

**Lewis Dot Structures - Ionic & Metallic Bonding**

**Valence Electrons**

**Electron Dot Diagrams**

**How to Make a Dot Diagram:**

**Ionic Bonding**

Explain: Are these pairs likely to form ionic compounds?

* + Cl, Br \_\_\_\_\_\_\_\_\_\_ Why?
  + K, He \_\_\_\_\_\_\_\_\_ Why?
  + Na, Cl \_\_\_\_\_\_\_\_\_ Why?

**4 Properties of Ionic Compounds**

**Metallic Bonding**

**Ion & Lewis Dot Structure Practice**

*Use your notes to answer the following.*

1. How can the periodic table be used to find the number of valence electrons in an atom?

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

2. How many valence electrons does each atom have?

a. potassium \_\_\_\_\_\_\_\_\_\_\_ c. fluorine\_\_\_\_\_\_\_\_\_\_\_\_

b. magnesium\_\_\_\_\_\_\_\_\_\_ d silicon\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Write the electron dot structure (Lewis Dot Diagram) for each element in question 2.

a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Write complete electron configurations for the 1+ ion of sodium (Na) and the 3- ion of nitrogen (N).

Na+\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

N3-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Metals \_\_\_\_\_\_\_\_\_\_\_ electrons to become cations. Nonmetals \_\_\_\_\_\_\_\_\_\_ electrons to become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

6. How many electrons will each element gain or lose in forming an ion?

a. calcium (Ca) \_\_\_\_\_\_\_\_\_\_\_\_ b. aluminum (Al) \_\_\_\_\_\_\_\_\_\_

c. fluorine (F) \_\_\_\_\_\_\_\_\_\_\_\_\_ d. oxygen (O) \_\_\_\_\_\_\_\_\_\_\_\_\_

7. Write the ion symbol for each of the ions in question 6.

a. calcium (Ca) \_\_\_\_\_\_\_\_\_\_\_\_ b. aluminum (Al) \_\_\_\_\_\_\_\_\_\_

c. fluorine (F) \_\_\_\_\_\_\_\_\_\_\_\_\_ d. oxygen (O) \_\_\_\_\_\_\_\_\_\_\_\_\_

8. What are the 4 characteristics of ionic compounds?

a.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. How many electrons must be gained by each of the following atoms to achieve a stable electron configuration?

a. N \_\_\_\_\_\_\_\_\_\_\_\_ b. S \_\_\_\_\_\_\_\_\_\_\_\_\_

c. As \_\_\_\_\_\_\_\_\_\_\_\_ d. Se \_\_\_\_\_\_\_\_\_\_\_\_

10. Circle the pairs of elements that will **not** form ionic compounds.

a. sulfur and oxygen b. sodium and calcium

c. sodium and sulfur d. oxygen and chlorine

11. For each of the above pairs, **explain** why it will or won't form an ionic compound..

a. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Chemical Formulas and Chemical Compounds**

**Sample problems**: **circle** the correct answers.

* 1. CaO is a(n) { ionic compound / molecule }.
  2. The formula for CaO is known as a { formula unit / molecular formula }
  3. CaO is bonded by { ionic / covalent } bonds.
  4. An oxygen molecule, O2, is a(n) { ionic compound / molecule }.
  5. O2 is bonded by { ionic / covalent } bonds.

**Chemical Formulas**

1. A chemical formula could be either a molecular formula or a formula unit.
2. Either way, the chemical formula indicates the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of each \_\_\_\_\_\_\_\_\_\_\_ in a chemical compound.
3. Parentheses around a polyatomic ion identify it as \_\_\_\_\_\_\_\_\_\_\_ unit and ***any subscripts written next to parentheses apply to all the atoms inside the parentheses.***

**Sample problems:** circle or fill in the correct answers.

1. Butane, C4H10, is a(n) { ionic compound / molecule } that has \_\_\_\_\_\_ carbon atoms and \_\_\_\_\_\_ hydrogen atoms.
2. Aluminum oxide, Al2O3, is a(an) { ionic compound / molecule } that has \_\_\_\_\_\_ aluminum ions and \_\_\_\_\_\_oxide ions in its simplest ratio.
3. Calcium chlorate, Ca(ClO3)2, has \_\_\_\_ calcium ions Ca2+,

\_\_\_\_ chlorate ions ClO3-, \_\_\_\_ chlorine atoms Cl, and \_\_\_\_ oxygen atoms O.

1. Magnesium phosphate, Mg3(PO4)2, has \_\_\_\_\_\_\_ magnesium ions Mg2+,

\_\_\_\_\_\_ phosphate ions PO43-, \_\_\_\_\_\_ phosphorous atoms P, and \_\_\_\_\_\_ oxygen atoms O.

**Naming monatomic cations (positive ions) – alkali and alkaline-earth metals.**

Naming ions for alkali and alkaline-earth metals is ***easy***. Just use the element’s name plus the word ***ion***.

Use your periodic table to assign charges. (remember charges are a result of elements following the **octet rule** when forming compounds!)

Complete the table:

Atom Ion formed Ion name

**Ex.** Be Be+2 Beryllium ion

Li \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Na \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mg \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ca \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**You try:** Atom Ion formed Ion name

Al \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ba \_\_\_\_\_\_\_ \_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Naming monatomic cations – transition metals and Sn and Pb**

1. When naming ions for transition metals, the **Stock system** is used; a **Roman numeral** in parentheses is added to the name to indicate the charge of the ion.
2. For example; Cu1+ is copper (I) and Cu2+ is copper (II).
3. Complete the table:

Ion Ion name Ion Ion name

Pb2+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ iron (III) ion

Pb4+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_ iron (II) ion

**You try:** Ion Ion name

Cu2+ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_ titanium (II) ion

**Naming monatomic anions (negative ions) – nonmetals**

1. When naming anions for the nonmetals, **drop the ending of the elements name and add the suffix *–ide*.**
2. Complete the table:

Atom Ion formed Ion name

**Ex.** Cl Cl-1 Chlor**ide** ion

F \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

I \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

O **\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

N \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**You try:**

Atom Ion formed Ion name

P \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Br \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Forming binary ionic compounds (Criss-Cross Method)**

**Naming binary ionic compounds**

* Combine the names of the cation and the anion.
* Example: BaBr2 is named barium bromide.
* First write the ions formed for the following elements. Then use the Criss Cross method to determine the formula. Then name the compounds.

**Elements Ions formed Formula Unit Name**

1. magnesium and iodine \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. potassium and sulfur \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. chlorine and aluminum \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. zinc and bromine \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. sulfur and cesium \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. strontium and oxygen \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. calcium and nitrogen \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. calcium and oxygen \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. copper(I) and oxygen \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. copper(II) and chlorine \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. mercury(II) and oxygen \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. nitrogen and aluminum \_\_\_\_\_ \_\_\_\_\_ \_­\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Writing names from formulas**

Examples: Name the following compounds:

CaCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

FeO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CuCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

TiO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**You try:**

HgF \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

ZnBr2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Al2O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

CuO \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Chromium (III) sulfide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Naming binary ionic compounds that contain polyatomic ions**

The ***polyatomic ions are in your reference packet.***

The most common oxyanions – polyatomic anions that contain oxygen, end in –*ate.* Oxyanions with one less oxygen end in *–ite*.

For example:

NO3-1 is nitrate SO42- is sulfate

NO2-1 is nitrite SO32-is sulfite

Anions with one less oxygen than the *–ite­* ion are given the prefix *hypo-*.

Anions with one more oxygen than the *–ate* ion are given the prefix *per-*.

ClO-1 is hypochlorite ClO3-1 is chlorate

ClO2-1 is chlorite ClO4-1 is perchlorate

Naming compounds with polyatomics is the same as naming other compounds, just name the cation and then the anion. If there is a transition metal involved, be sure to check the charges to identify which ion (+1, +2, +3, +4….) it may be so that you can put the correct Roman numeral in the name.

Name the following:

NaOH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ KClO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ca(NO3)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ NaC2H3O2  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

NH4NO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Co(NO2)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mn(SO4)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CuPO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Determining the formula unit when the compound has a polyatomic ion**

Use the Criss-Cross Method. ***Parentheses are used around polyatomic ion if more than one polyatomic ion is present.***

Determine the formula for the following Ions formed Formula unit

1. potassium hydroxide \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. ammonium acetate \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. magnesium permanganate \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. iron(III) nitrate \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. sodium sulfate \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Naming binary molecular compounds (You must memorize the prefixes!!)**

With molecules, the prefix system is used

1 mono- 6 hexa-

2 di- 7 hepta-

3 tri- 8 octa-

4 tetra- 9 nona-

5 penta- 10 deca-

* The ***less-electronegative*** element is always written first. The first element only gets a prefix if it has more than one atom in the molecule.
* The second element **always** gets the prefix and the ending *–ide.*
* The *o or a* at the end of the prefix is dropped when the word following the prefix begins with another vowel, for example monoxide or pentoxide.

**Molecular Naming Practice**

**Write the Formula Write the Name**

|  |  |
| --- | --- |
| 1) diantimony trioxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 1) CO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 2) carbon monoxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 2) CI4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 3) oxygen difluoride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 3) P2O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 4) sulfur hexachloride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 4) N2O3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 5) sulfur tetraiodide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 5) Cl2O7 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 6) dicarbon octafluoride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 6) BI3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 7) dichlorine heptaoxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 7) S2Cl4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 8) tetraphosphorus decaoxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 8) NO \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 9) pentaphosphorus nonachloride \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 9) CS2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 10) sulfur trioxide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 10) I2O5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 11) dihydrogen tribromide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 11) N2O4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 12) nitrogen trisulfide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 12) SiBr4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 13) heptachlorine monophosphide \_\_\_\_\_\_\_\_\_\_\_\_\_ | 13) P6F9 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 14) fluorine monosulfide \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 14) Br2Cl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 15) hexabromine dinitride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 15) I8P \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**Naming Acids – memorize acid names for test!**

* Names and formulas for some common acids. Traditional acids begin with H+
* Binary acids those made of one element and H are usually named Hydro (element) ic.
* Acids formed from polyatomic ions that end with ate are named with ion(drop ate)-ic

HCl hydrochloric acid H3PO4  phosphoric acid

HNO3 nitric acid H2SO4 sulfuric acid

H2CO3 carbonic acid HC2H3O2 (CH3COOH) acetic acid

**Hydrates**: Ions that are chemically bonded to water molecules are called hydrates.

* *Formulas for hydrated compounds place the water following a dot after the regular formula.*
* Prefixes used in naming hydrates are the same as those used in naming molecular compounds (see table above)

**Example** CaSO4 **∙** 2 H2O is calcium sulfate dihydrate

And the formula for copper (II) sulfate pentahydrate is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**You try:** *Name Formula*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ CaCrO4 **∙** 3 H2O

Iron (II) fluoride octahydrate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Naming chemical compounds flowchart**

**Starting with the formula – is the first element H?**

**No Yes**

The compound contains: compound is an acid- use acid list

**Only 2 elements 3 or more elements**

Compound is binary compound contains a **polyatomic ion – use poly list**

Will use – ide ending If the first element is in 1A, IIA, IIIA If the first element

or is Zn (2+) or Ag (1+) is a transition metal

name the cation and then the polyatomic ion use a roman numeral for the cation

(Li2CO3 = lithium carbonate) and then write the polyatomic ion

(make an X and solve for it)

(CuSO4 = copper (II) sulfate)

**Is the first element a metal?**

NO – it is a nonmetal – this is a molecular compound – use

YES prefixes in the name (N2O3 = dinitrogen trioxide)

If the first element is IA, IIA, IIIA or Zn (2+) or Ag (1+) name the cation and then

the anion making the ending –ide.

If the first element is

A transition metal – Use a roman numeral for The cation and write the anion with an –ide ending- use an X to solve

For the roman numeral

**Starting with the name of the compound**

**Contains a prefix?**

**NO YES Molecular compound** – use

prefixes in the formula

**Ionic Compound**

Identify symbols

If the first element is **IA, IIA, IIIA** **Roman Numerals** present **Polyatomic ions** (more than

or **Zn (2+) or Ag (1+)** use the gives charges for transition 2 elements present) use

periodic table for charges cation packet for charges

**Balance charges** – use crisscross method – add parenthesis for any multiple polyatomic ions

**Writing Formulas and Naming Compounds**

**Introduction**

Writing formulas and naming compounds can be confusing because there are different types of compounds that follow different rules. Additionally, some compounds (H2O, NH3, CH4, etc.) simply have ***common names*** that must be memorized.

The two types of compounds we will focus on first are ***ionic compounds*** (formed from positive and negative ions) and ***binary nonmetal compounds*** (molecular compounds). Later we will add ***acids***. So… you must recognize the ***type*** of compound before you try to name it. [Note: + ion = “cation” and – ion = “anion”.]

|  |  |  |
| --- | --- | --- |
|  | **Ionic** | **Binary Nonmetal** |
| **Formula** | + ion before – ion  ex: NaCl (NH4)2SO4 Al2S3 | usually the less electronegative atom is first  ex: CO CO2 N2O |
| **Naming** | Name of cation + name of anion  sodium chloride  ammonium sulfate  aluminum sulfide | Indicate the number (mono, di, tri, and kind of atoms. First element is simply name of element. Second element name ends with “ide”  carbon monoxide  carbon dioxide  dinitrogen monoxide |

**I. Writing Ionic Formulas**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Cl | NO3 | S2 | CO32 | N3 | PO43 | OH |
| Na+ |  |  |  |  |  |  |  |
| NH4+ |  |  |  |  |  |  |  |
| Sn2+ |  |  |  |  |  |  |  |
| Hg22+ |  |  |  |  |  |  |  |
| Al3+ |  |  |  |  |  |  |  |
| Sn4+ |  |  |  |  |  |  |  |

**II. Naming Ionic Compounds**

|  |  |  |  |
| --- | --- | --- | --- |
| **Cation** | **Anion** | **Formula** | **Name** |
| Cu2+ | OH |  |  |
| Ba2+ | SO42 |  |  |
| NH4+ | Cr2O72 |  |  |
| Ag+ | C2H3O2 |  |  |
| Fe3+ | S2 |  |  |

**Writing Chemical Formulas**

1. calcium chloride\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 23. manganese (II) nitrate \_\_\_\_\_\_\_\_

2. Hydrogen bromide \_\_\_\_\_\_\_\_\_\_\_\_\_ 24. chromium (III) sulfate \_\_\_\_\_\_\_\_

3. potassium hydride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 25. Ammonium sulfide \_\_\_\_\_\_\_\_

4. aluminum oxide\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 26. Rubidium acetate \_\_\_\_\_\_\_\_\_\_

5. sodium fluoride \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 27. ammonium sulfate \_\_\_\_\_\_\_\_

6. lithium chloride \_\_\_\_\_\_\_\_\_\_\_ 28. lithium carbonate \_\_\_\_\_\_\_\_\_

7. aluminum chloride \_\_\_\_\_\_\_\_\_\_\_ 29. Cerium (III) phosphate \_\_\_\_\_

8. Zinc iodide \_\_\_\_\_\_\_\_\_\_ 30. Carbon trioxide \_\_\_\_\_\_\_\_\_\_

9. potassium fluoride \_\_\_\_\_\_\_\_\_ 31. Barium nitrite \_\_\_\_\_\_\_\_\_\_\_

10. calcium telluride \_\_\_\_\_\_\_\_ 32. magnesium oxide \_\_\_\_\_\_\_\_\_

11. copper (II) carbonate \_\_\_\_\_\_\_\_\_\_\_\_ 33. Lithium sulfite \_\_\_\_\_\_\_\_

12. potassium hydroxide \_\_\_\_\_\_\_\_\_ 34. Magnesium hydroxide \_\_\_\_\_\_

13. calcium carbonate \_\_\_\_\_\_\_\_\_\_\_ 35. tin (I) chloride \_\_\_\_\_\_\_\_

14. rubidium cyanide \_\_\_\_\_\_\_\_\_ 36. Strontium hydroxide \_\_\_\_\_\_\_

15. Iron (II) iodide \_\_\_\_\_\_\_\_ 37. Magnesium nitrate \_\_\_\_\_\_\_

16. sodium cyanide \_\_\_\_\_\_\_\_ 38. Aluminum sulfate \_\_\_\_\_\_\_

17. manganese (III) oxide \_\_\_\_\_\_\_\_\_ 39. Potassium cyanide \_\_\_\_\_\_\_\_

18. magnesium phosphate \_\_\_\_\_\_\_\_ 40. Tin (IV) chloride \_\_\_\_\_\_\_\_

19. mercury (II) cyanide \_\_\_\_\_\_\_\_\_\_ 41. dinitrogen tribromide\_\_\_\_\_\_\_\_\_

20. Nickel (II) oxide \_\_\_\_\_\_\_\_\_ 42. Strontium phosphide \_\_\_\_\_\_\_\_\_\_\_

21. potassium nitrate \_\_\_\_\_\_\_\_\_\_\_ 43. sodium hydroxide \_\_\_\_\_\_\_\_\_\_

22. Mercury (II) chloride \_\_\_\_\_\_\_\_ 44. Magnesium sulfate monohydrate

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

**Naming Chemical compounds**

1. BaCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 23. Na3PO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. NaCl \_\_\_\_\_\_\_\_\_\_\_\_\_ 24. NH4Cl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. HgCl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 25. Zn(NO3)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. H2S \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 26. NaNO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. KBr \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 27. (NH4)2SO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. AlCl3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 28. Fe(NO3)3 \_\_\_\_\_\_\_\_\_\_\_\_\_

7. Na2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 29. NaC2H3O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. BaSe \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 30. NH4C2H3O2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. HCl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 31. CuSO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. KCl \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 32. Ca(C2H3O2)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. NaOH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 33. Cd3P2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. CuSe \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 34. NaOH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. FeO2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 35. Co3(PO4)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14. K2CO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 36. LiH \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

15. Ga2Te3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 37. NH4Cl\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

16. CsC2H3O2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 38. Mn(NO3)2 **∙** 4 H2O\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

17 Ba(OH)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 39. CaF2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

18. Pb(CN)2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 40. KC2H3O2 \_\_\_\_\_\_\_\_\_\_\_\_

19. HgI2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 41. MgH2 \_\_\_\_\_\_\_\_\_\_\_\_

20. NH4NO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 42. MnO \_\_\_\_\_\_\_\_\_\_\_\_\_\_

21. Na2SO4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 43. H2CO3  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

22. Al(NO2 )3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 44. HNO3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Mixed Naming Practice:

|  |  |
| --- | --- |
| **Chemical Formula** | **Name of Compound** |
| 1. CCl4 |  |
|  | Nitrogen gas |
|  | Oxygen gas |
|  | Tin (II) fluoride |
| 1. CO2 |  |
|  | Argon gas |
|  | Trinitrogen hexoxide |
| 1. NO |  |
| 1. NO2 |  |
| 1. PbSe |  |
|  | Hydrogen gas |
| 1. CO |  |
| 1. OF2 |  |
|  | Sulfur dioxide |
|  | Beryllium phosphide |
| 1. SO3 |  |
|  | Carbon monoxide |
|  | Lead (IV) carbonate |
|  | Ammonia |
|  | Beryllium phosphate |
| 1. CaSO3 |  |
| 1. P2O5 |  |
|  | Zinc chlorate |
| 1. CS2 |  |
| 1. BaS |  |
|  | Methane |
| 1. SrS |  |
|  | Beryllium hydroxide |
|  | Dinitrogen pentoxide |

**Review Sheet - Nomenclature Chemistry**

*Answer the following questions.*

1. Give three examples of elements that are metals. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Give three examples of elements that are non-metals. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Give three examples of metalloids. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Write the common oxidation number (charge) for the following monoatomic and polyatomic ions.*

4. silver \_\_\_\_\_ 5. alkali metals (group 1) \_\_\_\_\_ 6. Halogens (group 17) \_\_\_\_\_

7. choride \_\_\_\_\_ 8. carbonate \_\_\_\_\_ 9. magnesium \_\_\_\_\_

10. chlorates \_\_\_\_\_ 11. sodium \_\_\_\_\_ 12. phosphate \_\_\_\_\_

*Write the chemical formula or name of each of the following compounds. Remember that a compound always has a neutral charge.*

1. calcium chloride \_\_\_\_\_\_\_\_\_\_ 26. Al2 (SO4)3 \_\_\_\_\_
2. potassium chloride \_\_\_\_\_\_\_\_\_\_ 27. NaF \_\_\_\_\_
3. lithium fluoride \_\_\_\_\_\_\_\_\_\_ 28. Li2O \_\_\_\_\_
4. barium iodide \_\_\_\_\_\_\_\_\_\_ 29. MgCl2 \_\_\_\_\_
5. iron (II) nitrate \_\_\_\_\_\_\_\_\_\_ 30. CuO2\_\_\_\_\_\_
6. beryllium carbonate \_\_\_\_\_\_\_\_\_\_ 31. K2S ٠ 5 H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. barium chlorate \_\_\_\_\_\_\_\_\_\_
8. cobalt (III) nitride \_\_\_\_\_\_\_\_\_\_
9. ammonium chloride \_\_\_\_\_\_\_\_\_\_
10. hydrochloric acid \_\_\_\_\_\_\_\_\_\_
11. potassium sulfate \_\_\_\_\_\_\_\_\_\_
12. rubidium phosphate \_\_\_\_\_\_\_\_\_\_
13. sodium acetate \_\_\_\_\_\_\_\_\_\_

**Answers:**

1. various: Li, Na, Cu etc.

2. Various: F, Cl, He

3. Various: Si, As, Sb

4. 1+ 5. 1+ 6. 1- 7. 1- 8. 2- 9. 2+

10. 1- 11. 1+ 12. 3- 13. CaCl2 14. KCl 15. LiF

16. BaI2 17. Fe(NO3)2 18. BeCO3 19. Ba(ClO3)2 20. CoN 21. NH4Cl

22. HCl 23. K2SO4 24. Rb3PO4 25. NaC2H3O2

26. aluminum sulfate

27. Sodium fluoride

28. Lithium oxide

29. Magnesium chloride

30. Copper (IV) oxide

31. Potassium sulfide pentahydrate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| BOND | Atoms involved | Force | Properties | Examples | Relative strength |
| IONIC – transfer of electrons  (∆ EN) is >1.7 | Metal &  Nonmetal or  Metal & polyatomic ion | Attraction between ions, opposite charges attract | High melting point.  High boiling point  Water soluble  Crystalline  Aq solutions conduct a current | NaCl  MgO  CaS  K2SO4 (also includes cov bond) | Generally the strongest bond type = the larger the ion charges the stronger the ionic bond. |
| COVALENT-  Sharing of electrons  (∆ EN) is <1.7 | Two nonmetals  **Polar = unequal sharing = partial charge**  **Nonpolar = equal sharing = no charge** | Sharing of electrons | Low melting & boiling point  Brittle  Nonconductors | Water  CO2  NH3 | Weakest bond type-  (exception network solids like diamonds)  Strongest: H bond  Dipole-dipole  Weakest: dispersion forces |
| METALLIC-  Free flow of  Electrons | Two metals | Sharing of electrons between all atoms | Good conductors.  **Malleable = shapeable,**  **Ductile = able to be drawn into wire** | Copper wire  Iron bar |  |

**VSEPR & Molecular Geometry**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Molecular Shape** | **Type of Molecule** | **Atoms Bonded to Central Atom** | **Lone Pairs of e-s on Central Atom** |
| **Linear** |  | **AB2** | **2** | **0** |
| **Bent** | **2 surrounding atoms – I pair of lone e-s** | **AB2E** | **2** | **1** |
| **Trigonal Planar** |  | **AB3** | **3** | **0** |
| **Tetrahedral** |  | **AB4** | **4** | **0** |
| **Trigonal Pyramidal** | **3 surrounding atoms – I pair of lone e-** | **AB3E** | **3** | **1** |
| **Bent** | **2 surrounding atoms – 2 pairs of lone e-** | **AB2E2** | **2** | **2** |
| **Trigonal**  **Bipyramidal** | **5 surrounding atoms – 0 pairs of lone e-** | **AB5E0** | **5** | **0** |
| **Octahedral** | **6 surrounding atoms – 0 pairs of lone e-** | **AB6E0** | **6** | **0** |

**NASL Method for Determining Molecular Shape:**

**N** stands for the number of electrons that will satisfy the rule of eight.

For *representative elements*, **N = 8**,

**EXCEPT, H and He N = 2 Be N = 4 B N = 6**

To get **N** for a molecule or molecular ion**,** add the N values for all atoms in the molecule**.**

**A** stands for the number of available electrons, ie, electrons in the valence shell. This is the same as the group no. : IA, IIA, IIIA, IVA, VA, VIA, VIIA, and VIIIA. If you do not know the group number for some reason, write the electron configuration and count up all the electrons in the valence shell.

To get **A** for a molecule or molecular ion, count up the valence electrons for each atom in the molecule and add the charge if it is negative, but subtract the charge if it is positive.

**S** stands for the number of electrons that are shared.

**S = N – A** Divide this number by 2 to the get the number of covalent bonds in the molecule.

**L** stands for the number of electrons that are left over.

**L = A – S** Divide this number by 2 to get the number of lone pairs in the structure.

When using this method, always keep the molecule before you. There are exceptions to the rule of eight and you must be conscious of this when using any method for writing Lewis structures.

* **Practice NASL Method** : Lewis Structures of Covalent Compounds worksheet

Remember: atoms form compounds to create a full \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of valence electrons

(***Example slides***: bonding of hydrogen and oxygen to form water)

**We can use Lewis dot structures to represent covalent compounds!**

1. Add up the valence electrons of \_\_\_\_\_\_\_\_\_\_\_\_\_\_the atoms in the compound.
2. Write the symbols for the elements and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_them with a line(s).
   1. Least electronegative element goes in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (for example: carbon). H is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the outside.
   2. The other elements usually \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the center element.
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2 from the total for each line drawn and arrange the rest of the electrons (dots) in pairs around the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ elements first so that each atom has an octet. (H likes 2. B is happy with \_\_\_\_\_\_\_\_\_\_\_\_.)

4. Check for happiness (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)!

**Example…NH3, Ammonia**

N is in group 5A, so it has \_\_\_\_\_\_\_\_ valence electrons. H is in group 1A, so it has \_\_\_\_\_\_\_\_ valence electron.

The compound NH3 has 1 N and 3 Hs, so 5 + (3 x 1) gives a total of \_\_\_\_\_\_\_ valence electrons for the whole compound.

••

N is surrounded by 8 electrons, and each H has 2 electrons. (Each \_\_\_\_­­­\_\_\_\_\_\_\_\_\_ in the dot structure represents 2 electrons.)

Subtracting 2 from the total for each line drawn:

8 – 6 = 2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

H – N – H H – N – H

H

H

**You try…** HF H2O F2

**Double and Triple Bonds**

* DOUBLE and TRIPLE bonds are formed when atoms share 2 or 3 pairs of electrons to attain a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, noble gas configuration.
* These bonds are represented with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lines in a dot diagram.

**Example: Nitrogen molecule, N2**

1. Count the total number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons, 5 for each nitrogen atom giving a total of 10.
2. Draw the atoms \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a line.
3. Then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2 for each bond (line). 10 – 2 = 8 remaining. Place the 8 remaining electrons in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_around the 2 nitrogen atoms.
4. But, the Ns aren’t happy. They only have \_\_\_\_\_\_\_\_\_ electrons each. What can we do??

We can share \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than one pair.

***Draw the final N2 structure with a triple bond here:***

Now each N has \_\_\_\_\_\_\_ electrons and is happy.

**Let’s try a couple together…** CO2 C2H2

(Show your work.)

**Coordinate Covalent Bonds**

Formed when one atom contributes \_\_\_\_\_\_\_\_\_ bonding electrons so that each atom can achieve a noble gas configuration

To represent this type of bond, we use an arrow going \_\_\_\_\_\_\_\_\_\_\_\_ the donor TO the atom who is receiving the electrons.

Let’s look at the compound \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

O donates a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pair of electrons for sharing, forming a COORDINATE COVALENT BOND and allowing each atom to achieve noble gas configuration.

Draw the final structure for CO here:

Remember to include the arrow.

**Resonance Structures**

Structures that occur when it is possible to write 2 or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_electron dot structures that have the same # of electron pairs for a molecule or an ion.

**Example O3, Ozone**

**Structural Formula Practice**

**Draw the Lewis dot structure for the following compounds with single bonds:**

**1) HBr 2) PCl3 3) H2S**

**4) SCl2 5) PH3 6) CCl2F2**

**Draw the Lewis dot structures for the following compounds with double or triple bonds:**

**1) SO3 2) HCN**

**3) SO2 4) N2**

**Structural Formulas**

|  |  |  |
| --- | --- | --- |
| CS2 | BF3 | NI3 |
| H2Se | Cl2 | C2H4 |

**4 (Unit 5B)**

**VSEPR Theory**

V\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ S\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ E\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ P\_\_\_\_\_\_\_\_\_\_\_\_\_ R\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Definition:** Because electrons repel, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ adjusts so the valence-electron pairs are as far apart as possible.

**Molecular Shape**

The shape of a molecule is determined by 2 factors:

1. The number of atoms bonded to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom.

Double and triple bonds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change the general shape.

2. The number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pairs of electrons on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom.

Unshared pairs of electrons on \_\_\_\_\_\_\_\_\_\_\_\_\_\_ atoms in the compound don't affect the shape.

**VSEPR Theory: Predicts 3D shape of molecules.**

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. \_\_\_\_\_\_\_\_\_\_\_ 3. trigonal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. trigonal\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 6. trigonal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2 Examples of Linear

**Linear**

* 2 atoms bonded to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom
* 0 lone \_\_\_\_\_\_\_\_\_\_\_\_\_ on the ***central*** atom.
* All 2-atom molecules are considered linear.

**Bent**

Example of Bent

* 2 atoms bonded to the central atom
* 1 or 2 lone pairs on the central atom
* Notice that the Lewis structure does \_\_\_\_\_\_\_ have

to show the bent shape.

**Trigonal Planar**

Example of Trigonal Planar

* 3 atoms bonded to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom
* 0 lone pairs on the central atom.
* Since there are no lone pairs on the central atom,

the compound is \_\_\_\_\_\_\_\_\_\_\_\_\_.

Example of Trigonal Pyramidal

**Trigonal Pyramidal**

* 3 atoms bonded to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom
* 1 lone pair on the central atom
* The lone pair on the central atom \_\_\_\_\_\_\_\_\_\_\_\_\_\_

down on the other 3 atoms causing a pyramidal shape.

Example of Tetrahedral

**Tetrahedral**

* 4 atoms bonded to the central atom
* 0 lone pairs on central atom

**Trigonal Bipyramidal**

* \_\_\_\_\_\_\_ atoms bonded to the central atom

Example of Trigonal Bipyramidal

* + An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ octet
  + Possible for p-group elements from \_\_\_\_\_\_ or later periods
* 0 \_\_\_\_\_\_\_ pairs on central atom

**Octahedral**

Example of Octahedral

* \_\_\_\_\_\_\_ atoms bonded to the central atom
  + Also an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ octet
* 0 lone pairs on central atom

**Summary**

|  |  |  |
| --- | --- | --- |
| **Shape** | **# of atoms bound to central atom** | **# of lone pairs on central atom** |
| Linear |  |  |
| Bent |  |  |
| Trigonal Planar |  |  |
| Trigonal Pyramidal |  |  |
| Tetrahedral |  |  |
| Trigonal Bipyramidal |  |  |
| Octahedral |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Chemical Formula** | **Lewis Structure** | **Sketch of Molecule** | **Shape of Molecule** |
| **H2O** |  |  |  |
| **NH3** |  |  |  |
| **CH4** |  |  |  |
| **H2S** |  |  |  |
| **CCl4** |  |  |  |
| **CCl2F2** |  |  |  |
| **N2** |  |  |  |
| **CO2** |  |  |  |

**Bond Types**

**3 Types of Bonds**

Ionic, Polar Covalent (Molecular), & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Molecular)

**Remember Electronegativity?**

The tendency for an atom to attract electrons to itself in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The higher the value, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ it is at attracting electrons.

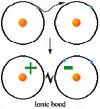
The difference b/w electronegativity values determines what type of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ will be formed.

Electronegativity is a scale from \_\_\_\_\_\_\_\_\_\_, Cs, to \_\_\_\_\_\_\_\_\_\_, F.

It generally \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ across a period and decreases \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a group.

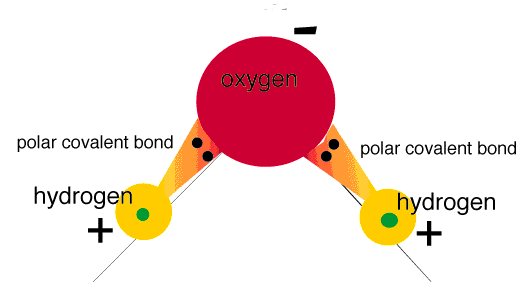
Why don’t noble gases have a value? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Ionic Bonds**

* If the electronegativity difference is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, one atom will pull the electron completely \_\_\_\_\_\_\_\_\_\_\_\_\_\_ from the other atom.
* The electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ shared.
* An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond is formed as + and – attract.
* Electronegativity of Na is \_\_\_\_\_\_\_\_\_\_\_\_\_; Cl is \_\_\_\_\_\_\_\_\_\_\_\_\_.
* 3.0 – 0.9 = 2.1; difference \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, so…Ionic.

**Polar Covalent Bonds**

* Covalent bonds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons.
* The shared pairs are pulled, similar to a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, between the nuclei of the atoms sharing the electrons.
* If the electronegativity difference is between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, one side of the bond becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_more negative and the other side becomes slightly more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



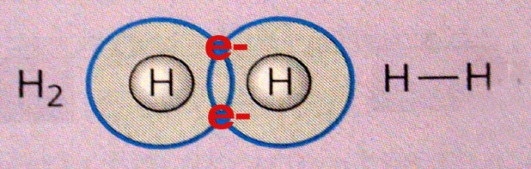
**Oxygen**

* This is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond.
* The electronegativity of H is \_\_\_\_\_\_\_\_\_\_\_; Cl is \_\_\_\_\_\_\_\_\_\_\_\_
  + 3.0 – 2.1 = \_\_\_\_\_\_\_\_\_\_; difference is b/w 0.4 – 2.0,

so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent.

* The electronegativity of O is \_\_\_\_\_\_\_\_\_\_\_\_; H is\_\_\_\_\_\_\_\_\_\_\_\_\_
  + 3.5 – 2.1 = \_\_\_\_\_\_\_\_; difference is b/w 0.4 – 2.0, so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent.

**Nonpolar Covalent Bonds**

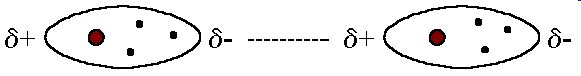
* When the atoms have equal pull, causing the electrons to be equally shared, the bond is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent.
* Neither side of the bond is even slightly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or negative.
* The electronegativity difference is b/w \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* This is the type of bond that occurs between 2 atoms of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ element. (H2, O2, Cl2, etc.)
* The electronegativity of H is 2.1.
  + 2.1 – 2.1 = \_\_\_\_\_\_\_\_\_; difference is b/w 0.0 – 0.4, so \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covalent.

**Attractions *Between* Molecules: Van der Waals Forces**

* Weaker than either the ionic or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bonds that form between atoms in a compound.

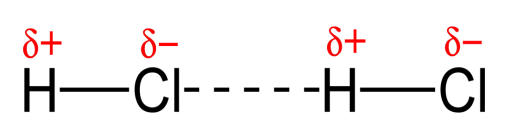
Responsible for determining if a compound is a liquid, gas, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* 3 basic types from weakest to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + (London) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ forces
  + Dipole \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**London Dispersion Forces**

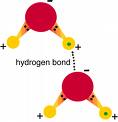
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of all molecular attractions
* Caused by the motion of electrons producing a temporary \_\_\_\_\_\_\_\_\_\_\_\_
* Strength of dispersion forces generally increases as # of electrons in the molecule \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_ molecules have these weak attractions

****

**Dipole Interaction**

Occurs when \_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules are attracted to one another.

**Hydrogen Bonds**

* Occurs b/w molecules in which H is covalently bonded to O, N, or \_\_\_\_\_\_\_\_ which are very electronegative
  + Causes \_\_\_\_\_\_\_\_\_\_ polar molecules that are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ attracted to each other
  + Still only has about \_\_\_\_\_\_\_\_\_\_ of the strength of a covalent bond
* Very Important
  + Reason ice is less \_\_\_\_\_\_\_\_\_\_\_\_ than water
  + Reason for the relatively \_\_\_\_\_\_\_\_\_\_\_\_ b.p. of water
  + Responsible for the double helix of the \_\_\_\_\_\_\_\_\_ molecule.

**Nonpolar or Polar Molecules**

* We now know how to determine if the bond b/w atom and atom in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is polar or nonpolar.
* But…what about the whole \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_?

Draw the Lewis \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If the central atom has any unshared pairs, the molecule is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

If there are no unshared pairs on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ atom, look at the atoms around the central atom.

If they are all the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the molecule is nonpolar.

If any one of them is different, the molecule is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(In a 2-atom molecule, if the bond between the 2 atoms is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, then the whole molecule is polar.)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Dot Structure** | **Polar / Nonpolar** |  | **Dot Structure** | **Polar / Nonpolar** |
| **H20** |  |  | **HCN** |  |  |
| **CO2** |  |  | **N2** |  |  |
| **HCl** |  |  | **CH3Cl** |  |  |

**Polarity**

* **Involves sharing electrons (to get an octet = 8 valence e-s)**
* **equal sharing = nonpolar - no charge**; this occurs when both elements have the same **electronegativity (the attraction to an electron)** so this occurs when there is a bond between **2 of the same nonmetal** for example N2 – both N have an equal pull on the shared electron pair – so there is **no partial charge**.
* **unequal sharing = polar – slight charges**; this occurs when the two elements have different electronegativities ie you have **two different nonmetals** in a covalent bond; the more electronegative element (the one further to the right and up on the PT) pulls more on the shared electrons and has a slightly negative charge – the other element will be slightly positive.

**Ex**: Classify the following as polar or nonpolar bonds: HCl, I2

**You try**: classify as polar or nonpolar: F2, NO

**\*** There are some special molecular cmpds – called **network solids (or network crystals)** that contain extensive covalent bonding throughout a network of atoms. These compounds are very hard and brittle and have very high melting points **ex: graphite and diamonds** These are the strongest bonds!

**Polarity Practice**

Draw the Lewis Structure.

* If the central atom has any unshared pairs, the molecule is polar.
* If there are no unshared pairs on the central atom, look at the atoms around the central atom.
  + If they are all the same, the molecule is nonpolar.
  + If any one of them is different, the molecule is polar.
* In a 2-atom molecule, if the bond between the 2 atoms is polar (electronegativity difference is greater than 0.4), then the whole molecule is considered polar.

Remember, a molecule with more than 2 atoms can have polar bonds between its atoms (based on differences in electronegativity) and still be an overall nonpolar molecule.

|  |  |  |  |
| --- | --- | --- | --- |
| **Molecule** | **Lewis Structure** | **Geometry**  **(Shape Name)** | **Polar / Nonpolar** |
| **H2** |  |  |  |
| **BH3** |  |  |  |
| **N2** |  |  |  |
| **SO2** |  |  |  |
| **NH3** |  |  |  |
| **CO2** |  |  |  |
| **CO** |  |  |  |

**BOND STRENGTHS:**

* **Ionic:** Generally the strongest bond type = the larger the ion charges the stronger the ionic bond ie Calcium Chloride, CaCl2 is stronger than potassium chloride KCl because Ca has 2+ charge involves 2 e- transferring and K has a 1+; only 1 e- transferring
* **Metallic:** medium strength between ionic and covalent
* **Covalent**: Weakest bond type- (exception network solids like diamonds- strongest bond type)

**Ex problem**: Classify the following from strongest to weakest bond:

Copper wire, carbon dioxide, lithium chloride (LiCl) and aluminum nitride (Al3N2).

**You try**: Rank the following from strongest to weakest bond:

Water, potassium iodide (KI), pure gold necklace, and calcium fluoride (CaF2)

**Review Sheet & Naming Practice**

**Lewis Dot Structures**

**1.** Write the symbols for the elements and connect them with a line. H is always on the outside. The other elements usually surround the center one.

**2.** Add up the valence electrons of all atoms in the compound. Subtract 2 for each line drawn.

**3.** Arrange the remaining electrons in pairs around the outer elements first so that each atom has an octet. (H likes 2. B is happy with 6.)

**4.** Check for happiness (stability)!

**5.** Change unshared pairs of electrons into extra bonds if necessary.

**VSEPR Shapes**

|  |  |  |
| --- | --- | --- |
| **Shape** | **Atoms Bound to Central Atom** | **Unshared Pairs on Central Atom** |
| Linear | 2 | 0 |
| Bent | 2 | 1 or 2 |
| Trigonal Planar | 3 | 0 |
| Trigonal Pyramidal | 3 | 1 |
| Tetrahedral | 4 | 0 |
| Trigonal Bipyramidal | 5 | 0 |
| Octahedral | 6 | 0 |

**Polar or Nonpolar Bonds**

|  |  |
| --- | --- |
| **Type of Bond** | **Difference in Electronegativity Values** |
| Nonpolar Covalent (Molecular) | 0.0 – 0.4 |
| Polar Covalent (Molecular) | 0.5 – 2.0 |
| Ionic | Greater than 2.0 |

**Polar or Nonpolar Molecule**

**1.** Draw the Lewis Structure.

**2.** If the central atom has any unshared pairs, the molecule is polar.

**3.** If there are no unshared pairs on the central atom, look at the atoms around the central atom.

a. If they are all the same, the molecule is nonpolar.

b. If any one of them is different, the molecule is polar.

**4.** In a 2-atom molecule, if the bond between the 2 atoms is polar (electronegativity difference is greater than 0.4) then the whole molecule is considered polar.

**Naming Molecular Compounds**

* First, is the compound molecular?
  + If the first element is a nonmetal, then the compound is molecular.

**1- mono**

**2- di**

**3- tri**

**4- tetra**

**5- penta**

**6- hexa**

**7- hepta**

**8- octa**

**9- nona**

**10- deca**

* DO NOT USE CHARGES!!! DO NOT SIMPLIFY!!!
* Use PREFIXES to show how many of both elements!
* Don’t write mono- on first element.
* First element keeps its name; 2nd element ends in –ide.

**Bonding Basics Review**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element** | **Atomic symbol** | **Total # of Electrons** | **# of Valence Electrons** | **# of Electrons Gained or Lost** | **Oxidation Number (charge)** |
| Bromine |  |  |  |  |  |
| Lithium |  |  |  |  |  |
| Calcium |  |  |  |  |  |
| Sulfur |  |  |  |  |  |
| Boron |  |  |  |  |  |
| Silicon |  |  |  |  |  |
| Phosphorus |  |  |  |  |  |

**2. Ionic Bonds - Draw the Lewis dot diagrams for each atom, draw arrows to show the transfer of electrons, write the charge for each ion, and then write the chemical formula. We will do A together!**

(A) Potassium + sulfur

(B) Magnesium + Oxygen

(C) Lithium + Nitrogen

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

(A) Fluorine + Fluorine

(B) 3 Hydrogen + 1 Phosphorus

(C) 2 Hydrogen + 1 Sulfur

**Properties of ionic, covalent and metallic bonds:**

**Strongest bond type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ remember this involves a transfer of electrons.**

Because this is the strongest bond type: ionic compounds tend to have:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ melting points and boiling points (it takes more energy for these compounds to change states of matter).

Are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - they will break down into ions in water and will **conduct an electric current**.

Ionic compounds tend to be brittle.

**Weakest bond type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ remember this involves sharing electrons.**

Because this is the weakest bond type: covalent bonds tend to have:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ melting points and boiling points (it requires less energy for these compounds to change states of matter).

Are \_\_\_\_\_\_\_\_\_\_\_\_\_\_ - they will not conduct an electric current in water.

Covalent bonds may be polar (unequal sharing – partial charges) or nonpolar (equal sharing – no charges).

**Review on Bonding**

|  |  |  |  |
| --- | --- | --- | --- |
| Bond Type  Fill in the table to the right. | Type of atoms | One Property | One example |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

2. Explain why the oxidation number of Magnesium is 2+ in ionic compounds (It is recommended you use an electron configuration diagram in your explanation)

For the following use: C) Covalent Bond I) Ionic Bond M) Metallic Bond

3. KBr

4. Copper wire

5. NaCl

6. NH3

7. Br2

8. Which of the above would have the highest boiling point(s)?

9. Which of the above have the weakest bonds?

10. which of the above is soluble in water?

11. Which of the above is nonpolar covalent?

12. Which of the above is polar covalent?

13. Which of the above would be malleable and ductile?

**Unit 5 Problem Set**

***Review Questions:***

1. We are taking a class field trip to Europe to practice the factor-label conversion method. For each question show your work and include all units.
2. You are filling out the passport application using a pencil containing lead 0.7 mm in diameter. What is the diameter in cm?

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

1. The class is flying from GSO to London. If the trip is 3200 miles, what is the distance in km?

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

1. In meters?

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

1. Identify the following bond types: (ionic, covalent or metallic)
2. CaCl2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ c. H2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. gold necklace \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. List the above in order of strongest bond to weakest bond:

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

(strongest) (weakest)

1. Identify the family (name not number), period and metal/non-metal for the following elements:

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Family name | Valence Electrons | Metal, nonmetal, metalloid |
| Ca |  |  |  |
| O |  |  |  |
| He |  |  |  |
| As |  |  |  |
| F |  |  |  |

1. Comparing radio waves, IR and UV light which:
2. Has the longest wavelength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Has the highest frequency \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Has the lowest amount of energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. Is the produced when an electron jumps from n = 5 to n = 4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write the symbol for the following elements:
2. An atom with 33 protons and 33 electrons \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. An atom with 33 protons and 36 electrons \_\_\_\_\_\_\_\_\_\_\_\_\_
4. An atom with 33 protons, 33 electrons and 44 neutrons\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Write the letter (A, B or C) for the above atom that represents an ion \_\_\_\_\_\_\_\_\_\_\_\_
6. Write the letter (A, B or C) for the above atom that represents an isotope \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
7. Draw Lewis dot diagrams and show the transfer of electrons when strontium and chlorine atoms combine in an ionic compound – **write the formula for the compound formed and name the compound**.
8. What is the wavelength and energy type when a Hydrogen atom jumps from n = 5 to n = 3?

Is Energy released or absorbed?

Wavelength:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Energy type:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

E released or absorbed:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Describe the 3 intermolecular forces (IMFs), include their relative strengths. (Be specific!)
2. Why would sugar (C12H22O11) melt before salt (NaCl)?
3. Write the Lewis Structures for each of the following, identify the shape of the molecule and identify as polar or nonpolar. **(Show all work to receive full credit!)**
4. water c. sulfur hexoxide
5. ammonia d. boron trihydride