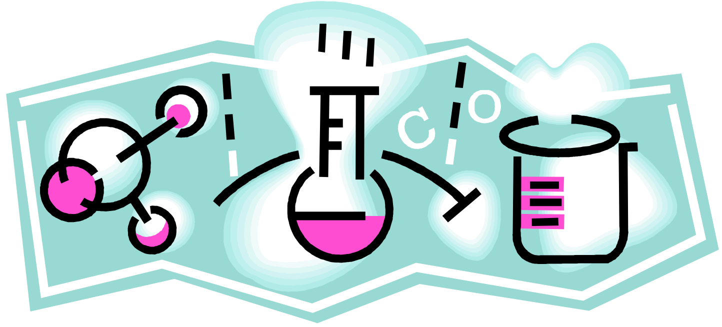
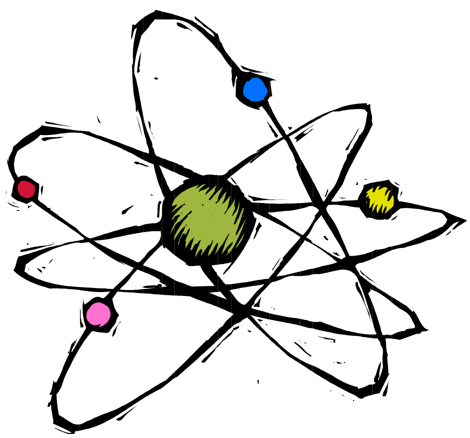
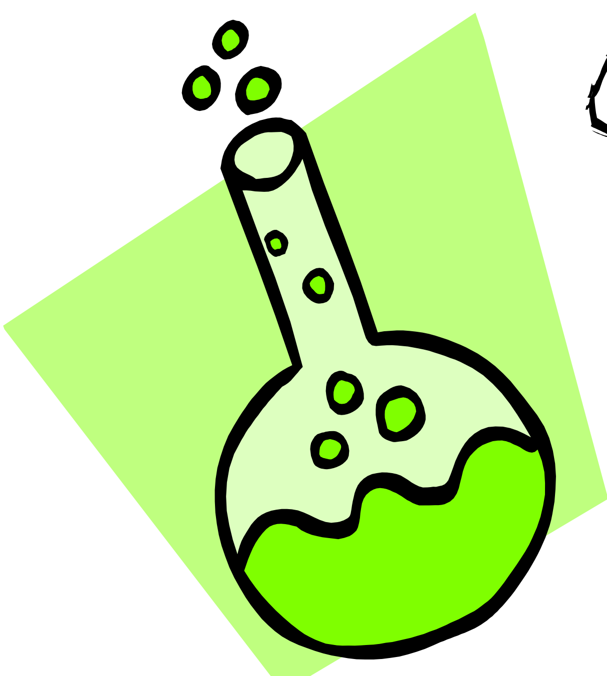
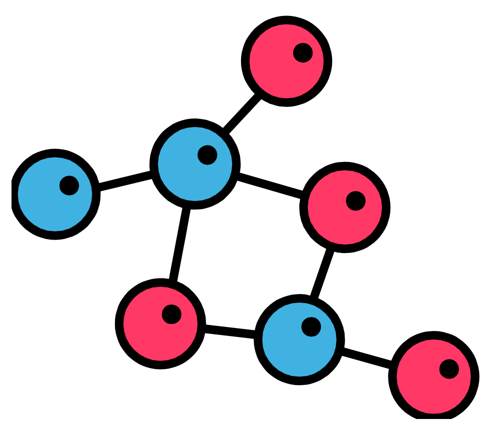


Materials Science







Chemistry Intro

What is chemistry?

- Chemistry is the study of the composition and properties of ___________________.
- Matter has two general properties; it occupies ___________________ and has ___________________.

Why study chemistry?

- Chemistry can help to explain how things work.
- Chemistry may help you in your future career. Even if you are not planning on being a chemist, many jobs require a basic understanding of chemistry.
- Chemistry can help you to be an informed citizen. Knowledge of chemistry can help you to evaluate data, arrive at an informed opinion and take appropriate action.

Boat Challenge Assignment

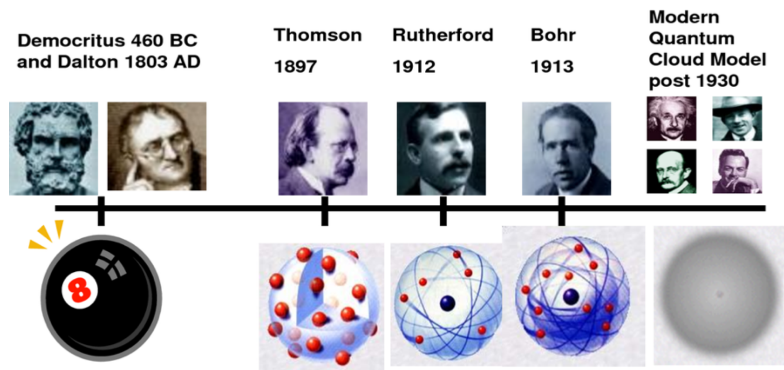
The Scientific Method:

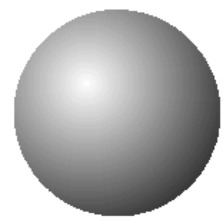
- Scientific method is the process that scientists follow in order to perform __________________ to investigate the world around them.
- The scientific method:
    - Gather information through __________________
    - Define the __________________
    - Create a __________________
    - __________________ an experiment to test the hypothesis
    - __________________ and observe the experiment
    - __________________ data from experiment
    - Modify of create new __________________

Boat Challenge Assignment

Model of the Atom

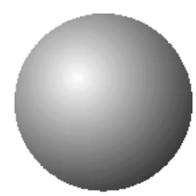
http://thehistoryoftheatom.weebly.com/





Democritus (400 B.C.)

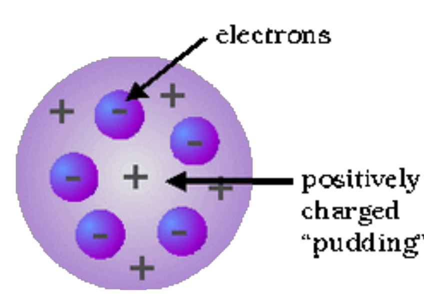
____
Lived from: 460-370 BC
Put forward atomic model in: 442 BC
Description of his model:



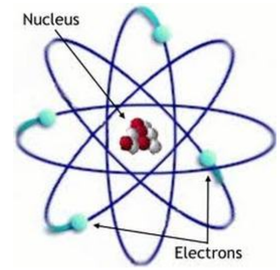
Dalton 1803-1805

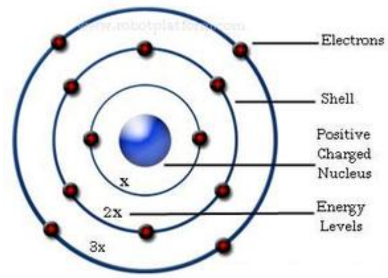
____
Lived from: 1766-1844
Put forward atomic model in: 1803
Nickname for his model: ____________________________Model
Description of his model:

J.J. ____________________
Lived from: December 18, 1856 - August 30, 1940.
Put forward atomic model in: 1904
Nickname for his model: ______________________________________
Model (or Raisin Bread Model)
Description of his model:

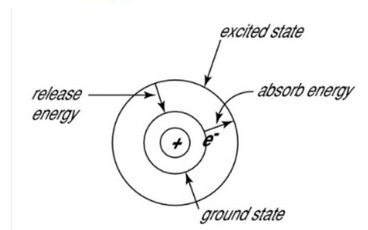


LORD ERNEST ____________________
Lived from: 1871- 1937
Put forward atomic model in: 1911
Nickname for his model: ____________________ Model
Description of his model:

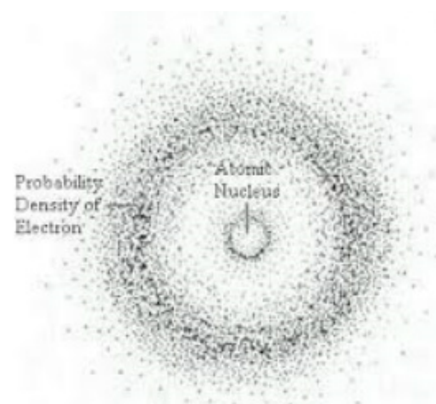




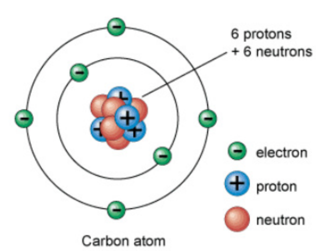
NIELS ____________________
Lived from: 1885 to 1962
Put forward atomic model in: 1913
Nickname for his model: _________________________Model
Description of his model:



MODERN THEORY: QUANTUM MECHANICAL MODEL
Description of this model:



Erwin ___________________________
Date: 1926
Quick summary



JAMES ____________________
Date: 1932
Quick Summary:

See History of the atom & periodic table assignment (Q1 & 2)

About the Periodic Table

What is the periodic table?

- A way to organize ___________________
- Contains all elements ever discovered or ___________________

Development of the Periodic Table:

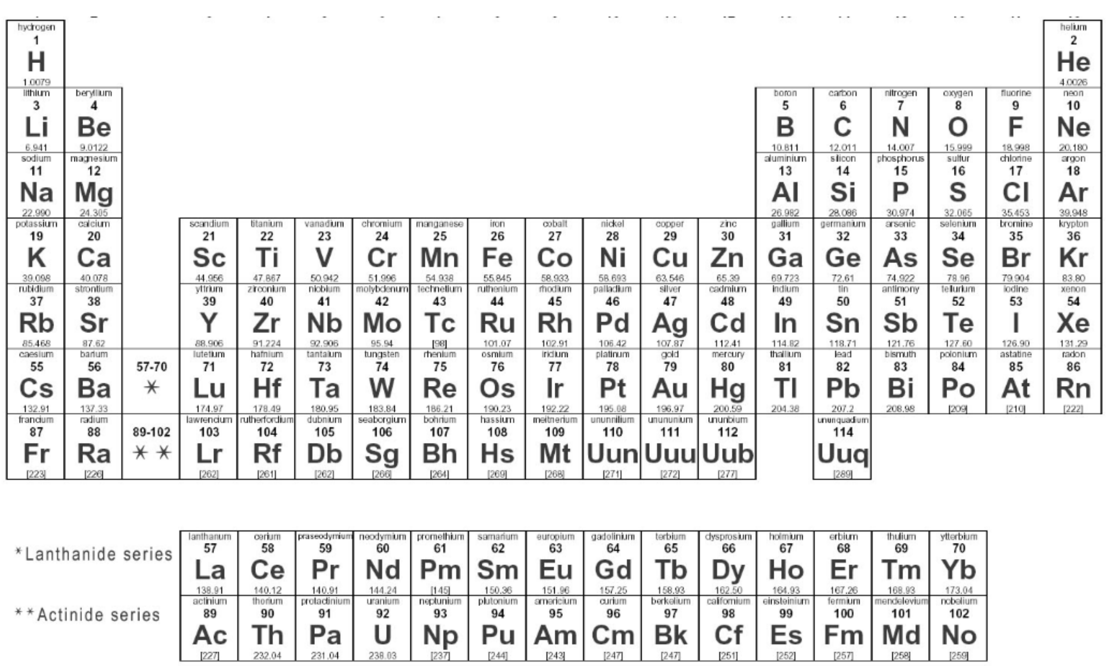
- The periodic table was developed by _______________ ____________________ (Russian Chemist). He recognized trends in properties of elements when organized by __________________________.
- He used these ____________________ to organize the periodic table.
- He was then able to use the periodic table to ____________________ the properties of elements that had not yet been discovered or created.

How is the periodic table organized?

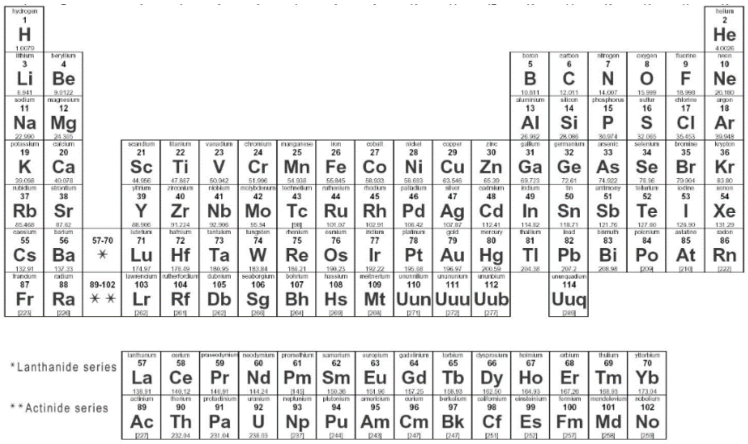
- The periodic table is organized by increasing ____________________ number.
- It is organized into families and periods. ____________________ are the horizontal rows of the periodic table, and ____________________ (or groups) are the vertical rows of the periodic table. Most elements in a family have similar ____________________.

Label the periodic table

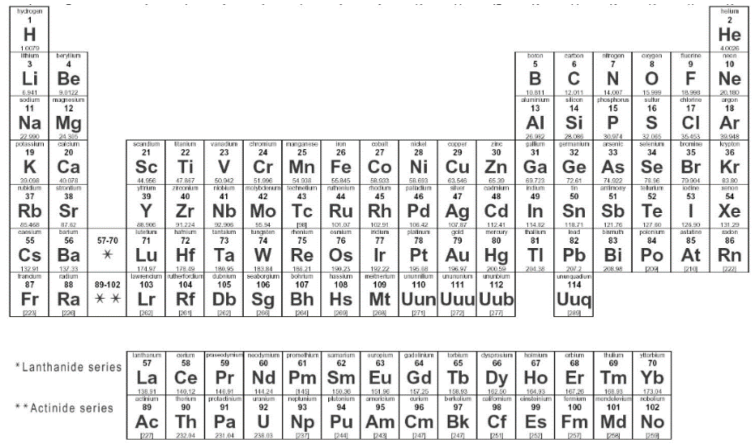
Periods and Groups & diatomic elements (elements found in pairs in nature):



Metals, Non Metals Metalloids:



Solids Liquids and Gases (@ room temp):



Valence Electrons

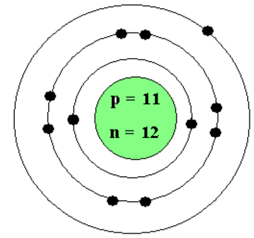
What are they?

- Valence electrons are those that are in the ____________________ electron shell (valence shell) of an atom. The valence shells are the outermost s and p orbitals. The outermost s and p orbitals are the highest ____________________ orbitals of an atom.
- Valence electrons determine how an element ____________________ with other elements.
  - The ____________________ valence electrons an atom has, the less stable it is and the more likely it is to react.
  - The ____________________ valence electrons an atom has, the more stable it is and the less likely it is to react. Something that is unlikely to react is called ____________________.

Octet Rule:

- The most valence electrons an atom can have is 8, because that is a full valence (2 electrons in the s orbital, 6 electrons in the p orbital). All atoms would like to have 8 valence electrons because then they are stable. This is called the ____________________ rule (or the rule of 8).
  - Exceptions:
    - Hydrogen and helium can only have 2 electrons in their valence shell (1s).
    - ____________________ metals (+ a few others) are also exceptions because orbitals can hybridize. We will not be learning about hybridized orbitals in this course.

NOTE: 8 valence electrons and 0 valence electrons both make for stable atoms because with 0 valence electrons, they essentially do have 8 because the next valence shell below the one that was emptied is full…



Easy Way to Determine Number of Valence Electrons:

- Group 1 has ____ valence electron, group 2 has ____ valence electrons, groups 3 to 12 are transition metals so we don't need to determine the number of valence electrons they have, group 13 has ____ valence electrons, group 14 has ____ valence electrons, group 15 has ____ electrons, group 16 has ____ electrons, group 17 has _____ electrons, group 18 has ____ electrons.

Lewis dot diagrams

- *Electron-dot formula* method or ____________________ *Formula* method is used to represent the number of ____________________ in the valence shell.
    1. The core is represented by the ___________________ for the element; valence electrons are represented by ___________________.
    2. The symbol is assumed to have ___________________ sides and the valence electrons are distributed around the sides.
    3. When we distribute valence electrons, we first place ___________________ dot on each of the four sides before we locate ___________________ of electrons on any one side. Usually no more than ___________________ electrons can be placed on any one side.

Examples:

calcium **selenium** **bromine**

Finish Assign 1 & Valence Electrons, Ions & Lewis dot Assignment (columns 1 & 4)

Intramolecular Forces

- Intra" is latin for "____________________".
- Intramolecular forces are forces **within** a molecule or compound holding it ____________________.
- Atoms want to have a ______________ valence shell, because then they will be stable. Atoms can fill or empty their valence shell by sharing, gaining or losing ______________.
- There are three types of intramolecular forces we will discuss: metallic bonding, ___________________ bonding and covalent bonding.

1. Metallic Bonds

Formation of metallic bonds

- Metals are made up of ____________________ with loosely held valence electrons.
- The valence electrons of a pure metal can be modeled as a "__________" of electrons.
- The electrons are able to ______________ freely from one part of the metal to another.
- Metallic bonds are the forces of attraction between free floating valence electrons and the positively charged metal ions.

Properties of Metals:

- The "sea of electrons" can help to explain the properties of metals.
- Good conductors of electricity
  - because charges (electrons) can ___________________________in the metal.
- Metals are ductile (can be drawn into wires) and malleable (bendable/moldable)
  - because the metal cations are surrounded by electrons ("sea") so when force is applied, the electrons act as a ______________________ or insulator preventing the positively charged ions from getting too close. This means protons will not repel to cause breaking but rather move and glide ______________________ one another allowing the metal to ______________________.
- Metals form crystalline structures
  - because they are made of ____ which naturally like to have a close packed arrangement (similar to how fruit stacks at the grocery store).

Alloys

- Alloys are a mixture of two or more ______________________ where at least one of those elements is a ______________________.
- Alloys often have ______________________ properties than the metals that make them up
- Ex. Sterling silver (92.5% silver and 7.5% copper) is ______________________ and ____than pure silver, but still soft enough to make jewelry or silverware.
- Steels are important alloys with a wide range of useful properties such as ______________________ ____.

2. Ionic Bonding

- One way an atom will ____it's valence shell is through ionic bonding (creating ions)
- Ionic bonding occurs when a ______________________ bonds with a ________________________
- Ionic bonding occurs when there is a complete ______________________ of one or more electrons from one atom to another.
- You can predict the ______________________ of the ion created through ionic bonding based on the number of valence electrons it contains. (**remember electrons are negatively charged)**

Element	Number of Valence e-	e- gain/lose to fill octet	Charge with full valence
Oxygen			
Sodium			
Hydrogen			

Formation of Ions:

- When an atom loses or gains electrons it forms an_____________(this is ionic bonding).
- An ion is an atom or group of atoms with an overall ____.
- Usually atoms on the left of the staircase (metals) ____________________ electrons, forming ____________________ with a ____________________charge.
- Atoms on the right of the staircase (non-metals) tend to ____________________ electrons, forming ____________________ with a ____________________ charge.
- The cations and anions combine together in a ratio that ____________________ their charge
- Since cations and anions have opposite charges, they are ________________________ each other. This attraction, called electrostatic force, holds them together in an ionic bond.
- An atom and an ion are very different.
  - Example: **Table** Some differences in chemical and physical properties for sodium ion and sodium atom.

Property	**Na atom**	**Na^+ ion**
charge		
pure form		
reaction with water		
conductivity		

Elements with multiple ionic charges:

- ____________________ elements are ones that can form more than one stable ion. Most ____________________ metals are multivalent.
- Multivalent elements are ones that occur on your common ion sheet ____ (ex. Copper, iron, tin)
- When naming elements containing these compounds we use ____________________ __________________to distinguish which ion is used.

Polyatomic ions:

- ____.
- Polyatomic ions often have complicated sounding names which makes them seem dangerous or synthetic but many poyatomic ions occur naturally.

Lewis Dot diagrams for ions

1. Determine the number of ____________________ the ion has (look at how many the neutral atom would have and how many electrons were gained or lost based on the charge).
2. Draw your lewis dot structure
3. Place ____ around the diagram with the charge outside the bracket in the top right corner.

Examples:

K + As^{3-}

Valence Electron, Ions & Lewis dot Assignment (complete all columns)

Lewis dot for the Formation of Ionic Bonds:

- Example: Sodium Chloride
  - Sodium has 1 valence electron and would like to lose one, chloride has 7 valence electrons and would like to gain one, so an ionic bond will occur where one sodium atom will give it's valence electron to a chlorine, making the sodium have a +1 charge and chlorine/chloride have a -1 charge. Since the atoms are now a cation and an anion, they are attracted to one another.
  - Lewis drawing:
- Not all ionic compounds are created from cations and anions with a 1:1 ratio.
- Example: Aluminum Bromide
  - Lewis Drawing:

See Ionic Compound Lewis Assignment

RECALL FROM PREVIOUS STUDIES

CHEMICAL FORMULA:

- To determine the chemical formula of a compound you look at charges and determine what the lowest number ratio the cation and anion could pair up in to cancel their charges.
- Remember subscripted numbers indicate the number of atoms/ions present.
- The cation should always be written first followed by the anion.
    - Ex: Aluminum sulfide
- If a compound contains a polyatomic ion where more than one is present, parenthesis are used to indicate how many polyatomic ions there are.
    - Ex. Calcium phosphate
- If using criss cross method, remember to always reduce. Ionic compounds are written as formula units which is the whole number ratio of ions.
    - Ex. Barium sulfate

NAMING:

- To name a binary ionic compound simply write the name of the metal and then the name of the nonmetal with and "ide" ending (subscripted numbers do not need to be included in the name as long as there is only one possible charge).
    - Ex. $MgBr_2$
- To name ions containing a polyatomic ion, simply write the name of the cation and then the name of the anion (do not need to change the endings).
    - Ex. Na_3PO_4
- If you are naming a compound with a multivalent element, use roman numerals to indicate which ion is present.
    - Ex. $FePO_4$

https://www.youtube.com/watch?v=U7wavimfNFE

Structure of Ionic Compounds:

- Looking at the structure of ionic compounds can help us to understand their ____________________
- Ionic compounds form rigid arrangements of ions called a ____
- Different sized ions pack together to form different ____________________ crystals
- An ionic compound contains a huge number of positive and negative ions in a fixed ratio (____).

Properties:

- ____solids at room temperature
    - because their bonds resist being stretched
- ____________________ melting and boiling points
    - because they are held together by strong electrostatic forces (ionic bonds)
- Crystals made of ionic compounds can be easily ____________________
    - because when an outside force strikes a crystal it can offset the lattice making positively charged particles sit next to other positively charged particles. Since positives repel one another the crystal breaks.
- Conduct electricity when _________________ (molten) but not as __________________.
    - When molten the ions are able to move around and carry charges (conduct electricity).
- Conduct electricity when ____.
    - When dissolved in water, water pulls the ions out of the crystalline lattice. Since they are then able to move about freely, they can then carry a charge and conduct electricity.

3. Covalent Bonds

- Another way for atoms to fill their valence shell is through _________________________
- Covalent bonding occurs between a ____________________and a __________________.
- Covalent bonding occurs when electrons are _________________ between two atoms.
- Covalent bonds can occur as single, double or triple bonds
    - Single bonds occur when _______________ pair of electrons is shared between two atoms (each atom donating 1 electron to share)
    - Double bonds occur when _______________ pairs of electron are shared between two atoms (each atom donating two electrons to share)
    - Triple bonds occur when _______________ pairs of electrons are shared between two atoms (each atom donating three electrons to share)
- You can predict the number of covalent bonds needed based on the number of valence electrons an atom contains. (**remember electrons are negatively charged)**

Element	**Number of Valence e-**	**e- needed to fill octet**	**Possible bonds created**
Oxygen			
Nitrogen			
Carbon			

Molecules and Molecular Compounds

- A molecule is a neutral group of atoms _____________________ together through covalent bonds.
- Noble gases have full valence shells naturally so they are the only _____________________ elements.
- There are 7 diatomic elements that occur in pairs in nature: ____.
- Determining the chemical formula of a molecule is more difficult than with an ionic compound because there can be ________________________________ compounds possible for the same two elements depending on the types of bonds that form.
- Unlike ionic compounds, covalent molecules molecular formula is not ______________________ to the lowest ratio. It represents the exact number of atoms that combine to form exactly one molecule.

Lewis Dot for the Formation or Molecular Compounds

- When given the chemical formula, you can use lewis dot structures to represent the bonding and show the structural formula for a molecule.
- Start by drawing out the lewis dot for each of the atoms involved. Then determine where the electrons will share in order for all atoms to bond together
- If you have a chemical formula where there is one atom of one element and several atoms of a different element, usually the element with one atom is in the middle surrounded by the others.
    - Ex: F_2

    - Ex. HCN

    - Ex. NH_3 Notice that an unshared pair can affect the shape of the molecule.

See Covalent Bonding Lewis Dot Assignment

RECALL FROM PREVIOUS STUDIES

NAMING MOLECULES:

- **Binary compounds**: These are compounds that contain only ______________________. When naming binary compounds we use ______________________ to indicate the amount of each element present.

1	2	3	4	5	6	7	8	9	10
Mono*	di	tri	tetra	penta	hexa	hepta	octa	nona	deca

*Mono is only used for the second element in a compound.

Ex. CO_2 P_4O_{10} CF_4

CHEMICAL FORMULA:

Use the prefix to determine the number of each element and then write it down:

Dinitrogen trioxide

Diphosphorus pentoxide

Electronegativity:

- Electronegativity is the ability of an atom to ______________________ electrons to it when bonded
- The electronegativity scale was created by ______________________________________in 1922 to help develop a better understanding of chemical bonds
- We can compare electronegativity values between atoms to determine the type of ______________________ that will form between them.
- An element with a _______________ electronegativity value is really good at attracting electrons and an element with a low electronegativity is not.
- In general, electronegativity ______________________ as you move from left to right across the periodic table and ______________________ as you move from top to bottom.

Electronegativity difference	Most probable bond type
0.0-0.4	Nonpolar covalent
0.4-1.0	Moderately polar covalent
1.0-1.7(ish)	Very polar covalent
>1.7	ionic

Electronegativity values of the elements (Pauling scale)

H 2.1																	He
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0	Ne
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0	Ar
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8	Kr 3.0
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5	Xe 2.6
Cs 0.7	Ba 0.9	La 1.1	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2	Rn 2.4
Fr 0.7	Ra 0.7	Ac 1.1															

Ce 1.1	Pr 1.1	Nd 1.1	Pm 1.1	Sm 1.1	Eu 1.1	Gd 1.1	Tb 1.1	Dy 1.1	Ho 1.1	Er 1.1	Tm 1.1	Yb 1.1	Lu 1.2
Th 1.3	Pa 1.5	U 1.7	Np 1.3	Pu 1.3	Am 1.3	Cm 1.3	Bk 1.3	Cf 1.3	Es 1.3	Fm 1.3	Md 1.3	No 1.3	Lr

Non Polar Bonds

- If both atoms have an equal (or approximately equal) _______________ on the electrons (same electronegativity), the bond is considered to be non-polar.
- Diatomic molecules are non-polar because they are made up of two atoms of ______________________ element with the same electronegativity and therefore both atoms have equal pull on electrons.
- Ex. Cl_2

  Electronegativity difference:

Polar Bonds

- When two covalently bonded atoms have a significant electronegativity difference (between 0.4 and 1.7) the electrons are shared ______________________.
- The atom with the higher electronegativity attracts electrons ________________________ and therefore gains a slightly ______________________ charge. The atom with the lower electronegativity gains a slightly ______________________ charge.
- The slightly positive and slightly negative parts of the molecule are called poles. Because polar covalent molecules contain a positive pole and a negative pole, they are called ______________________.
- Ex. HCl

  Electronegativity difference

- Since many molecules have more than one bond we have to consider ________________________ in a molecule to determine polarity.
- The shape of a molecule determines the polarity of the molecule. If the molecule contains polar bonds and the shape is ______________________ the molecule will be non polar. If there is ______________________ the molecule could be polar.

- Ex. CO_2 vs H_2O

See Polarity Assignment

VSEPR

What do the molecules really look like?

Next we will look at what a molecule looks like in 3 dimensional space. We use molecular __________________________and VSEPR Theory. VSEPR stands for ____. The VSEPR theory determines the __________________________ of a molecule by looking at the electrons surrounding the central atom and whether they are shared pairs of lone pairs (bonding or non-bonding pairs).

Determine Molecular geometry using VSEPR:

1. Determine the lewis dot formula
2. Determine the total number of electron pairs around the central atom
3. Use the table provided to determine the electron pair geometry
4. Use the table provided to determine the shape
5. Use the diagram chart to draw a 3D diagram

VSEPR Chart			
Total pairs of e^- around central atom	**Number of bonded pairs**	**Electron Pair geometry**	**Molecular geometry**
2	2	Linear	Linear
3	2	Trigonal Planar	Bent
3	3	Trigonal Planar	Trigonal Planar
4	2	Tetrahedral	Bent
4	3	Tetrahedral	Trigonal Pyramidal
4	4	Tetrahedral	Tetrahedral
5	2	Trigonal Bipyramidal	Linear
5	3	Trigonal Bipyramidal	T-Shaped
5	4	Trigonal Bipyramidal	Seesaw
5	5	Trigonal Bipyramidal	Trigonal Bipyramidal

6	2	Octahedral	Linear
6	3	Octahedral	T-Shaped
6	4	Octahedral	Square Planar
6	5	Octahedral	Square Pyramidal
6	6	Octahedral	Octahedral

VSEPR Geometry 3D diagrams:


Going into the page

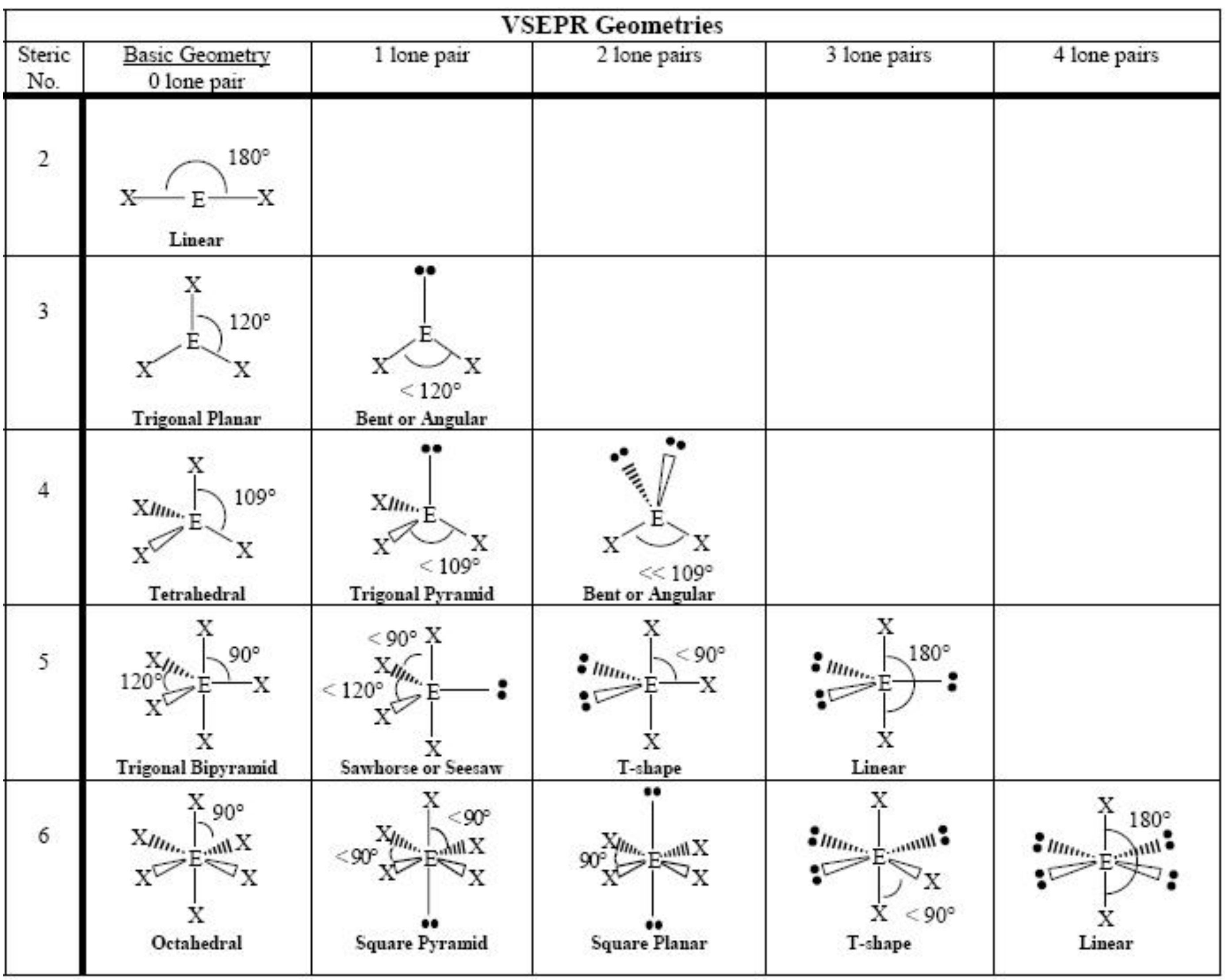

Coming out of the page

In plane with the page

E = Central Atom

X =Bonded Atom

• • = Unbonded pair of electrons

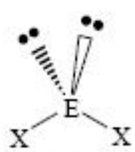


Examples:

OF_2

Oxygen has ______ pairs of electrons around it, ______ are bonded ______ are lone, so it has a geometry of ____.

The 3D drawing for tetrahedral bent is:



So you just need to fill in the atoms where they belong:

PCl_3

PCl_3 has ______ pairs of electrons around it, ______ of the pairs are bonded. This means that PCl_3 has a geometry of ____.

Sometimes in a double or triple bond you have to assume that the atom has only one shared pair of electrons in order to get the proper geometry.

CS_2

Even though this actually has ________ shared pairs of electrons and all are bonding electrons, the shape is linear. In this molecule we pretend that Carbon has ______ pairs of electrons and both are bonded.

Molecules that Break the Octet Rule:

Normally assume that atoms want to have _____ valence electrons, however sometimes atoms like to have more. In situations like this we say that the atom _________________________ the octet rule. In this class you will always be told if an element breaks the octet rule.

XeF_4

Xe has _____ valence electron and Fluorine has _______,

This molecule has _______ pairs of electrons around it, and _______ of them are involved in bonds so it's geometry is ____.

3D drawing:

Balloon Molecules Assignment

Create the molecules assigned to your group using the balloons provided. There are different coloured balloons. Assign one colour to represent the bonded electron pairs and the other to represent the lone electron pairs. Make sure you specify which is which.

Create your molecules so that it is stable enough to get knocked over and still maintain its shape. You will be provided with tape and balloons. After you have created your molecule with the balloons, label it with masking tape and your names. You then need to make a 3 dimensional drawing of each of your molecules (not drawings of the balloons). Use the dashed and solid lines to represent the atoms that go into the page and the atoms that come out of the page. Each member of your group should submit a drawing of both molecules. On the paper you hand in, write down which balloon colors represent bonded electrons and which represent lone pairs. Don`t forget your names!

When you have finished building and drawing your molecules, you need to find a space on the counter and place all of your molecule representations together. You can then work on the "VSEPR" assignment.

(See VSEPR assignment)

Intermolecular Forces

- Inter is latin for "____________________"
- These are the forces that occur between ____________________ (rather than within).
- Intermolecular forces are ____________________ than intramolecular forces.
- The two types of intermolecular forces we will look at are Van Der Waals and hydrogen bonds.

A. Van Der Waals

- The two weakest intermolecular forces are both classified as Van Der Waals forces

Dipole Interactions

- This is when one polar molecule is ______________________ to another polar molecule
- The slightly negative atom from one polar molecule is ______________________ to a slightly positive atom from another polar molecule.
- These dipole interactions are similar to ______________________ bonds, but much weaker

Dispersion Forces:

- These are the ______________________intermolecular force
- Dispersion forces occur between both polar and nonpolar molecules.
- When the moving electrons happen to be ______________________ on the side of the molecule closest to a neighboring molecule their electrical forces influence the neighboring molecules electrons to be momentarily more on the opposite side. This shift causes a ______________________ attraction between the two molecules.

- Dispersion forces generally get stronger as the number of electrons in the molecule increases.

B. Hydrogen Bonds

- Hydrogen bonds are weak bonds formed by the attractions of slightly negative atoms to the slightly positive ____________________ when bonded covalently.
- Hydrogen bonds occur between hydrogen, and ______________________, ____________________, ________________________.
- Hydrogen bonds are also called ____________________
- Because hydrogen has a low electronegativity, when it pairs up with one of the high electronegativity elements ____________________, a highly polar molecule is created.
- Hydrogen bonds are a very strong dipole force.
- Hydrogen bonds are weaker than covalent bonds but ____________________ than van der waals.
- Hydrogen bonds help to explain the high melting and boiling point of water, the low density of ice, the unusually high surface tension of water and the unusually high heat capacity of water.

Properties of Covalent Compounds:

- Intermolecular interactions affect the physical properties of covalent compounds

Molecular Solids:

- Most covalent compounds have ______________________ melting and boiling points compared to ionic compounds.

Network Solids:

- Some covalent compounds have ______________________ melting points or decompose without melting at all. These stable substances are network solids, where all of the atoms are covalently bonded to one another.
- Melting a network solid would require ______________________ covalent bonds thoughout the entire solid.

https://youtu.be/PVL24HAesnc

See Intermolecular Forces Assignment

Properties Summary:

Type of Solid	Interaction	Properties	Examples
Ionic	I________________	• ____________ Melting Point, • ________________, • ________________, • Often ________________ in water.	NaCl, MgO
Metallic	________________ Bonding	• ________________ Hardness and Melting Point (depending upon strength of metallic bonding), • ________________, • usually not ________________.	Fe, Mg
Molecular	________________ Bonding, ________________, Dispersion	• ________________ Melting Point, • ________________, • can be ________________.	H_2, CO_2
Network	________________ Bonding	• ________________ Melting Point, • ________________, • ________________, • tend not to ________________ in water.	Some forms of C, SiO_2

Bond types summary:
https://youtu.be/QXT4OVM4vXI?list=PL8dPuuaLjXtPHzzYuWy6fYEaX9mQQ8oGr

See Types of Solids Assignment

Name:______________________________________

Boat Challenge

The Challenge:

As a group build the best boat. Your boat must be able to float in a sink of water as well as support the weight of at least one can of vegetable soup.

Your boat will be made out of aluminum foil. Be sure to think about your design before you build it. You will have one trial boat and then be given a chance to adjust your design and create a new boat.

Design: Draw a picture of your initial boat design and your redesigned boat design.

Analysis:

1. Why did you decide on the design you used?____

2. Did your initial design work well? Explain why or why not. ____

3. How did you adjust your design to improve it? Why did you adjust it the way you did?

4. What designs worked best in the class? What elements of the design made them work well? Why?____

5. How did this challenge relate to what scientists and engineers do? ________________________________
____
____
____
____

6. What was your thinking process throughout this task? (how did you come up with your design? How did you decide what to do to improve it). ____
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7. How was the process you went through with this task similar to the classic "scientific method"? ← *wait to answer this until we have learned about the scientific method*____
____
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8. Do you think that the scientific method is the only process that should/can be used to do scientific research? Explain.____
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Name____________________________

History of the Atom & the Periodic Table

1. Explain why we study the historical development of the model of the atom (give at least 2 reasons)

2. Draw and label the current model of the atom:

3. Describe the arrangement of the periodic table with regards to the following:

    a. Metals and non-metals

    b. Solids, liquids and gases

    c. Valence Electrons

4. In your own words, explain why an empty valence shell is equivalent to a full valence shell.

Name:____________________

Valence Electron, Ions & Lewis dot Assignment

Complete the following table:

Name	# of valence electrons	# of electrons to gain or lose	Common charge	Lewis dot for neutral atom	Lewis dot for common ion
Aluminum					
Argon					
Beryllium					
Boron					
Carbon					
Chlorine					
Fluorine					
Helium					
Hydrogen					
Lithium					
Magnesium					
Neon					
Nitrogen					
Oxygen					
Phosphorus					
Silicon					
Sodium					
Sulfur					

Describe two ways an ion forms from an atom:

Name:________________

Ionic Compound Lewis Assign:

Use the Lewis formulas for atoms to determine which ions and ionic compounds will form when the following elements combine:

1. Lithium and Fluorine

2. Calcium and chlorine

3. Magnesium and oxygen

4. Aluminum and iodine

5. Calcium and phosphorus

6. Sodium and nitrogen

7. Why do nonmetal atoms tend to form anions when they react to form compounds?

Name:__________________

Covalent and Ionic Bonding Assignment

Classify the following compounds as ionic (metal + non-metal), covalent (non-metal + non-metal) or both (compound containing a polyatomic ion), then name the compound using IUPAC naming rules.

1. $CaCl_2$ ________________________________
2. CO_2 ________________________________
3. H_2O ________________________________
4. $BaSO_4$ ________________________________
5. K_2O ________________________________
6. NaF ________________________________
7. Na_2CO_3 ________________________________
8. CH_4 ________________________________
9. SO_3 ________________________________
10. LiBr ________________________________

Name:____________________________________

Covalent Bonding Lewis Dot Assignment

Draw the lewis dot structure for the covalent molecules created from the elements below. Be sure to draw the lewis dot in 2 steps, to show how the electrons are involved in bonding.

1. H_2
2. O_2
3. N_2
4. CO_2
5. H_2O
6. HNO_3

7. Explain why neon is monatomic but chlorine is diatomic.

Name:________________

Polarity Assignment

1. How must electronegativities compare is a covalent bond between them is polar?

2. Using only their relative position on the periodic table, arrange the following elements in order of increasing electronegativity: K Cs Br Fe Ca F Cl

3. Predict what type of bond (non-polar covalent, polar covalent, or ionic) would form between the following:

   a. Ca-S
   b. H-F
   c. P-H
   d. C-Cl
   e. C-O
   f. Li-Cl
   g. N_2
   h. NH_3
   i. H_2O
   j. FeO
   k. $MgCl_2$

4. Determine whether the following molecules are polar or non polar:

   a. Hydrogen bromide, HBr
   b. Nitrogen gas, N_2
   c. Hydrogen sulfide, H_2S
   d. Ethane, C_2H_6
   e. Tetrachloroethene, C_2Cl_4
   f. Phosphine PH_3

Name: ______________________

VSEPR Assign

Determine the electron pair geometry and the molecular geometry for the following, then draw the 3D structure of the molecule:

Follow Octet:

CH_4

NF_3

PH_3

SBr_2

Break the Octet:

XeH_2

$ArCl_4$

NH_5

FCl_3

OBr_4

Name:____________________________

Intermolecular Forces Assignment

Determine whether the following molecules will have polar bonds, dipole interactions, dispersion forces, or H-bonds. Be sure to include all forces (i.e. there may be more than one that applies), If the molecule is polar, draw the dipole(s).

1. NH_3

2. I_2

3. CH_4

4. O_2

5. H_2O

6. HBr

7. HOOH

8. CH_3Cl

9. Depict a hydrogen bond between a water molecule and an ammonia molecule.

Name:______________________

Types of Solids Assignment

Determine if the following compounds are metallic solids, ionic solids, network atomic solids, molecular solids, or amorphous solids based on their properties. These are all actual chemical compounds.

1) This material forms crumbly crystals and has a melting point of 16.6^0 Celsius. It has a low density in solid form.

______________________________ (acetic acid)

2) This material forms very hard colorless crystals. It does not dissolve in water and burns at high temperatures.

______________________________ (diamond, C-C bond)

3) This material forms colorless crystals that have a melting point of 661^0 C. It is hard, brittle, and dissolves well in water.

______________________________ (sodium iodide)

4) This material forms silver crystals that do not dissolve in water and have a melting point of 1414^0 C. This material is very hard and is not a good conductor of electricity.

______________________________ (silicon)

5) This material is hard and melts at a temperature of 1610^0 C. It dissolves only with difficulty in very reactive acids and doesn't conduct electricity when molten. It forms colorless crystals.

______________________________ (quartz)

6) This material is soft and doesn't form crystals. It has a melting point of 660^0 C. It doesn't dissolve in water. It is used as a structural material in the construction of airplanes and rockets.

______________________________ (aluminum)

Name:________________________________

OPTIONAL PRIOR KNOWLEDGE PRACTICE QUESTIONS

Determining Number of Atoms

Determine the number of atoms in each of the following compounds:

1. KCl: ____________
2. $NaCl$: ____________
3. $CaCl_2$: ____________
4. KNO_3: ____________
5. H_2SO_4: ____________
6. $CaCO_3$: ____________
7. C_2H_6: ____________
8. $MgCl_2$: ____________
9. NH_4Br: ____________
10. $Ca_3(PO_4)_2$: ____________
11. $Al(OH)_3$: ____________
12. Hg_2Cl_2: ____________
13. $(NH_4)_3PO_4$: ____________
14. $As_2(SO_4)_5$: ____________
15. $Zn_3(PO_4)_2$: ____________

Criss Cross Method

Determine the chemical formula for the compounds created by the combination of the ions below.

	Cl^-	**O^{2-}**	**PO_4^{3-}**	**OH^-**
Na^+				
Mg^{2+}				
NH_4^+				
Fe^{3+}				

Determining Charges:

1. What is the charge of the metal in the following compounds?

a) $CuBr_2$

b) $FeBO_3$

c) $CoCrO_4$

d) $Cu_3(PO4)_2$

e) $Ni_3(PO4)_2$

f) Ag_2HPO_4

Naming Ionic Compounds Assignment

Name the following ionic compounds using Roman Numerals where necessary:

1. $BaCl_2$ ______________________________
2. CuBr ______________________)_________
3. FeO ______________________________
4. MgS ______________________________
5. Al_2O_3 ______________________________
6. $PbSO_3$ ______________________________
7. CaC_2O_4 ______________________________
8. Fe_2O_3 ______________________________
9. $Mg(NO_2)_2$ ______________________________
10. $CuSO_4$______________________________
11. $NaHCO_3$ ______________________________
12. $NiBr_3$ ______________________________

Naming Covalent Compounds Assignment

Name the following compounds using the prefix method:

1. CO ______________________________
2. CO_2 ______________________________
3. N_2O ______________________________
4. SO_3 ______________________________
5. CCl_4 ______________________________
6. NO ______________________________
7. N_2O_5 ______________________________
8. P_2O_5 ______________________________
9. SCl_6 ______________________________
10. SiO_2 ______________________________

Writing Formulas from Names Assignment

Write the chemical formula for the compounds listed below:

1. Sodium chloride ______________________
2. Carbon tetrachloride __________________
3. Dihydrogen monoxide _________________
4. Iron (II) fluoride ______________________
5. Magnesium sulfate ____________________
6. Dinitrogen pentoxide __________________
7. Phosphorous trichloride ________________
8. Copper (I) carbonate ___________________
9. Potassium hydrogen carbonate __________
10. Sulfur trioxide _________________________
11. Ammonium phosphate ________________
12. Iron (II) oxide __________________________
13. Iron (III) oxide _________________________
14. Carbon monoxide _____________________
15. Magnesium hydroxide _________________
16. Copper (II) sulfate _____________________
17. Lead (IV) chromate ____________________
18. Potassium permagnate ________________
19. Sodium hydrogen carbonate ____________
20. Aluminum sulfite _______________________

Naming Ionic and Covalent Compounds

1. $CrCl_2$ ___________________________
2. Ba_3P_2 ___________________________
3. $FeCl_3$ ___________________________
4. N_2O_4 ___________________________
5. CS_2 ___________________________
6. $Be(NO_3)_2$ ________________________
7. $AuCl_3$ ___________________________
8. PBr_5 ___________________________
9. $KMnO_4$ ___________________________
10. OF_2 ___________________________
11. PCl_3 ___________________________
12. $Zn_3(PO_4)_2$ ________________________
13. NH_4NO_3 ________________________
14. N_2O_3 ___________________________
15. BeS ___________________________
16. MnO ___________________________
17. $FeSO_4$ ___________________________
18. $Al(OH)_3$ ________________________
19. PCl_5 ___________________________
20. $CuC_2H_3O_2$ ________________________