CHEMISTRY | LEE

NAME ____

DATE ____________________________ BLOCK ___________

UNIT FIVE

PROBLEM SET

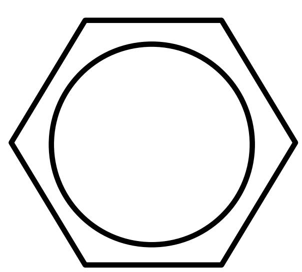
Score:

Do not cheat by copying the work of another person, or by allowing another person to copy your answers. Cheating results in a 0% grade for both parties involved.

Signature_____________________________ Date_________

In the event any or all of this Problem Set is assessed for a grade,
it must be signed and dated in order to receive a grade. The work shall be your own.

Problem Sets are generally not accepted late. Late assignments are 50% off.



Ch 12 WS 5 Combined Gas Law Problems

1. What is the equation for the Combined Gas Law?

2. A student collects 450. mL of HCl(g) hydrogen chloride gas at a pressure of 100. kPa and a temperature of 17°C. What is the volume of the HCl at 0°C and 101.3 kPa? (Ans = 418 mL)

3. A sample of fluorine gas, F_2, occupies a volume of 15 mL at 200. K and 203 mmHg. What volume will the fluorine gas occupy at 273 K and 406 mmHg? (Ans = 10. mL)

4. A weather balloon has a volume of 250 Liters at 37°C at 99 kPa. The balloon rises to an elevation of 10,000 meters where the balloon's volume increases to 270 Liters and the pressure is 66 kPa. What is the temperature of the gas in the balloon in Kelvin?(Ans = 223 K)

5. A 10.0 L sample of gas has a pressure of 3.0 atmospheres at -30°C. What will be the pressure of the gas if the volume decreases to 7.0 Liters and the temperature increases to 20°C? (Ans =5.2 atm)

6. A 2.50 L sample of gas exerts a pressure of 600. mmHg at 245 K. What temperature (in K) would the gas be if it exerted 750. mmHg and occupied 1.4 L?(Ans = 172 K)

7. A 4.2 mL sample of gas exerts a pressure of 100. kPa at 200. K. What would be the new pressure if the gas was heated to 250 K and the volume decreased to 4.0 mL? (Ans = 131 kPa)

8. A 455 L sample of gas exerts a pressure of 250 kPa at 22^{o}C and at 30^{o}C it has a volume of 600 L. What is the final pressure?(Ans = 195 kPa)

Ideal Gas Law
Chem Worksheet 14-4

Name ________________

The ideal gas law is an equation that relates the volume, temperature, pressure and amount of gas particles to a constant. The ideal gas constant is abbreviated with the variable *R* and has the value of 0.0821 atm·L/mol·K. The ideal gas law can be used when three of the four gas variables are known. When using this equation it is important that the units for **pressure** are atmospheres (atm), **volume** is in liters (L), and **temperature** is converted to kelvins (K). The **amount** of gas is measured in units called moles (mol).

USEFUL EQUATIONS

$PV = nRT$	1.00 atm = 101300 Pa
$R = 0.0821 \frac{atm \cdot L}{mol \cdot K}$	1.00 atm = 101.3 kPa
$T_K = T_C + 273$	1.00 atm = 760 mmHg
$1\ cm^3 = 1\ mL$	1.00 atm = 760 torr
1 L = 1000 mL	1.00 atm = 14.7 psi

Unknown	Equation	Known Variables
pressure	$P = \frac{nRT}{V}$	amount, temp., volume
volume	$V = \frac{nRT}{P}$	amount, temp., pressure
temperature	$T = \frac{PV}{nR}$	pressure, volume, amount
amount	$n = \frac{PV}{RT}$	pressure, volume, temp.

example

The pressure exerted by 2.8 moles of argon gas at a temperature of 85ºC is 420 torr. What is the volume of this sample?

- list the variables: $P = 420$ torr $V = ?$ $n = 2.8$ mol $R = 0.0821 \frac{atm \cdot L}{mol \cdot K}$ $T = 85$ºC
- convert the variables: $\frac{420\ \cancel{torr}}{1} \times \frac{1\ atm}{760\ \cancel{torr}} = 0.553\ atm$ $T = 85ºC + 273 = 358\ K$
- substitute into the equation: $V = \frac{nRT}{P}$ $V = \frac{(2.8\ \cancel{mol})(0.08206 \frac{\cancel{atm} \cdot L}{\cancel{mol} \cdot \cancel{K}})(358\ \cancel{K})}{0.553\ \cancel{atm}} = 82\ L$

Solve the following problems.

1. A tank contains 115 moles of neon gas. It has a pressure of 57 atm at a temperature of 45ºC. Calculate the volume of the tank.
2. A scuba tank has a pressure of 195 atm at a temperature of 10ºC. The volume of the tank is 350 L. How many moles of air are in the tank?
3. A helium-filled balloon has a volume of 208 L and it contains 9.95 moles of gas. If the pressure of the balloon is 1.26 atm, determine the temperature in Celsius degrees.
4. A tank of oxygen has a volume of 1650 L. The temperature of the gas inside is 35ºC. If there are 9750 moles of oxygen in the tank what is the pressure in PSI?
5. A canister of acetylene has a volume of 42 L. The temperature of the acetylene is 305 K and the pressure is 780 torr. Determine the amount (moles) of gas in the canister.
6. Calculate the volume of a CO_2 cartridge that has a pressure of 850 PSI at a temperature of 21ºC. The cartridge contains 0.273 mol of CO_2.
7. A tank contains 2500 L of argon gas. The pressure is13790 kPa and the temperature is 25ºC. How many moles of argon are in the tank?

Chapter 12 WS 6 Ideal Gas Law Problems

1. What is the equation for the Ideal Gas Law?

2. What units must you use for volume in Ideal Gas Law problems?

3. What units must you use for temperature in Ideal Gas Law problems?

4. What does **n** stand for?

$$\boxed{\mathbf{R} = 8.31\,\frac{kPa \bullet L}{moles \bullet K}} \quad \text{or} \quad \boxed{R = 8.31\,\frac{\text{kPa} \bullet \text{dm}^3}{\text{moles} \bullet \text{K}}}$$

5. What will be the volume of a balloon containing 0.30 moles of Helium at 220 K and 330 kPa? (Ans=1.7L)

6. A cylinder containing 4.2 moles of gas has a volume of 5.0 liters at 100.°C. What is the pressure of the gas in KPa? (Ans=2600 kPa)

7. A typical birthday balloon contains 8.0 dm^3 of gas at 25°C and 101.3 kPa. How many moles of helium are in the balloon?(Ans = 0.33 mol)

8. An engineer pumps 5.00 mole of carbon monoxide gas into a cylinder that has a capacity of 20.0 L. What is the pressure in kPa of the CO inside the cylinder at 25°C?(Ans = 619 kPa)

9. Challenger: A syringe contains 15 mL of fluorine gas, F_2, at 0°C and 1 atmosphere. How many grams of F_2 does the syringe contain? Remember, convert to correct units and you can get from moles to grams. (Ans = 0.025 g F_2)

Chapter 12 WS 6a Mixed Gas Law Problems

$$R = 8.31 \frac{kPa \bullet L}{moles \bullet K}$$

or

$$R = 8.31 \frac{kPa \bullet dm^3}{moles \bullet K}$$

1. A weather balloon contains 120 Liters of nitrogen at 15°C and 0.95 atmospheres. What will be the balloon's volume at 0.32 atmospheres and 0°C? *(Ans = 338 = 340 L)*

2. A 25 liter rigid cylinder contains 14.2 moles of gas at 25°C. What is the pressure inside the cylinder in kPa?(*Ans = 1400 kPa)*

3. A 14 liter rigid cylinder contains nitrogen gas at a pressure of 8200 torr at 420°C. What will be the pressure in the cylinder if the temperature drops to 25°C? *(Ans = 3500 torr)*

4. How many moles of gas are needed to pressurize a 8.0 liter cylinder to 1500 kPa at 35°C? *(Ans = 4.7 mol)*

5. A balloon has a volume of 16 liters at 101.3 kPa. What will be the balloon's volume when the new pressure is 202.6 kPa? *(Ans = 8.0 L)*

6. A sample of sulfur dioxide occupies a volume of 652 mL at 40.° C and 720 mm Hg. How many mLs will the sulfur dioxide occupy at STP?*(Ans = 540 mL)*

Gas Stoichiometry
Chem Worksheet 14-5

Name _______________

Use your knowledge of *Stoichiometry* and the *Ideal Gas Law* to solve the following problems. The chemical equations given are all balanced.

1. What volume of O_2 is produced when 28.5 g of hydrogen peroxide (H_2O_2) decomposes to form water and oxygen at 150°C and 2.0 atm?

   $$\mathbf{2H_2O_2\ (aq) \rightarrow 2H_2O\ (l) + O_2\ (g)}$$

2. This reaction uses 18.2 g of copper (I) sulfide (Cu_2S). What volume of sulfur dioxide gas would be collected at 237°C and 10.7 atm?

   $$\mathbf{2Cu_2S\ (s) + 3O_2\ (g) \rightarrow 2Cu_2O\ (s) + 2SO_2\ (g)}$$

3. When 62.7-g nitrogen and excess oxygen react they generate nitrogen dioxide. If the NO_2 is collected at 625 K and 0.724 atm, what volume will it occupy?

   $$\mathbf{N_2\ (g) + 2O_2\ (g) \rightarrow 2NO_2\ (g)}$$

4. What volume of hydrogen gas is evolved from a reaction between 0.52 g of Na and water? The gas is collected at 20.°C and 745 mmHg.

   $$\mathbf{2Na\ (s) + 2H_2O\ (l) \rightarrow 2NaOH\ (aq) + H_2\ (g)}$$

5. At what pressure is the nitrogen gas sample that is collected when 48.4 g of NaN_3 decomposes? The temperature of the gas is 25°C and the volume is 18.4 L.

   $$\mathbf{2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)}$$

6. When 2.4-g zinc is added to hydrochloric acid, 450 mL of hydrogen gas forms at a temperature of 32°C. What is the pressure of the gas?

   $$\mathbf{Zn\ (s) + 2HCl\ (aq) \rightarrow ZnCl_2\ (aq) + H_2\ (g)}$$

7. The following reaction forms 6.41 L of oxygen at a temperature of 18.7°C and a pressure of 731 torr, what mass of $KClO_3$ must have decomposed?

   $$\mathbf{2KClO_3\ (s) \rightarrow 2KCl\ (s) + 3O_2\ (g)}$$

8. What mass of $CaSO_3$ must have been present initially to produce 14.5 L of SO_2 gas at a temperature of 12.5°C and a pressure of 1.10 atm?

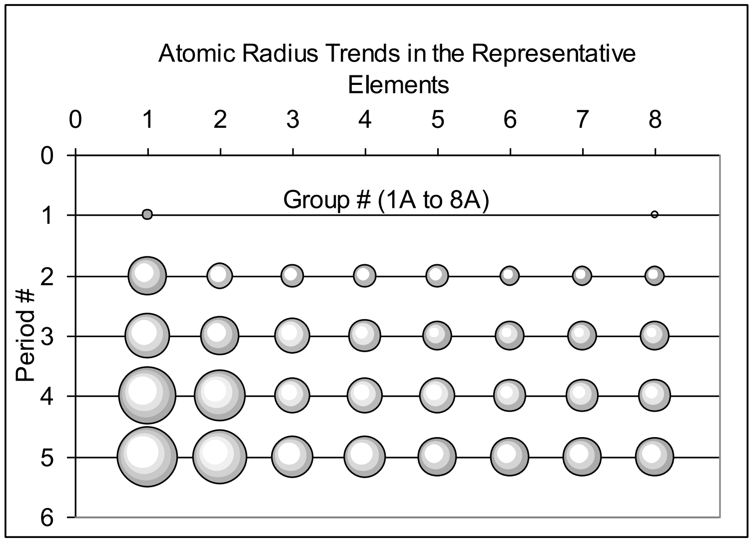
   $$\mathbf{CaSO_3\ (s) \rightarrow CaO\ (s) + SO_2\ (g)}$$

Ch 14 WS 1: Atomic Radius Trends

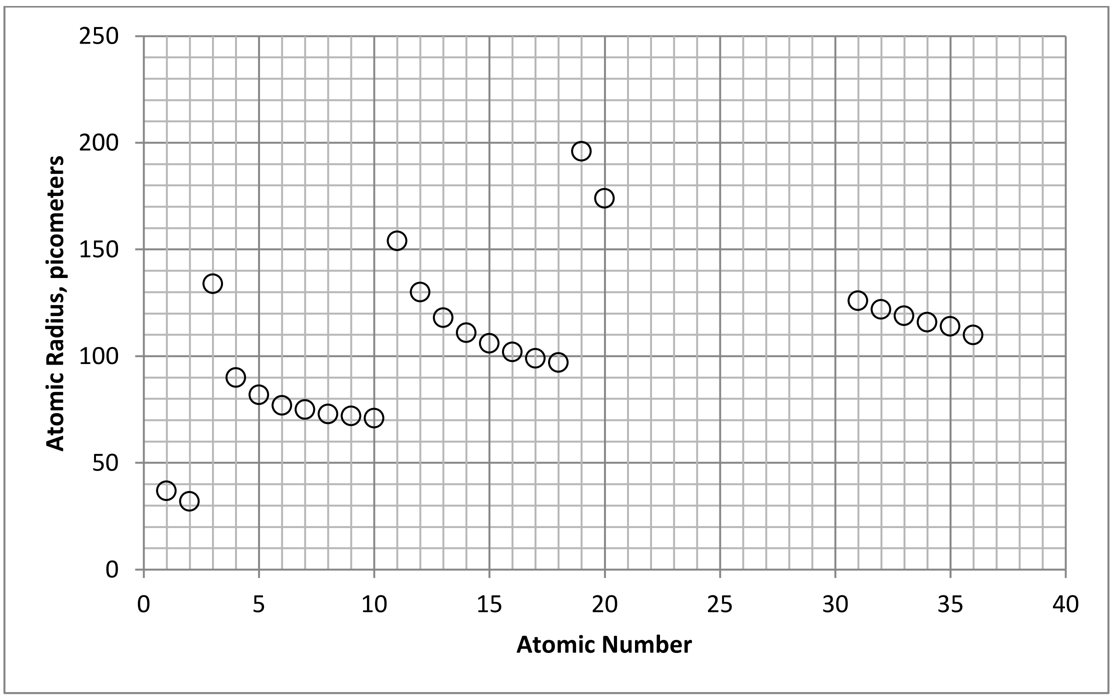
Atomic Radii trends

The figure to the right shows the relative atomic radii of the representative elements (tall columns). Note that radius decreases from left to right across a period. Note also that radius increases down a group.

You will be completing a plot of atomic radius versus atomic number (number of protons). Generally, atomic radius increases as the number of principle energy levels increases. **Color code the *alkali*, *alkaline earth*, *boron*, *carbon*, *nitrogen*, *oxygen*, *halogen* and *noble gas* families using different colors.** Put the color legend on the graph. Connect the dots in atomic order number (from left to right).



Graph 1: Periodic Trends in Atomic Radius for the Representative Elements.



1. Which family has the smallest atomic radius in each period?_____________________________

2. Which family has the largest atomic radius in each period?____________________________

3. Which period that you graphed has the greatest atomic radius?___________________________

4. How do the atomic radii change as you go from left to right across a period?_________________________________

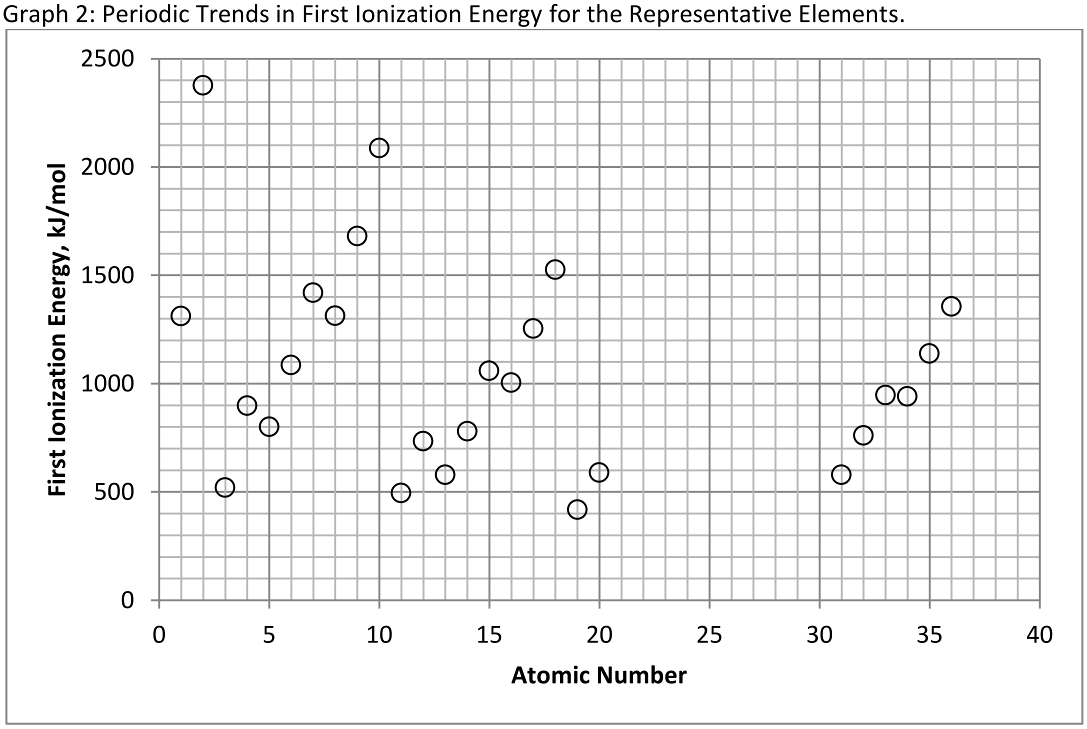
5. How does atomic radius change as you down a group?___________________________________

Ch 14 WS 2: First Ionization Energy Trends

First Ionization Energy trends

This graph shows the plot of first ionization energy values versus atomic number (number of protons). The first ionization energy is the energy required to remove the outermost valence electron from a neutral atom. Generally, the closer a valence electron is to the nucleus, the harder it is to remove the electron. **Color code the *alkali*, *alkaline earth*, *boron*, *carbon*, *nitrogen*, *oxygen*, *halogen* and *noble gas* families using different colors.** Put the color legend on the graph. Connect the dots in atomic number order (from left to right).

Graph 2: Periodic Trends in First Ionization Energy for the Representative Elements.



1. Which family has the greatest first ionization energy in each period?____________________________

2. Which family has the lowest first ionization energy in each period?

3. Which period that you graphed has the largest first ionization energy?__________________________

4. How do the first ionization energies tend to change as you go from left to right across a period?____________________

5. How do first ionization energies tend to change as you down a group?____

6. What is the relationship between atomic radius sizes and first ionization energies?______________________________

____

____

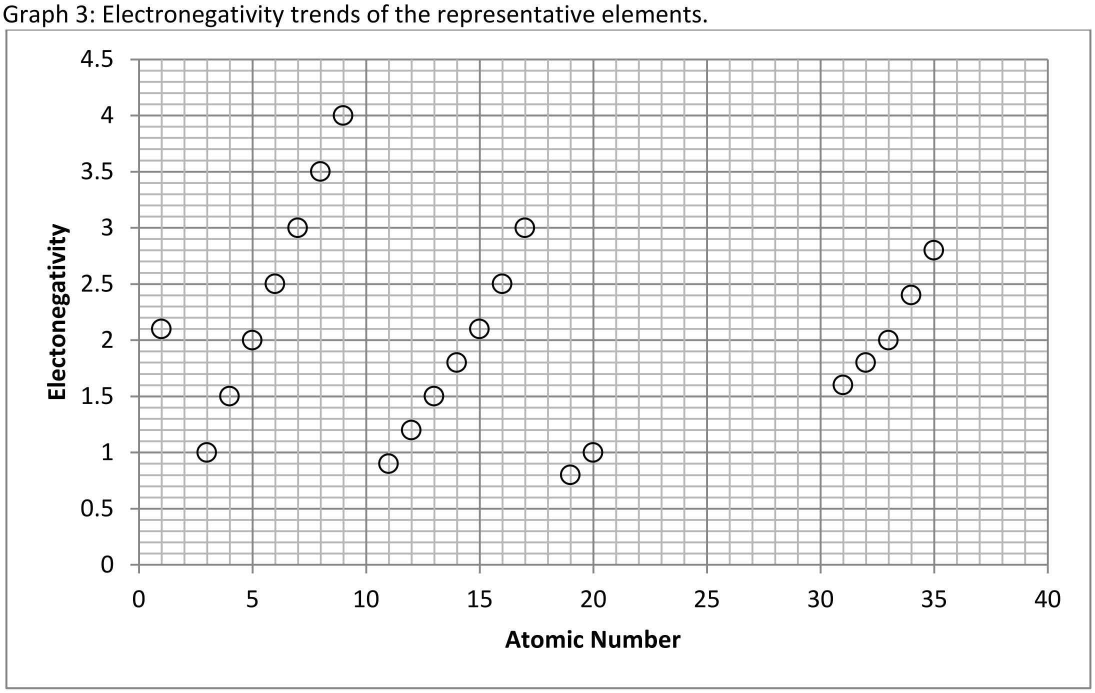
____

Ch 14 WS 3: Electronegativity Trends

Electronegativity trends

This graph shows the plot of electronegativity values versus atomic number (number of protons). Electronegativity is the tendency of an atom to attract electrons in a chemical bond. Generally, the closer an electron can get to the nucleus by entering the valence shell, the higher the atom's electronegativity. **Color code the *alkali*, *alkaline earth*, *boron*, *carbon*, *nitrogen*, *oxygen*, *halogen* and *noble gas* families using different colors.** Put the color legend on the graph. Connect the dots in atomic number order (from left to right).

Graph 3: Electronegativity trends of the representative elements.



1. Which family has the greatest electronegativity in each period?______________________________
2. Which family has the lowest electronegativity in each period?_________________________________
3. How does electronegativity change as you from left to right across a period?___________________________
4. How does electronegativity change as you down a group?_____________________________________
5. Why were the noble gases omitted from this graph?____

____

6. Which family, excluding the noble gases, has the lowest electronegativity in each period?_______________________
7. Which period that you graphed has the greatest electronegativity? ________________________
8. What is the relationship between atomic radius sizes and electronegativity?_________________________________

____

____

____

Chapter Fourteen Worksheet 4

Describe the difference between Moseley's and Mendeleev's ordering of the periodic table. Answer in one or two full sentences.

Fill in the table below using your knowledge of periodic trends.

Pair of atoms	largest atomic size	highest ionization energy	highest electronegativity
Li and Rb			
K and Br			
O and Ne			
Ca, As, Be, N			
Mg, Si, S, Ar			
C, Se, O, Ge			

Provide the electron configuration for the following atoms (1/2 pt each). Indicate the valence electrons by placing a box around them

Cl :
Cl- :
Na+ :
Na :

Circle larger atom in each pair.

Cl or Cl^-

Na or Na^+

Cl^- or Br^-

Ch 14 WS 5 Periodic Trends

1. As you go from left to right across a period, the nuclear charge is (increasing/decreasing)
2. As you go from left to right across a period, the number of shielding electrons (increases/decreases/remains constant)
3. As you go from left to right across a period, the effective nuclear charge is (increasing/decreasing/remains constant). Why?______________________________

   ____

   ____

4. As you go from left to right across a period, the atomic size (decreases/increases). Why?________

   ____

   ____

5. As you travel down a group, the atomic size (decreases/increases). Why? ?___________________

   ____

   ____

6. A negative ion is (larger/smaller) than its parent atom>
7. A positive ion is (larger/smaller) than its parent atom.
8. As you go from left to right across a period, the first ionization energy generally (decreases/ increases) Why?____

   ____

9. As you go down a group, the first ionization energy generally (decreases/increases). Why?______

   ____

   ____

10. Where are the most electronegative elements found?_____________________________
11. Where are the least electronegative elements found?_____________________________
12. What sublevels are filling across the Transition elements?__________________________
13. Elements within a group have a similar number of ______________________________
14. Elements across a period have the same number of ______________________________
15. As you go from left to right across the periodic table, the elements go from (metals/non-metals) to (non-metals/metals)
16. The majority of the elements in the periodic table are (metals/nonmetals)

<u>Ch 9 WS 5 Percent, Actual, and Theoretical Yield-Two Sides</u>

Theoretical Yield: This is the stoichiometric yield. This will be the amount of product made if everything goes perfectly.

Actual Yield: How much product was actually produced.

Percent Yield = (actual yield/theoretical yield) x 100

Solving: First figure out the stoichiometric yield using stoichiometry and the reactant. Then calculate percent yield. The stoichiometric yield goes in the denominator.

1) $\boxed{2LiOH + CuCl_2 \rightarrow 2LiCl + Cu(OH)_2}$

20.0 grams of lithium hydroxide reacts with excess potassium chloride. What is the theoretical yield of copper(II) hydroxide in grams?(Ans = 40.7 g $Cu(OH)_2$)

b) The reaction actually produced 18.1 grams of copper(II)hydroxide. What is the percent yield? (Ans = 44.4%)

2) 5.0 grams of C_3H_8 react with excess oxygen to produce 7.5 grams of water. What is the percent yield of water?(Ans = 92%)

$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$$

3) $\boxed{2\ NaCl + CaO \rightarrow CaCl_2 + Na_2O}$

20. grams of calcium oxide reacts with excess sodium chloride to produce 11 grams of sodium oxide. What is the percent yield of the reaction?(Ans=50%)

Ch 9 WS 5 Continued

4) $\boxed{2Fe_2O_3 + 3C \rightarrow 3CO_2 + 4\ Fe}$

Excess carbon reacts with 34 grams of Iron(III) oxide, Fe_2O_3, to produce 21 grams of Iron, Fe. What is the percent yield of the reaction?(Ans = 88%)

5) $\boxed{TiS + H_2O \rightarrow H_2S + TiO}$

What is the percent yield of titanium (II) oxide if 20. grams of titanium (II) sulfide reacts with excess water to produce 12 grams of titanium (II) oxide?(Ans = 75%)

6) $\boxed{2Ag_2O \rightarrow 4Ag + O_2}$

What is the percent yield if 89 grams of Silver oxide decomposes to produce 75 grams of silver? (Ans = 91%)

Chapter 16 WS 1: **Name______________________**
Structural Formula Practice

Draw the dot structures and structural formulas for the following molecules:

Steps for drawing structural formulas:

1. Count the number of total valence electrons. If the molecule is a polyatomic anion, add one electron for each negative charge.
2. Draw a skeleton structure with the atoms connected by single bonds around a central atom. Remember, each single bond uses two electrons. (for compounds with more than 2 atoms)
3. Place the remaining electrons on the outside atoms to complete the octet rule. Remember, H can only have two electrons.
4. After completing the octets on the outside atoms, use any remaining electrons to fill the octet on the central atom.
5. If the central atom does not have a full octet, try sharing lone pairs from the outside atoms to form double or triple bonds.

Compound	Total # valence electrons	Structural formula	Lewis dot structure
F_2			
Cl_2			
I_2			
O_2			
N_2			
HCl			
CO			
CO_2 (C in center)			

Compound	Total # valence electrons	Structural formula	Lewis dot structure
H_2O (O in center)			
CH_4 (C in center)			
NH_3 (N in center)			
$CHCl_3$			
SiO_2 (Si in center)			
SO_3 (S in center)			
NO_3^-			

Name________________________________ Block_____ Date____________

Ch 16 WS 2 Structural Formula Practice

Draw the structural formulas for the following compounds or polyatomic ions. The bolded element should be placed in the center.

H**C**N	S**C**N$^-$
CH_2Cl_2	**P**Br_3
SeO_3	**Se**O_3^{2-}
SO_2	**C**O_2

Name________________________________ Block_____ Date____________

Ch 16 WS 3 Structural Formula and Geometry Practice

Draw the structural formula for the following compounds or polyatomic ions and predict their three dimensional geometry (linear, bent triatomic, trigonal planar, pyramidal, tetrahedral). The bolded element should be placed in the center.

SiO_3^{2-} Geometry:	**N**H_4^{+} Geometry:
BrO_2^{-} Geometry:	**S**O_4^{2-} Geometry:
CI_4 Geometry:	**N**O_2^{-} Geometry:
SiO_2 Geometry:	**S**Cl_2 Geometry:
SeO_3 Geometry:	**P**H_3 Geometry:

Name________________________________ Block_____ Date____________

Ch 16 WS 4 Structural Formula Practice

Draw the structural formulas for the following polyatomic ions. The first element of the polyatomic goes in the center

Hydroxide	phosphate
sulfate	nitrate
carbonate	ammonium
Chlorite (ClO_2^-)	Chlorate (ClO_3^-)

Naming and Formula Practice

Name the following compounds

$(NH_4)_2S$

PbS_2

SiO_2

$NiCO_3$

Li_2SO_3

PCl_3

CF_4

Fe_2O_3

OBr_2

$CaBr_2$

Na_3PO_4

TiO_2

Al_2S_3

N_2O_4

Write the formulas of the following compounds

Iron(II) nitrite

Diphosphorus pentoxide

Zinc nitrate

Chromium(IV) sulfate

Nitrogen triiodide

Magnesium carbonate

Silver nitrate

Calcium chlorate

Copper(I) oxide

Potassium hypochlorite

Silicon tetraflouride

Ammonia

Methane

Sulfur trioxide