

You are expected to be familiar with certain concepts of chemistry before the year begins. This assignment is formative and will not be counted for a grade. Due to the magnitude of content covered in class and the limited timeframe to complete it, we will complete the first unit, Unit 0: Intro to Chemistry, at an accelerated pace. The goal of the assignment below is to allow your teacher to know what topics to emphasize during instructional time, and for you to know what questions to ask. We will discuss this assignment and the corresponding unit during the first days of class. You are expected to attempt all of the problems on your own as this is the only way you can get an understanding of your level of knowledge, and so your teacher can judge how well his class is doing based on your performance. **The assignment will not be graded, but is due for feedback purposes on Tuesday, August 13th.** You are expected to know the list of polyatomic ions and strong acids below with a **quiz on Tuesday, August 13th.**

Prerequisite Objectives

The following are a list of objectives you are expected to know and will not be taught, but can be necessary to solve problems or explain fundamental concepts in chemistry.

1. I can convert between SI units (m \rightarrow km)
2. I can, given the formula of a compound, calculate any compounds molar mass.
3. I can apply the rules of significant figures to round answers to appropriate number of digits.
4. I can apply the formula for percent error to a set of data
5. I can find the percent composition of a compound
6. I can balance a chemical equation
7. I can determine the number of protons, neutrons, and electrons in an isotope
8. I can determine the charge of an ion from its location on the periodic table
9. I can use the periodic table to determine if a compound is ionic or covalent
10. I can recall the common diatomic molecules and know when to apply them (H, O, F, Br, I, N, Cl all should be written as H₂, O₂, etc.)
11. I can recall the formula and name of a polyatomic ion from a list (see below) of common polyatomic ions
12. I can recall the names and formulas of the six strong acids (see below)
13. I can use Avogadro's number, 6.02×10^{23} , to convert between particles and moles
14. I can use dimensional analysis, aka conversion factors, to convert between units (especially grams \rightarrow mol)

Unit 0: Chemistry Fundamentals Objectives (Subject to Change)

1. I can write the formula or name ionic, hydrated ionic compounds, and covalent compounds.
2. I can write the formula or name binary and oxyacids.
3. I can determine the atomic mass of an element given a list of isotopes and their abundances or mass spectrometer data.
4. I can calculate the empirical formula of a compound given percent by mass, or given masses of all elements in the compound
5. I can calculate the percent yield of a reaction given experimental data
6. I can determine the molecular formula of a compound from its empirical formula and its molar mass
7. I can evaluate hydrate analysis data to determine the formula of a hydrate.
8. I can evaluate combustion analysis data to determine the formula of a hydrocarbon.
9. I can use stoichiometric calculations to determine the following: amount of product produced, the limiting and excess reactant, amount of excess reactant remaining

Polyatomic Ion List also found on quizlet search "Williamson AP PAI" or <http://goo.gl/hZjDx1>

Name	Formula	Name	Formula
Ammonium	NH ₄ ⁺	Iodate	IO ₃ ⁻
Hydromium	H ₃ O ⁺	Periodate	IO ₄ ⁻
Bromate	BrO ₃ ⁻	Permanganate	MnO ₄ ⁻
Carbonate	CO ₃ ²⁻	Nitrate	NO ₃ ⁻
Hypochlorite	ClO ⁻ or OCl ⁻	Nitrite	NO ₂ ⁻
Chlorite	ClO ₂ ⁻	Oxalate	C ₂ O ₄ ²⁻
Chlorate	ClO ₃ ⁻	Peroxide	O ₂ ²⁻
Perchlorate	ClO ₄ ⁻	Phosphate	PO ₄ ³⁻
Chromate	CrO ₄ ²⁻	Phosphite	PO ₃ ³⁻
Cyanide	CN ⁻	Sulfate	SO ₄ ²⁻
Acetate	C ₂ H ₃ O ₂ ⁻ or CH ₃ COO ⁻	Sulfite	SO ₃ ²⁻
Hydrogen Sulfate or Bisulfate	HSO ₄ ⁻	Hydroxide	OH ⁻
Hydrogen Carbonate	HCO ₃ ⁻	Dichromate	Cr ₂ O ₇ ²⁻

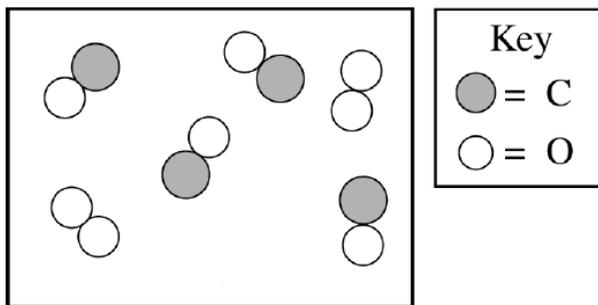
Strong Acids

Name	Formula	Name	Formula
Hydrobromic acid	HBr	Perchloric acid	HClO ₄
Hydroiodic acid	HI	Nitric acid	HNO ₃
Hydrochloric acid	HCl	Sulfuric acid	H ₂ SO ₄

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Problems

1. A mixture of $\text{CO}(\text{g})$ and $\text{O}_2(\text{g})$ are combined in the in a container as shown below and will react to form $\text{CO}_2(\text{g})$.



a) Write the balanced chemical equation described above.

b) In the box below, draw the particle level representation that accurately depicts the container after the reaction has gone to completion.



c) Calculate the percent by mass of C in each carbon containing compound in the reaction described above.

i) $\text{CO}(\text{g})$

ii) $\text{CO}_2(\text{g})$

Propane (C_3H_8) is a common fuel used in cooking and heating. When propane is combusted in a low oxygen environment, incomplete combustion will occur, and the products will be carbon monoxide gas and water.

d) Write the balanced chemical equation described above.

e) What mass of oxygen reacts during the incomplete combustion of 18.0 g of propane?

f) What additional mass of oxygen would be required for the 18.0 grams of combustion to undergo complete combustion to produce carbon dioxide and water.

2. An unknown organic contains only carbon and hydrogen and has a molar mass of 78.1 g/mol. Analysis shows the compound to be 7.69% hydrogen by mass.

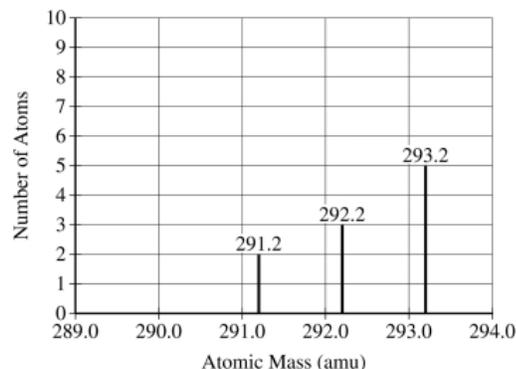
a. Find the empirical formula for this compound.

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5. A new element with atomic number 116 was discovered in 2000. In 2012 it was named livermorium, Lv. Although Lv is radioactive and short-lived, its chemical properties and reactivity should follow periodic trends.

a) According to periodic properties, what would be the most likely formula for the product obtained when livermorium reacts with hydrogen gas?

b) Shown at right is a hypothetical mass spectrum for a sample of Lv containing 10 atoms. Using the information in the graph, determine the average atomic mass of Lv in the sample to four significant figures.



c) The lightest isotope of Lv is livermorium-291. How many protons and neutrons are in the nucleus of this isotope?

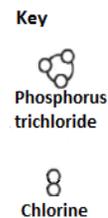
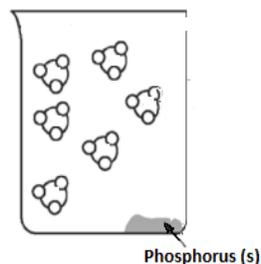
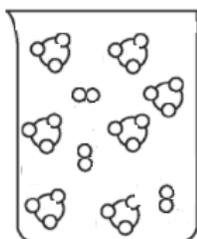
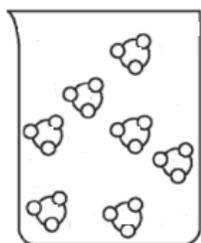
6. Solid phosphorus exists as P_4 , a covalent compound. The solid phosphorus will react with chlorine gas to produce phosphorus trichloride gas.

a. If 3.79 g of phosphorus reacts with 4.19 g of chlorine, what is the limiting reactant?

b. Determine the mass of the excess reactant remaining after the reaction has gone to completion.

c. What volume of the phosphorus trichloride gas was produced in this reaction at STP?

d. Which of the following pictures best represents the reaction vessel after the reaction is complete? Explain.



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7. A hydrocarbon, C_xH_y , where x and y are unknown, is combusted. 10.077 L CO_2 gas and 6.08 g of liquid water are collected at $0.00^\circ C$ and 760 mmHg.

a) Determine the moles of carbon in the hydrocarbon.

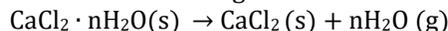
b) Determine the moles of hydrogen in the hydrocarbon.

c) Determine the empirical formula.

d) The molar mass of the hydrocarbon is found to be 54 g/mol. What is the molecular formula for the compound?

8. Use the data from this experiment to answer the following questions regarding $CaCl_2 \cdot nH_2O$

Hydrated calcium chloride is heated in a crucible. The following reaction occurs during heating.



Mass of Empty Crucible	18.435g
Mass of Crucible and Sample	23.951g
Mass of sample and crucible after 1 st heating	22.780g
Mass of sample and crucible after 2 nd heating	22.601g
Mass of sample and crucible after 3 rd heating	22.601g

a) Explain how you could conclude the hydrate had been heated a sufficient number of times.

b) Calculate the number of moles of water lost during heating

c) Determine the mass of anhydrous calcium chloride remaining in the crucible after heating.

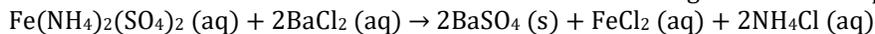
d) Determine the formula and name of the original hydrated compound.

e) If some solid spatters out of the crucible during the heating process, what effect would this have on your calculated moles of water lost? Explain.

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9. The value of x in $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$ can be found by determining the amount, in moles, of sulfate in the compound.

A 1.959g sample was dissolved in water and excess BaCl_2 was added and the following reaction takes place



The precipitate of BaSO_4 was separated and dried and found to weigh 2.33 g.

(a) Calculate the amount in moles of BaSO_4 in the 2.33 g precipitate

(b) Calculate the amount, in moles, of iron in the 1.959 g sample of $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$

(c) Determine the mass of the following present in the 1.959 g sample of $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$

(i) Iron

(ii) ammonium

(iii) sulfate

(d) Using your answer from (c), determine the amount, in moles, of water present in the 1.959g sample of $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2 \cdot x\text{H}_2\text{O}$.

(e) Determine the amount, in moles of $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$ and the value for x .