1) For each of the following place the appropriate element name or symbol in the blank.
   a) Sb ___________ b) Cs _________
   c) zirconium ___ d) rhodium ___________

2) For each of the following, place the appropriate compound name or chemical formula in the blank.
   a) CuClO₃ ___________

3) Consider the following compound: C₂HBrClF₂
   a) What is the molar mass of this compound?
      \[ (2 \text{ mol C})(12.00 \text{ g/mol}) + (1 \text{ mol H})(1.008 \text{ g/mol}) + (1 \text{ mol Br})(79.90 \text{ g/mol}) + (1 \text{ mol Cl})(35.35 \text{ g/mol}) + (2 \text{ mol F})(19.00 \text{ g/mol}) = 178.36 \text{ g/mol} \]
   b) How many grams of fluorine are in 1 mole of this compound?
      \[ 1 \text{ mol cmpd} \times (2 \text{ mol F/1 mol cmpd}) \times (19.00 \text{ g/mol F}) = 38.00 \text{ g} \]
   c) What is the mass percent of fluorine in this molecule?
      \[ \text{In one mole: } \frac{38.00 \text{ g F}}{178.36 \text{ g cmpd}} \times 100 = 21.31 \% \]

4) For each compound below, provide the empirical formula and the empirical mass. The molar mass is provided.
   a) C₅H₁₀O₄ (134.1 g/mol)
      \[ \text{C₅H₁₀O₄} \]
      \[ 134.1 \text{ g/mol} \]
   b) C₆H₆Br₂O₆ (495.66 g/mol)
      \[ \text{C₆H₆Br₂O₆} \]
      \[ 247.83 \text{ g/mol} \]

5) Complete combustion of a 1.505 g sample of molecule containing carbon, hydrogen, and sulfur yields 2.726 g CO₂ and 1.116 g H₂O. The molecular weight of this compound is 148.02.
   a) What is the empirical formula?
      Use CO₂ to determine mass of carbon, use H₂O to determine mass of H. Mass of sulfur can then be determined through the following equation: Sample mass = mass of carbon + mass of hydrogen + mass of sulfur
      \[ 2.726 \text{ g CO₂} \times \text{ mol CO₂/44.0 g} \times 1 \text{ mol C}/1 \text{ mol CO₂} \times 12.01 \text{ g/mol C} = 0.745 \text{ g carbon} \]
      \[ 1.116 \text{ g H₂O} \times \text{ mol H₂O/18.02 g} \times 2 \text{ mol H}/1 \text{ mol H₂O} \times 1.008 \text{ g/mol H} = 0.125 \text{ g hydrogen} \]
      \[ 1.505 \text{ g} = \text{ mass C} + \text{ mass H} + \text{ mass S} = 0.745 \text{ g} + 0.125 \text{ g} + x \]
      \[ x = 0.635 \text{ g S} \]
      Convert all masses to moles:
      \[ 0.745 \text{ g C} \text{ x mol/12.01 g} = 0.062 \text{ mol C} \]
      \[ 0.125 \text{ g x mol/1.008 g} = 0.124 \text{ mol} \]
      \[ 0.635 \text{ g x mol/32.065} = 0.0198 \text{ mol} \]
      Convert all moles to ratio by dividing by the smallest number of moles. In this case it is 0.0198.
      \[ 0.062/0.0198 = 3.13 \text{ mol C} \]
      \[ 0.124/0.0198 = 6.06 \text{ mol H} \]
      \[ 0.0198/0.0198 = 1 \text{ mol S} \]
      The empirical formula is C₃H₆S and the empirical mass is 74.143 g/mol.
b) What is the molecular formula?

\[
\text{molar mass/empirical mass} = n
\]

\[
\frac{168.02}{74.143} = 2.27 \text{ this is close enough to 2 to use as an integer and multiply all mole}
\]

\[C_6H_{12}S\]

6) Balance the following reactions.

a) \[
2\underline{\text{NO}} + \underline{\text{O}_2} \rightarrow 2\underline{\text{NO}_2}
\]

b) \[
2\underline{\text{H}_3\text{PO}_4} + 3\underline{\text{CaO}} \rightarrow \underline{\text{Ca}_3(\text{PO}_4)_2} + 3\underline{\text{H}_2\text{O}}
\]

7) Convert the following reaction description to a chemical equation. Include appropriate states and balance if necessary.

An aqueous solution of barium hydroxide is mixed with sulfuric acid. Water and a precipitate of barium sulfate are formed.

\[\text{Ba(OH)}_2 (\text{aq}) + \text{H}_2\text{SO}_4 (\text{aq}) \rightarrow \text{BaSO}_4 (\text{s}) + 2 \text{H}_2\text{O (l)}\]

8) Aluminum reacts with oxygen to form aluminum oxide according to the chemical reaction below.

\[4 \text{ Al(s)} + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{Al}_2\text{O}_3 \text{(s)}\]

a) Determine the following and complete the reaction table below.

i) How many moles of oxygen are required to react completely with 2.75 moles Al (s)?

\[
2.75 \text{ mol Al(s)} \times \frac{3 \text{ mol O}_2}{4 \text{ mol Al}} = 2.06 \text{ mol O}_2
\]

ii) How many moles of aluminum oxide will be formed from the reaction in i)?

\[
2.75 \text{ mol Al(s)} \times \frac{2 \text{ mole Al}_2\text{O}_3}{4 \text{ mole Al}} = 1.375 \text{ mol Al}_2\text{O}_3
\]

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b) How many molecules of oxygen are required to react in the presence of excess aluminum to form 1.50 g of aluminum oxide.

\[
\text{mass Al}_2\text{O}_3 \text{ to mole Al}_2\text{O}_3 \text{ to mole O}_2 \text{ to molecules O}_2
\]

\[
1.50 \text{ g} \times \frac{\text{mol Al}_2\text{O}_3}{101.96 \text{ g}} \times \frac{3 \text{ mol O}_2}{2 \text{ mol Al}_2\text{O}_3} \times 6.022 \times 10^{23} \text{ molecules/mol} = 1.33 \times 10^{22} \text{ molecules}
\]

c) If only 1.20 g of aluminum oxide formed under the conditions of b) what is the percentage yield?

\[
\left(\frac{\text{actual mass/theoretical mass}}{}\times 100\right) = \left(\frac{1.20}{1.50}\right) \times 100 = 80
\]

9) When reagents are present in stoichiometric amounts it means that

a) the same number of moles of each reagent is present
b) the same mass of each reagent is present
c) the amount of each reagent present is such that if the reaction goes to completion, there will be none of either reagent left.
d) the amount of each reagent present is such that the reaction will have some of one of the reagents left.