5. (2 pts) What is the coefficient in front of NaCl when the following equation is balanced using lowest possible whole number stoichiometric coefficients?
\[ 3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow 1\text{Ca}_3\text{(PO}_4)_2 + 6\text{NaCl} \]
(a) 1
(b) 2
(c) 3
(d) 6
(e) 9

5. (2 pts) What is the coefficient in front of \( \text{H}_2\text{O} \) when the following equation is balanced using lowest possible whole number stoichiometric coefficients?
\[ 2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{I}_2 \]
(a) 3
(b) 2
(c) 4
(d) 1
(e) 6

4. (3 pts) Consider the following reaction: \( 4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O} \)
What will be the limiting reagent when 15 grams of \( \text{NH}_3 \) reacts with 33 grams of \( \text{O}_2 \)?
(a) \( \text{NH}_3 \)
(b) \( \text{O}_2 \)
(c) \( \text{NO} \)
(d) \( \text{H}_2\text{O} \)
3. (2 pts) What is the molar mass of hydrobromic acid?

a) 80.9 g/mol  
b) 96.9 g/mol  
c) 128.9 g/mol  
d) 288.7 g/mol  
e) 384.7 g/mol

4. (3 pts) Consider the following reaction:  \(3 \text{NO}_2 + \text{H}_2\text{O} \rightarrow 2 \text{HNO}_3 + \text{NO}\)

What will be the limiting reagent when 63 grams of \(\text{NO}_2\) reacts with 20 grams of \(\text{H}_2\text{O}\)?

a) \(\text{NO}_2\)  
b) \(\text{H}_2\text{O}\)  
c) \(\text{HNO}_3\)  
d) \(\text{NO}\)

3. (4 pts) Calculate the total number of atoms in 40 grams of barium hydroxide (molar mass = 171.3 g/mol)

a) \(4.2 \times 10^{23}\)  
b) \(7.0 \times 10^{23}\)  
c) \(8.4 \times 10^{23}\)  
d) \(2.8 \times 10^{23}\)  
e) \(1.4 \times 10^{23}\)

3. (2 pts) A compound consists of only two elements, \(X\) and \(Y\). A sample of the compound is determined to contain 2.00 g of \(X\) and 1.90 g of \(Y\). How much \(X\) should another sample of this same compound contain if it contains 2.85 g of \(Y\).

a. 4.50 g  
b. 2.71 g  
c. 3.00 g  
d. 4.00 g  
e. 10.8 g

6. (3 points) How many atoms are present in 7.5 g of ammonia, \(\text{NH}_3\)?

a. \(9.0 \times 10^{23}\)  
b. \(7.3 \times 10^{-25}\)  
c. \(1.1 \times 10^{24}\)  
d. \(4.4 \times 10^1\)  
e. \(2.7 \times 10^{23}\)
9. (3 points) Nitrogen and oxygen form an extensive series of oxides with the general formula \( \text{N}_x\text{O}_y \). What is the empirical formula for an oxide that contains 36.85% by mass nitrogen?
   a. \( \text{NO}_2 \)
   b. \( \text{NO} \)
   c. \( \text{N}_2\text{O}_3 \)
   d. \( \text{N}_2\text{O} \)
   e. \( \text{N}_2\text{O}_5 \)

1. (3 points) When ethanol undergoes complete combustion, the products are carbon dioxide and water.
   \[ _n \text{C}_2\text{H}_5\text{OH}(l) + _m \text{O}_2(g) \rightarrow _p \text{CO}_2(g) + _q \text{H}_2\text{O}(g) \]
   What are the respective coefficients when the equation is balanced with the smallest whole numbers?
   a. 2, 7, 4, 6
   b. 1, 2, 1, 3
   c. 1, 1, 1, 1
   d. 2, 3, 4, 6
   e. 1, 3, 2, 3

2. (2 points) Europium has two naturally occurring isotopes. The average mass of Eu is 151.965 u. If 47.8% of Eu is found as Eu-151 (150.919847 u), what is the mass of the other isotope?
   a. 144.8 u
   b. 158.1 u
   c. 153.1 u
   d. 152.9 u
   e. 1.04 u

4. (3 points) A compound is found to be 14% hydrogen and 86% carbon. The empirical formula would be:
   a. \( \text{C}_7\text{H}_{14} \)
   b. \( \text{C}_2\text{H}_5 \)
   c. \( \text{CH}_2 \)
   d. \( \text{C}_4\text{H}_7 \)
   e. \( \text{C}_2\text{H} \)

6. (3 points) An ionic compound has the formula \( \text{MCl}_2 \). The mass of 0.3011 mol of the compound is 62.69 grams. What is the identity of the metal?
   a. \( \text{Hg} \)
   b. \( \text{Ba} \)
   c. \( \text{Ni} \)
   d. \( \text{Cu} \)
   e. \( \text{Sn} \)

8. (3 points) Consider the reaction:
   \[ 3 \text{MnO}_2(s) + 4 \text{Al}(s) \rightarrow 3 \text{Mn}(s) + 2 \text{Al}_2\text{O}_3(s) \]
   How many moles of which reagent are left over when 3.5 moles of \( \text{MnO}_2 \) reacts with 4.5 moles of \( \text{Al} \)? Assume that the reaction goes to completion.
   a. 0.16 mol \( \text{Al} \)
   b. 1.5 mol \( \text{Al} \)
   c. 0.13 mol \( \text{MnO}_2 \)
   d. 0.5 mol \( \text{Al} \)
   e. 0.5 mol \( \text{MnO}_2 \)
2. (2 pts) How many atoms of nitrogen are present in 8.00 g of magnesium nitride? 

A) $4.77 \times 10^{22}$ atoms

B) $9.54 \times 10^{22}$ atoms

C) $1.26 \times 10^{23}$ atoms

D) $1.59 \times 10^{23}$ atoms

E) $5.31 \times 10^{22}$ atoms

3. (2 pts) Calculate the molar mass of ammonium sulfate? 

A) 68.2 g/mol

B) 114.1 g/mol

C) 116.2 g/mol

D) 132.2 g/mol

E) none of these

4. (2 pts) Consider the following reaction: $4 \text{NH}_3 + 7 \text{O}_2 \rightarrow 4 \text{NO}_2 + 6 \text{H}_2\text{O}$

Identify the limiting reagent when 6 mol of NH$_3$ reacts with 10 mol of O$_2$. Assume that the reaction goes to completion.

A) NO$_2$

B) NH$_3$

C) O$_2$

D) H$_2$O

E) Both reagents are used up at the same time.
5. (2 pts) Consider the following reaction: \[ 2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O} \]
How many grams of \( \text{H}_2\text{O} \) will be formed when 36.8 g \( \text{H}_2 \) reacts with 40.2 g \( \text{O}_2 \)? Assume the reaction goes to completion.

A) 45.2 g  
B) 77.0 g  
C) 22.6 g  
D) 331 g  
E) 51.3 g

6. (2 pts) Sodium phosphate reacts with calcium nitrate to form sodium nitrate and calcium phosphate. What is the coefficient in front of sodium nitrate in the balanced equation using the smallest possible whole number stoichiometric coefficients?

\[ 2 \text{Na}_3 \text{PO}_4 + 3 \text{Ca(NO}_3)_2 \rightarrow 6 \text{NaNO}_3 + \text{Ca}_3(\text{PO}_4)_2 \]

A) 2  
B) 4  
C) 1  
D) 3  
E) 6

7. (3 pts) Consider the following reaction: \[ 2\text{H}_2\text{S} + \text{SO}_2 \rightarrow \text{S} + 2\text{H}_2\text{O} \]
In an experiment 3.0 moles of \( \text{H}_2\text{S} \) reacts with 2.0 moles of \( \text{SO}_2 \) to produce 4.0 moles of sulfur, \( \text{S} \). What is the percent yield of this reaction?

A) 50%  
B) 89%  
C) 75%  
D) 67%  
E) 100%

8. (3 pts) A metal oxide contains 74.2% metal by mass. Determine the identity of the metal oxide.

A) calcium oxide \( \xrightarrow{\text{CaO}} \) 61%  
B) strontium oxide \( \xrightarrow{\text{SrO}} \) 85%  
C) potassium oxide \( \xrightarrow{\text{K}_2\text{O}} \) 83%  
D) sodium oxide \( \xrightarrow{\text{Na}_2\text{O}} \) 74%  
E) rubidium oxide \( \xrightarrow{\text{Rb}_2\text{O}} \) 91%
4. (3 points) The combustion reaction \( \text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CO}_2(g) + 2 \text{H}_2\text{O}(l) \) can be classified as a(n)
   a. oxidation-reduction reaction
   b. metathesis reaction
   c. double replacement reaction
   d. precipitation reaction
   e. acid-base neutralization reaction

6. (5 points) Two stable isotopes of an element have isotopic masses of 10.0129 amu and 11.0093 amu. The average atomic mass is 10.81 amu. Which isotope is more abundant?
   a. The isotope with a mass of 11.0093 amu is more abundant.
   b. The isotope with a mass of 10.0129 amu is more abundant.
   c. There are equal amounts of each isotope.
   d. There is insufficient information to answer the question.

9. (6 points) Combustion analysis of 2.796 g of an unknown compound containing carbon, hydrogen, and oxygen produced 5.597 g of \( \text{CO}_2 \) and 2.268 g of \( \text{H}_2\text{O} \). What is the empirical formula of the compound?
   a. \( \text{C}_2\text{H}_10\text{O}_3 \)
   b. \( \text{C}_3\text{H}_6\text{O}_4 \)
   c. \( \text{C}_3\text{H}_5\text{O}_2 \)
   d. \( \text{C}_2\text{H}_3\text{O} \)
   e. \( \text{C}_2\text{H}_4\text{O} \)

16. (4 points) How many atoms are present in 7.5 g of ammonia, \( \text{NH}_3 \)?
   a. \( 4.4 \times 10^1 \)
   b. \( 7.3 \times 10^{-25} \)
   c. \( 1.1 \times 10^{24} \)
   d. \( 9.0 \times 10^{23} \)
   e. \( 2.7 \times 10^{23} \)

18. (5 points) What is the sum of the coefficients when the following equation is balanced using the lowest whole-numbered coefficients?
   \[
   4 \text{PH}_3(g) + 8 \text{O}_2(g) \rightarrow 1 \text{P}_4\text{O}_{10}(s) + 6 \text{H}_2\text{O}(g)
   \]
   a. 19
   b. 22
   c. 10
   d. 18
   e. 12

20. (6 points) How many grams of the excess reagent are left over when 6.00 g of \( \text{CS}_2 \) gas react with 10.0 g of \( \text{Cl}_2 \) gas in the following reaction?
   \[
   \text{CS}_2(g) + 3 \text{Cl}_2(g) \rightarrow \text{CCl}_4(l) + \text{S}_2\text{Cl}_2(l)
   \]
   a. 3.58 g
   b. 2.77 g
   c. 2.42 g
   d. 4.00 g
2. How many chlorine atoms are there in 64.3 grams of chlorine gas?

a) $2.73 \times 10^{23}$

b) $5.46 \times 10^{23}$

c) $6.02 \times 10^{23}$

d) $1.09 \times 10^{24}$

e) none of these

17. 35.0 grams of sodium reacts with 163.0 grams of iodine to form 53.8 grams of sodium iodide. The molar mass of sodium iodide is 149.89 g/mol. What is the percent yield for this reaction?

a) 27.9%

b) 23.9%

c) 35.9%

d) 100.%

e) none of these

20. Elemental analysis of a compound shows that it is 63.2% carbon, 8.76% hydrogen, and 28.1% oxygen by mass. What is the empirical formula of the compound?

a) $C_{0.632}H_{0.876}O_{0.281}$

b) $C_4H_5O$

c) $C_4H_5O$

d) $CH_2O$

e) none of these

22. Which compound has the greatest number of oxygen atoms in a 100 gram sample?

a) MgO

b) HCHO

c) CO$_2$

d) C$_6$H$_{12}$O$_6$

e) more than one of these

35. Consider the following reaction: $S_8$ (s) + 24 $F_2$ (g) $\rightarrow$ 8 $SF_6$ (g)

How many grams of $F_2$ are left over if you react 36.0 grams of $S_8$ with 400.0 grams of $F_2$? The reaction has a 73.8% yield.

a) 8.04 g

b) 104 g

c) 305 g

d) 358 g

e) none of these
36. Silver has two stable isotopes, $^{107}\text{Ag}$ (mass = 106.907 amu) and $^{109}\text{Ag}$ (mass = 108.910 amu). What is the abundance of $^{107}\text{Ag}$? **Note: you must use 107.868 amu as the average molar mass of silver.**

(a) 52.0%
(b) 37.6%
(c) 48.2%
(d) 0.00%
(e) 62.4%

3. A metal oxide contains 83.0% metal by mass. Determine the identity of the metal.

   a) Na
   b) Ca
   c) K
   d) Rb
   e) Sr

4. How many atoms of nitrogen are present in 3.52 g of calcium nitrate?

   a) $1.29 \times 10^{22}$
   b) $2.58 \times 10^{22}$
   c) $1.02 \times 10^{24}$
   d) $6.02 \times 10^{23}$
   e) $2.08 \times 10^{22}$

11. How many moles of sodium phosphate are required to react completely with 6.0 moles of calcium nitrate to form sodium nitrate and calcium phosphate?

   a) 1.0 mol
   b) 2.0 mol
   c) 4.0 mol
   d) 6.0 mol
   e) 8.0 mol
12. 10.0 g of Al and 10.0 g Br₂ react according to the equation \( 2 \text{Al} + 3 \text{Br}_2 \rightarrow 2 \text{AlBr}_3 \). What mass of AlBr₃ is formed, assuming 100% yield?

a) 10.0 g
b) 11.1 g
c) 25.0 g
d) 98.8 g
e) 110 g

32. A 0.4647-g sample of a compound known to contain only carbon, hydrogen, and oxygen was burned in oxygen to yield 0.8635 g of CO₂ and 0.1767 g of H₂O. What is the empirical formula of the compound?

a) CHO
b) C₂H₂O
c) C₃H₅O₂
d) C₄H₃O₂
e) C₃H₄O₂