Assignment 03 (A)

1- Balance the following equation:
   \[ \text{B}_{10}\text{H}_{18} + \text{O}_2 \rightarrow \text{B}_2\text{O}_3 + \text{H}_2\text{O} \]
   a) \( \text{B}_{10}\text{H}_{18} + 7\text{O}_2 \rightarrow 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O} \)
   b) \( \text{B}_{10}\text{H}_{18} + 19\text{O}_2 \rightarrow 10\text{B}_2\text{O}_3 + 9\text{H}_2\text{O} \)
   c) \( \text{B}_{10}\text{H}_{18} + 12\text{O}_2 \rightarrow 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O} \)
   d) \( \text{B}_{10}\text{H}_{18} + 9\text{O}_2 \rightarrow 5\text{B}_2\text{O}_3 + 9\text{H}_2\text{O} \)
   (There are 10 B, 18 H, and 24 O on each side of the equation)

2- How many carbon atoms are there in 200 molecules of \( \text{C}_3\text{H}_8\text{O} \)?
   a) 600 atoms
   b) 200 atoms
   c) 3.61 \times 10^{26} atoms
   d) 1.20 \times 10^{26} atoms
   (The ratio of molecules to carbon atoms is 1:3.)

3- What is the mass in grams of 0.257 mol of sucrose, \( \text{C}_{12}\text{H}_{22}\text{O}_{11} \)?
   a) 342 g
   b) 7.51 \times 10^{-4} g
   c) 88.0 g
   d) 8.80 g
   e) 12.5 g
   \((0.257 \text{ mol} \times 342 \text{ g/mol} = 88.0 \text{ g})\)

4- Balance the following equation and indicate whether it is a combustion, combination, or decomposition reaction.
   \[ \text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4 \]
   a) \( \text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4 \), decomposition reaction
   b) \( 2\text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4 \), decomposition reaction
   c) \( 2\text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4 \), combination reaction
   d) \( \text{H}_2\text{O}_2 + \text{SO}_2 \rightarrow \text{H}_2\text{SO}_4 \), combination reaction
   (Hydrogen peroxide and sulfur dioxide combine to give sulfuric acid.)

5- You are setting up a reaction between two chemicals that react according to the equation
   \[ 3 \text{A} + 4 \text{B} \rightarrow \text{products} \]
If you start with 1.00 mole each of both A and B, which chemical will be in excess at the end, and by how much (assuming the reaction goes to completion)?
   a) A is in excess by 0.333 mol.
   b) B is in excess by 0.333 mol.
   c) B is in excess by 0.250 mol.
   d) Neither A nor B is in excess, because the reaction "goes to completion."
   e) A is in excess by 0.250 mol.
   (Only three of the four quarters of A are required to react with the four quarters of B.)

6- For the reaction \( \text{Fe(CO)}_3 + 2\text{PF}_3 + \text{H}_2 \rightarrow \text{Fe(CO)}_2(\text{PF}_3)_2(\text{H})_2 + 3\text{CO} \), how many moles of CO are produced from a mixture of 5.0 mol \( \text{Fe(CO)}_3 \), 8.0 mol \( \text{PF}_3 \), and 6.0 mol \( \text{H}_2 \)?
   a) 15 mol
   b) 5.0 mol
   c) 18 mol
   d) 6.0 mol
   e) 12 mol
   (\( \text{PF}_3 \) is the limiting reagent.)
7- Determine the approximate formula weight of the following:

\[ \text{Ca(C}_2\text{H}_3\text{O}_2)\text{}_2 \]

a) 99  
b) 69  
c) 152  
d) 94  
e) 158

\[ (40 + (12 \times 4) + (1 \times 6) + (16 \times 4) = 158. \]

8- Balance the following equation:

\[ \text{Al} + \text{Cr}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + \text{Cr} \]

a) \[ 2\text{Al} + \text{Cr}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Cr} \]

b) \[ \text{Al} + \text{Cr}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Cr} \]

c) \[ 4\text{Al} + \text{Cr}_2\text{O}_3 \rightarrow 2\text{Al}_2\text{O}_3 + 4\text{Cr} \]

d) \[ 2\text{Al} + \text{Cr}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + \text{Cr} \]

(There are 2 Al, 2 Cr, and 3 O on each side of the equation.)

9- What mass of silver chloride can be made from the reaction of 4.22 g of silver nitrate with 7.73 g of aluminum chloride? (Be sure to balance the reaction.)

\[ \text{AgNO}_3 + \text{AlCl}_3 \rightarrow \text{Al(NO}_3)_3 + \text{AgCl} \]

a) 12.7 g  
b) 10.7 g  
c) 24.9 g  
d) 3.56 g

(There are 3, 1, 1, 3 AgNO\(_3\) is the limiting reagent.)

10- In order to balance the equation \( \text{C}_2\text{H}_6 + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{CO}_2 \), you should

a) add \( \text{H}_2 \) to the products to balance \( \text{H} \).

b) change the subscript of \( \text{O} \) in water to 2 to help balance the \( \text{O} \).

c) add \( \text{O}_2 \) to the product side to help balance the \( \text{O} \) in the equation.

d) change the coefficients.

(There is only characteristic of an equation that can be changed when balancing the equation.)

11- Calculate the mass in grams of 0.0112 mol of \( \beta \)-fructose, \( \text{C}_6\text{H}_{12}\text{O}_6 \).

a) 1.12 g  
b) 180. g  
c) 2.02 g  
d) 0.0112 g

\[ (0.0112 \text{ mol} \times 180. \text{ g/mol} = 2.02 \text{ g}) \]

12- Calculate the molecular weight of xenon tetrafluoride, \( \text{XeF}_4 \), a colorless, crystalline compound at room temperature.

a) 75.99 amu  
b) 207.28 amu  
c) 150.29 amu  
d) 601.15 amu  
e) 169.29 amu

\[ (131.29 + (18.998 \times 4) = 207.28 \text{ amu}) \]
13- Which of these samples contains the greatest number of atoms?
   a) a gram of americium
   b) a gram of europium
   c) a gram of francium
   d) a gram of gallium
   e) a gram of germanium
   *(This has the lowest atomic weight and therefore the highest number of moles.)*

14- What is the percent yield of CaO in the reaction CaCO₃ → CaO + CO₂ if 5.33 g of CaO are obtained when 10.0 g of CaCO₃ are used?
   a) 5.60%
   b) 53.3%
   c) 64.7%
   d) 5.33%
   e) **95.1%**
   *(The theoretical yield is 5.602 g, so the percent yield is (5.33 g/5.602 g) × 100%.)*

15- The alcohol in E85 fuel burns according to the following equation:
   C₂H₅OH + 3O₂ → 2CO₂ + 3H₂O
   How many grams of CO₂ are produced when 3.00 g of C₂H₅OH are burned in this way?
   a) 6.00 g
   b) 88.0 g
   c) 0.130 g
   d) **5.73 g**
   e) 2.87 g
   *(0.0651 moles of alcohol produce 0.130 moles of CO₂.)*

16- Calculate the mass percent of nitrogen in HNO₃.
   a) 45.2%
   b) 25.0%
   c) **22.2%**
   d) 20.0%
   e) none of these

17- Which of the following cannot be an empirical formula?
   a) CH
   b) CO₂
   c) NO₂
   d) C₃H₆
   e) H₂N
   *(The empirical formula for C₃H₆ is CH₃.)*

18- Consider the reaction C₇H₈ + 3HNO₃ → C₇H₅N₃O₆ + 3H₂O
   How many grams of HNO₃ are required to react with 10.0 g of C₇H₈?
   a) **20.5 g**
   b) 6.81 g
   c) 30.0 g
   d) 2.28 g
   e) 10.1 g
   *(The 10.0 g of C₇H₈ is converted to moles. Then the coefficients are used to find moles of HNO₃, which is used to find the mass of HNO₃ required to react.)*
19- Calculate the number of molecules in 6.2 g of formaldehyde, CH₂O.
   a. 3.7 × 10²⁴ molecules
   b. 1.2 × 10²³ molecules
   c. 2.4 × 10²³ molecules
   d. 6.0 × 10²³ molecules
   (There are 0.21 moles of CH₂O.)

20- A sample of glucose, C₆H₁₂O₆, contains 4.0 × 10²² atoms of carbon. How many atoms of hydrogen and how many molecules of glucose does it contain?
   a. 8.0 × 10²² atoms of H; 2.4 × 10²³ molecules of glucose
   b. 4.0 × 10²² atoms of H; 4.0 × 10²² molecules of glucose
   c. 8.0 × 10²² atoms of H; 8.0 × 10²² molecules of glucose
   d. 8.0 × 10²² atoms of H; 4.0 × 10²² molecules of glucose
   e. 8.0 × 10²² atoms of H; 6.7 × 10²¹ molecules of glucose
   (There is one carbon atom for every two hydrogen atoms, and six carbon atoms for every molecule of glucose.)

21- For the reaction 3NO₂ + H₂O → 2HNO₃ + NO, how many grams of HNO₃ can form when 1.00 g of NO₂ and 2.25 g of H₂O are allowed to react?
   a. 1.37 g
   b. 0.913 g
   c. 15.7 g
   d. 0.667 g
   (NO₂ is the limiting reagent. 0.0217 moles of NO₂ produce 0.0145 moles of HNO₃.)

22- If 4.0 moles of Li and 2.0 moles of O₂ are used in the reaction 4Li + O₂ → 2Li₂O, then the limiting reactant is __________ and the theoretical yield of Li₂O is __________ g.
   a. oxygen, 1.2 × 10¹³
   b. lithium, 6.0 × 10¹¹
   c. oxygen, 6.0 × 10¹⁷
   d. lithium, 3.0 × 10¹⁷
   (The theoretical yield is based on the complete conversion of grams of Li to grams of Li₂O; i.e., (4.0 mole Li)(2 mole Li₂O / 4 mole Li)(29.9 g).)

23- Potassium sulfate contains 44.9 percent potassium by mass. In a 50.0-g sample of potassium sulfate, the number of moles of potassium is:
   a. 1.28 mol
   b. 0.287 mol
   c. 2.00 mol
   d. 1.74 mol
   e. 0.574 mol
   ((0.449 x 50.0 g)/39.10 g/mol = 0.574 mol)

24- What is the empirical formula of a compound that contains 7.989 g of carbon and 2.011 g of hydrogen?
   a. C₃H
   b. C₄H₂
   c. CH₃
   d. C₂H₆
   e. C₃H₅
   (There are 0.6651 moles of carbon and 1.995 moles of hydrogen, or a 1:3 molar ratio.)
25- Aluminum and oxygen react according to the following equation:

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

In a certain experiment, 4.6 g Al was reacted with excess oxygen; 6.8 g of product was obtained. What was the percent yield of the reaction?

a. 74 %

b. **78 %**

c. 68 %

d. 134 %

*(8.7 g can theoretically be formed.)*