PRACTICE PROBLEMS:

1. When iron oxide, Fe_2O_3, reacts with 18.94 grams of aluminum metal, iron is produced along with 35.74 grams of aluminum oxide. What is the empirical formula for aluminum oxide?

Answers:

- ***First thing you MUST do is ask yourself: "What information is given in this question and what information must I calculate to answer this question correctly?" Okay, iron oxide has NOTHING to do with the question! Iron oxide is placed in the question as a distracter – get used to seeing things like this in your upper level courses (you must learn to ignore certain items and focus on others).***

- ***The 18.94 grams of Aluminum metal is important. The 35.74 grams of Aluminum oxide is also important. To find the Empirical Formula we must know the amounts of EACH element. We know the mass amount of the aluminum, but we do not know the amount of the oxygen (yet)… How can we determine the amount (mass) of the oxygen?***

- ***Since we know the mass amount of aluminum (18.94 g) and we know the mass of the compound that contains both aluminum and oxygen. The conservation of mass states that we cannot create or destroy matter – so to determine the mass of the oxygen, take the difference of the aluminum with oxygen from the aluminum:***

$$\begin{array}{l} 35.74 \text{ g } Al_xO_y \\ 18.94 \text{ g Al} \\ \hline 16.80 \text{ g O} \end{array}$$

- ***Let's know convert the mass (grams) to moles in order to determine the Empirical Formula for the compound.***

$$\textbf{\textit{Al:}} \quad \frac{18.94\ g\ Al}{} \times \frac{1\ mol\ Al}{26.98\ g} = 0.702\ mol\ Al \quad \textbf{:} \quad \frac{0.702\ mol}{0.702\ mol} = 1.00$$

$$\textbf{\textit{O:}} \quad \frac{16.80\ g\ O}{} \times \frac{1\ mol\ O}{16.00\ g} = 1.05\ mol\ O \quad \textbf{:} \quad \frac{1.05\ mol}{0.702\ mol} = 1.4957 = 1.50 = 1\frac{1}{2}$$

- ***Recall, we cannot have fractional values in our compound: So multiply each by the value in the denominator of the fraction…***

Al: 1.00 x 2 = 2 , O: 1.50 x 2 = 3

The ratio is:
2 : 3
Empirical Formula:
$\mathbf{Al_2O_3}$

2. Propane is a gas commonly used for cooking and heating. It contains the elements carbon and hydrogen. When 72.06 grams of carbon reacts with hydrogen gas, 88.06 grams of propane is produced. What is the empirical formula of propane?

Answers:

- ***Again, you are given a mass amount for one of the elements, but not for the other element. However, you are given the mass of the compound you are solving for… Therefore, take the difference between the compound and the known element mass:***

$$\begin{array}{l} 88.06 \text{ g } C_xH_y \\ 72.06 \text{ g C} \\ \hline 16.00 \text{ g H} \end{array}$$

- ***Again, convert the mass (grams) to moles:***

C: $\frac{72.06\ g\ C}{} \times \frac{1\ mol\ C}{12.01\ g} = 6.00\ mol\ C \qquad : \frac{6.00\ mol}{6.00\ mol} = 1.00$

H: $\frac{16.00\ g\ H}{} \times \frac{1\ mol\ H}{1.008\ g} = 15.87\ mol\ H \qquad : \frac{15.87\ mol}{6.00\ mol} = 2.6455 = 2\frac{2}{3}$

- ***Here is an interesting problem… How "much can you round"? When you calculate a decimal value, you will need to change the decimal to a fractional value. If you have Mr. Craig as your chemistry teacher, he will be looking to arrive at the following fractions (see to the right in the box): What I have seen in the past is that someone does a calculation and rounds the decimal way too much… Do Not round too much!!!***

.00 =	0
.25 =	$\frac{1}{4}$
.33 =	$\frac{1}{3}$
.50 =	$\frac{1}{2}$
.66 =	$\frac{2}{3}$
.75 =	$\frac{3}{4}$
1.00 =	0

- - ***We cannot have fractional values in our compound: So multiply each by the value in the denominator of the fraction…***

C: 1.00 x 3 = 3 , ***H:*** $2\frac{2}{3}$ ***x 3 = 8***

The ratio is:

3 : 8

Empirical Formula:

$\mathbf{C_3H_8}$