Friday Worksheet **Name: ……………….**

Gravimetric 1

1) Glyceryl trinitrate, more commonly known as nitroglycerin, is a compound of carbon, hydrogen, nitrogen and oxygen. Its molar mass is 227 g mol^{-1}.
   In an analysis of nitroglycerin, it was recorded that a 1.7321 g sample contains 0.2747 g of carbon, 0.3205 g of nitrogen and 1.0988 g of oxygen.

a. Use the data recorded in the analysis to determine: the molecular formula of glyceryl trinitrate.

Mass ratio C = 0.2747 : N = 0.3205 : O = 1.0988 : H = 0.0381
Mole ratio C = 0.0229 : N = 0.0229 : O = 0.0687 : H = 0.0381
Simplest ratio C = 1 : N = 1: O = 3: H = 1.66
Multiply by 3 to change to whole numbers C = 3 : N = 3: O = 9: H = 5
Empirical formula $C_3N_3O_9H_5$
Since the empirical mass and formula mass are equal the molecular formula is the same as the empirical formula. $C_3N_3O_9H_5$

b. Glyceryl trinitrate is an unstable compound which, when exposed to a shock, undergoes explosive decomposition to produce carbon dioxide, nitrogen, water vapour and oxygen according to the equation

$$\mathbf{4}\text{Glyceryl trinitrate} \rightarrow \mathbf{12}CO_{2(g)} + \mathbf{10}H_2O_{(g)} + \mathbf{6}N_{2(g)} + O_{2(g)}$$

A 50.1 g sample of glyceryl trinitrate decomposes explosively in a confined space of 800 mL. If a temperature of 227 ^{o}C is generated, calculate the pressure in MPa, that results from the explosion.

MPa = 1,000 KPa = 1,000,000 Pa
Mol of glyceryl trinitrate reacting = 50.1/227 = 0.221

According to the stoichiometry of the equation above if 0.221 mol of glyceryl trinitrate reacted then

- 0.221 X 3 mol of CO_2
- 0.221 X 2.5 mol of H_2O
- 0.221 X 1.5 mol of N_2
- 0.221 X 0.25 mol of O_2 are formed.

This give a total of 1.60 moles of gas particles.

We use the ideal gas equation PV = nRT
=> P =nRT / V
n = 1.60
R = 8.31
T = 500K
V = 0.800 L
=> P = 1.6 X 8.31 X 500 / 0.800 = 8310 KPa or 8.31 MPa.

When 50.0 mL of 0.168 M $AgNO_{3(aq)}$ is added to an aqueous solution of XO_4^{3-} ions, and reacts completely. A white precipitate is produced.
The precipitate is collected, dried, weighed and found to have a mass of 1.172 g.

a. Calculate the molar mass of the precipitate

Molar mass = mass/mol since we know the mass of precipitate 1.172g we now find the mol of precipitate.
Step 1 Find the mol of Ag
The equation for the reaction is
$3Ag^{+}(aq) + XO_4^{-3} \Rightarrow Ag_3XO_4$
$n_{Ag} = C \times V = 0.168\ M \times 0.0500L = 8.40 \times 10^{-3}$
$n_{precipitate} = (8.40 \times 10^{-3}) / 3 = 2.80 \times 10^{-3}$
Step 2 find the molar mass of the precipitate
molar mass $= 1.172 / 2.80 \times 10^{-3} = 419$

b. Identify element X.

$Ag_3XO_4 = 419$
$3 \times 108 + X + 4 \times 16.0 = 419$
$388 + X = 419$
$X = 31$ = *Phosphorus*

c. If the precipitate was not completely dry when weighed how would this affect the calculated molar mass? Explain your answer.

The mass of the precipitate would be higher as water would be present.
This would distort the molar mass of X and make it higher.