$$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$$

- 1) A student adds 200.0g of $C_7H_6O_3$ to an excess of $C_4H_6O_3$, this produces $C_9H_8O_4$ and $C_2H_4O_2$. Calculate the percent yield if 231 g of aspirin ($C_9H_8O_4$) is produced in an experiment.

$$C_7H_6O_3 + C_4H_6O_3 \rightarrow C_9H_8O_4 + C_2H_4O_2$$

$$\frac{200\text{ g } C_7H_6O_3}{} \left| \frac{1\text{ mol } C_7H_6O_3}{138\text{ g } C_7H_6O_3} \right| \frac{1\text{ mol } C_9H_8O_4}{1\text{ mol } C_7H_6O_3} \left| \frac{180\text{ g } C_9H_8O_4}{1\text{ mol } C_9H_8O_4} \right.$$

$= 260.87\text{ g } C_9H_8O_4$

$C_7H_6O_3$:
C – 7 x 12 = 84
H – 6 x 1 = 6
O – 3 x 16 = 48
= 138 g/mol $C_7H_6O_3$

$C_9H_8O_4$:
C – 9 x 12 = 108
H – 8 x 1 = 8
O – 4 x 16 = 64
= 180 g/mol $C_9H_8O_4$

$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100 = \%\text{ Yield}$$

$$\frac{231\text{ g } C_9H_8O_4}{260.87\text{ g } C_9H_8O_4} \times 100 = \mathbf{88.5\ \%}$$

$$C_7H_8 + HNO_3 \rightarrow C_7H_7NO_2 + H_2O$$

- 2) According to the following equation, Calculate the percentage yield if 550.0 g of toluene (C_7H_8)added to an excess of nitric acid (HNO_3) provides 305 g of the p-nitrotoluene ($C_7H_7NO_2$) product in a lab experiment.

$$C_7H_8 + HNO_3 \rightarrow C_7H_7NO_2 + H_2O$$

$$\frac{550.0\text{ g } C_7H_8}{} \times \frac{1\text{ mol } C_7H_8}{92\text{g } C_7H_8} \times \frac{1\text{ mol } C_7H_7NO_2}{1\text{ mol } C_7H_8} \times \frac{137\text{g } C_7H_7NO_2}{1\text{ mol } C_7H_7NO_2}$$

$= 819\text{ g } C_7H_7NO_2$

C – 7 x 12 = 84
H – 8 x 1 = 8
= 92 g/mol C_7H_8

C – 7 x 12 = 84
H – 7 x 1 = 7
N – 1 x 14 = 14
O – 2 x 16 = 32
= 137 g/mol $C_7H_7NO_2$

$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100 = \%\text{ Yield}$$

$$\frac{305\text{ g } C_7H_7NO_2}{819\text{ g } C_7H_7NO_2} \times 100 = \mathbf{37.2\%}$$

$$2Al + 3CuSO_4 \rightarrow 3Cu + Al_2(SO_4)_3$$

- 3) Aluminum reacts with an aqueous solution containing excess copper (II) sulfate. If 1.85 g Al reacts and the percentage yield of Cu is 56.6%, what mass of Cu is produced?

$$2Al + 3CuSO_4 \rightarrow 3Cu + Al_2(SO_4)_3$$

$$\frac{1.85\text{ g Al}}{} \left| \frac{1\text{ mol Al}}{23\text{ g Al}} \right| \frac{1\text{ mol Cu}}{1\text{ mol Al}} \left| \frac{63.5\text{ g Cu}}{1\text{ mol Cu}} \right. = 6.52\text{ g Cu}$$

Al – 1 x 23 = 23
= 23 g/mol Al

Cu – 1 x 63.5 = 63.5
= 63.5 g/mol Cu

$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100 = \%\text{ Yield}$$

$$\text{Actual Yield} = \frac{\%\text{ Yield}}{100} \times \text{Theoretical Yield}$$

$$\text{Actual Yield} = \frac{56.6}{100} \times 6.52\text{ g Cu}$$

Actual Yield = **3.69 g Cu**

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

- 4) The combustion of methane(CH_4) produces carbon dioxide and water. Assume that 2.0 mol of CH_4 burned in the presence of excess air. What is the percentage yield if in an experiment the reaction produces 87.0 g of CO_2?

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

$$\frac{2.0 \text{ mol } CH_4}{1} \times \frac{1 \text{ mol } CO_2}{1 \text{ mol } CH_4} \times \frac{44 \text{ g } CO_2}{1 \text{ mol } CO_2} = 88 \text{ g } CO_2$$

C – 1 x 12 = 12
O – 2 x 16 = 32
= 44 g/mol CO_2

$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100 = \% \text{ Yield}$$

$$\frac{87 \text{ g } CO_2}{88 \text{ g } CO_2} \times 100 = \mathbf{98.86\%}$$

$Li + Cu_3(PO_4)_2 \rightarrow Cu + Li(PO_4)_3$

- 5) 15.3 grams of Lithium is dropped into a solution containing excess copper II phosphate. When the reaction is completed, 1.25 grams of copper is formed. What is the percent yield?

$$Li + Cu_3(PO_4)_2 \rightarrow Cu + Li(PO_4)_3$$

$$\frac{15.3\text{ g Li}}{} \left| \frac{1\text{ mol Li}}{7\text{ g Li}} \right| \frac{1\text{ mol Cu}}{1\text{ mol Li}} \left| \frac{63.5\text{ g Cu}}{1\text{ mol Cu}} \right. = 138.8\text{ g Cu}$$

Li – 1 x 7 = 7
= 7 g/mol Li

Cu – 1 x 63.5 = 63.5
= 63.5 g/mol Cu

$$\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100 = \%\text{ Yield}$$

$$\frac{1.25\text{ g Cu}}{138.8\text{ g Cu}} \times 100 = \mathbf{0.9\ \%}$$