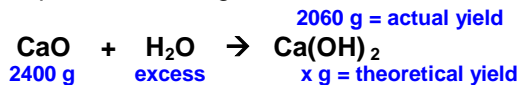


**Chemistry: Percent Yield**

Directions: Solve each of the following problems. Show your work, including proper units, to earn full credit.

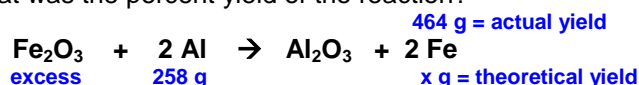
1. "Slaked lime,"  $\text{Ca(OH)}_2$ , is produced when water reacts with "quick lime,"  $\text{CaO}$ . If you start with 2 400 g of quick lime, add excess water, and produce 2 060 g of slaked lime, what is the percent yield of the reaction?



$$\text{x g Ca(OH)}_2 = 2400 \text{ g CaO} \left( \frac{1 \text{ mol CaO}}{56 \text{ g CaO}} \right) \left( \frac{1 \text{ mol Ca(OH)}_2}{1 \text{ mol CaO}} \right) \left( \frac{74 \text{ g Ca(OH)}_2}{1 \text{ mol Ca(OH)}_2} \right) = 3171 \text{ g Ca(OH)}_2$$

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \Rightarrow \% \text{ Yield} = \frac{2060 \text{ g Ca(OH)}_2}{3171 \text{ g Ca(OH)}_2} \times 100 \Rightarrow 65\%$$

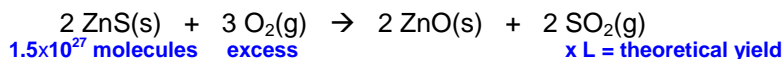
2. Some underwater welding is done via the thermite reaction, in which rust ( $\text{Fe}_2\text{O}_3$ ) reacts with aluminum to produce iron and aluminum oxide ( $\text{Al}_2\text{O}_3$ ). In one such reaction, 258 g of aluminum and excess rust produced 464 g of iron. What was the percent yield of the reaction?



$$\text{x g Fe} = 258 \text{ g Al} \left( \frac{1 \text{ mol Al}}{27 \text{ g Al}} \right) \left( \frac{2 \text{ mol Fe}}{2 \text{ mol Al}} \right) \left( \frac{55.8 \text{ g Fe}}{1 \text{ mol Fe}} \right) = 533 \text{ g Fe}$$

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \Rightarrow \% \text{ Yield} = \frac{464 \text{ g Fe}}{533 \text{ g Fe}} \times 100 \Rightarrow 87\%$$

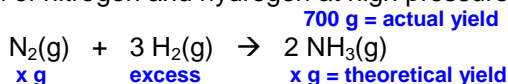
3. Use the balanced equation to find out how many liters of sulfur dioxide are actually produced at STP if  $1.5 \times 10^{27}$  molecules of zinc sulfide are reacted with excess oxygen and the percent yield is 75%.



$$\begin{aligned} \text{x L SO}_2 &= 1.5 \times 10^{27} \text{ molecules ZnS} \left( \frac{1 \text{ mol ZnS}}{6.02 \times 10^{23} \text{ molecules ZnS}} \right) \left( \frac{2 \text{ mol SO}_2}{2 \text{ mol ZnS}} \right) \left( \frac{22.4 \text{ L SO}_2}{1 \text{ mol SO}_2} \right) \\ &= 5.58 \times 10^4 \text{ L SO}_2 \leftarrow \text{theoretical yield} \end{aligned}$$

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \Rightarrow 0.75 = \frac{\text{x L SO}_2}{5.58 \times 10^4 \text{ L SO}_2} \Rightarrow 4.19 \times 10^4 \text{ L SO}_2$$

4. The Haber process is the conversion of nitrogen and hydrogen at high pressure into ammonia, as follows:



If you must produce 700 g of ammonia, what mass of nitrogen should you use in the reaction, assuming that the percent yield of this reaction is 70%?

$$\% \text{ Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 \Rightarrow 0.70 = \frac{700 \text{ g NH}_3}{\text{x g NH}_3} \Rightarrow 1000 \text{ g NH}_3$$

$$\text{x g N}_2 = 1000 \text{ g NH}_3 \left( \frac{1 \text{ mol NH}_3}{17 \text{ g NH}_3} \right) \left( \frac{1 \text{ mol N}_2}{2 \text{ mol NH}_3} \right) \left( \frac{28 \text{ g N}_2}{1 \text{ mol N}_2} \right) = 824 \text{ g N}_2$$

Answers:

1. 65%

2. 87%

3.  $4.19 \times 10^4 \text{ L SO}_2$

4. 824 g  $\text{N}_2$



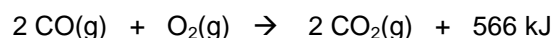
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## Chemistry: *Energy and Stoichiometry*

Directions: Solve each of the following problems. Show your work, including proper units, to earn full credit.

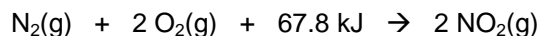
1. The combustion of propane ( $\text{C}_3\text{H}_8$ ) produces 248 kJ of energy per mole of propane burned. How much heat energy will be released when 1 000  $\text{dm}^3$  of propane are burned at STP?

2. Carbon monoxide burns in air to produce carbon dioxide according to the following balanced equation:



How many grams of carbon monoxide are needed to yield 185 kJ of energy?

3. Nitrogen gas combines with oxygen gas according to the following balanced equation:



Assuming that you have excess nitrogen, how much heat energy must be added to 540 g of oxygen in order to use up all of that oxygen?

4. Ethyl alcohol burns according to the following balanced equation:



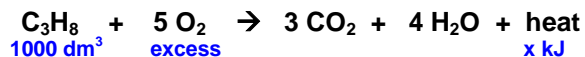
How many molecules of water are produced if 5 000 kJ of heat energy are released?

Answers:      1. 11 071 kJ      2. 18.3 g CO      3. 572 kJ      4.  $6.62 \times 10^{24}$  molecules  $\text{H}_2\text{O}$

## Chemistry: *Energy and Stoichiometry*

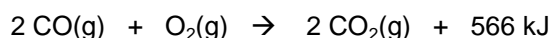
Directions: Solve each of the following problems. Show your work, including proper units, to earn full credit.

1. The combustion of propane ( $\text{C}_3\text{H}_8$ ) produces 248 kJ of energy per mole of propane burned. How much heat energy will be released when 1 000  $\text{dm}^3$  of propane are burned at STP?

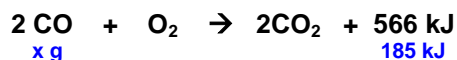


$$\text{x kJ} = 1000 \text{ dm}^3 \text{ C}_3\text{H}_8 \left( \frac{1 \text{ mol C}_3\text{H}_8}{22.4 \text{ L C}_3\text{H}_8} \right) \left( \frac{248 \text{ kJ}}{1 \text{ mol C}_3\text{H}_8} \right) = 11,071 \text{ kJ}$$

2. Carbon monoxide burns in air to produce carbon dioxide according to the following balanced equation:

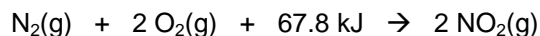


How many grams of carbon monoxide are needed to yield 185 kJ of energy?

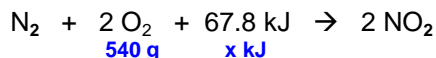


$$\text{x g CO} = 185 \text{ kJ} \left( \frac{2 \text{ mol CO}}{566 \text{ kJ}} \right) \left( \frac{28 \text{ g CO}}{1 \text{ mol CO}} \right) = 18.3 \text{ g CO}$$

3. Nitrogen gas combines with oxygen gas according to the following balanced equation:



Assuming that you have excess nitrogen, how much heat energy must be added to 540 g of oxygen in order to use up all of that oxygen?

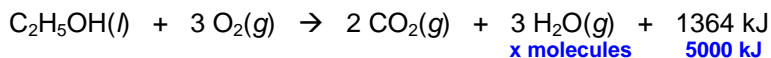


$$\text{x kJ} = 540 \text{ g O}_2 \left( \frac{1 \text{ mol O}_2}{32 \text{ g O}_2} \right) \left( \frac{67.8 \text{ kJ}}{2 \text{ mol O}_2} \right) = 572 \text{ kJ}$$

4. Ethyl alcohol burns according to the following balanced equation:



How many molecules of water are produced if 5 000 kJ of heat energy are released?



$$\text{x molecules H}_2\text{O} = 5000 \text{ kJ} \left( \frac{3 \text{ mol H}_2\text{O}}{1364 \text{ kJ}} \right) \left( \frac{6.02 \times 10^{23} \text{ molecules H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right) = 6.62 \times 10^{24} \text{ molecules H}_2\text{O}$$

Answers:      1. 11 071 kJ      2. 18.3 g CO      3. 572 kJ      4.  $6.62 \times 10^{24}$  molecules  $\text{H}_2\text{O}$