High School Science Virtual Learning

Chemistry

Theoretical Yield, Percent Yield, & Actual Yield

April 22, 2020

High School Chemistry
Lesson: 4/22/20

Objective/Learning Target:
Students will be able to calculate the theoretical yield and the percent yield, given an actual yield

Let's Get Started:

When sodium chloride reacts with silver nitrate, silver chloride precipitates.

1. Complete and balance the reaction described above.

2. What mass of AgCl is produced from 75.0 g $AgNO_3$?

Let's Get Started: Answer Key

1. $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$

2. $75\ g\ AgNO_3 \times \frac{1\ mole\ NO_3}{169.8\ g\ AgNO_3} \times \frac{1\ mole\ AgCl}{1\ mole\ NO_3} \times \frac{143.3\ g\ AgCl}{1\ mole\ AgCl} = 63g\ AgCl$

Lesson Activity:

Directions:

1. Answer the following questions on the handout, as you watch the following video.

Links:

- Video: Percent Yield Made Easy Video
- Handout: Percent Yield Made Easy Video Worksheet

Practice

Complete the following questions using the information you learned during the lesson activity.

Questions:

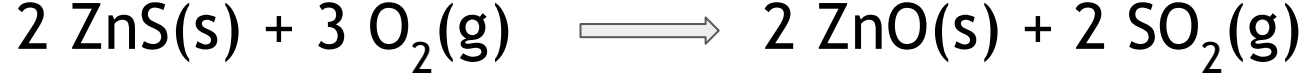
1. “Slaked lime,” $Ca(OH)_2$, is produced when water reacts with “quicklime,” CaO. If you start with 2400 g of quick lime, add excess water, and produce 2060 g of slaked lime, what is the percent yield of the reaction?

Questions:

2. Some underwater welding is done via the thermite reaction, in which rust (Fe_2O_3) reacts with aluminum to produce iron and aluminum oxide (Al_2O_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?

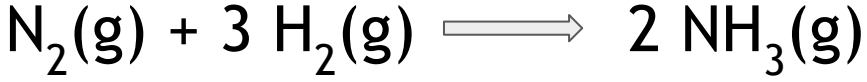
Questions:

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



Questions:

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%?

Once you have completed the practice questions check with the answer key.

1.

$$\underset{\text{2400 g}}{CaO} + \underset{\text{excess}}{H_2O} \rightarrow \underset{\text{x g = theoretical yield}}{Ca(OH)_2} \qquad \text{2060 g = actual yield}$$

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

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

2.

$$\underset{\text{excess}}{Fe_2O_3} + \underset{\text{258 g}}{2\,Al} \rightarrow Al_2O_3 + \underset{\text{x g = theoretical yield}}{2\,Fe} \qquad \text{464 g = actual yield}$$

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

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

Once you have completed the practice questions check with the answer key.

3. $$x\,L\,SO_2 = 1.5\times10^{27}\ m'cules\ ZnS\left(\frac{1\,mol\ ZnS}{6.02\times10^{23}\ m'cules\ ZnS}\right)\left(\frac{2\,mol\ SO_2}{2\,mol\ ZnS}\right)\left(\frac{22.4\,L\,SO_2}{1\,mol\ SO_2}\right)$$

$$= 5.58\times10^{4}\ L\,SO_2 \Leftarrow \text{theoretical yield}$$

$$\%\ Yield = \frac{\text{actual yield}}{\text{theoretical yield}}\times100 \Rightarrow 0.75 = \frac{X\ L\,SO_2}{5.58\times10^{4}\ L\,SO_2} \Rightarrow 4.19\times10^{4}\ L\,SO_2$$

4. $$\%\ Yield = \frac{\text{actual yield}}{\text{theoretical yield}}\times100 \Rightarrow 0.70 = \frac{700\ g\,NH_3}{X\,g\,NH_3} \Rightarrow 1000\ g\,NH_3$$

$$x\,g\,N_2 = 1000\ g\,NH_3\left(\frac{1\,mol\ NH_3}{17\,g\,NH_3}\right)\left(\frac{1\,mol\ N_2}{2\,mol\ NH_3}\right)\left(\frac{28\,g\,N_2}{1\,mol\ N_2}\right) = 824\ g\,N_2$$

More Practice:

Follow the links below to do more practice.

1. Percent Yield Worksheet
2. Percent Yield

Additional Practice:
Click on the link below for additional practice.
Khan Academy