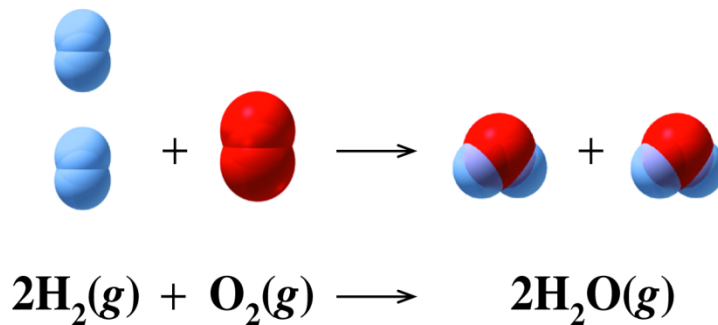




Chemical Quantities in Reactions

Percent Yield



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Theoretical, Actual, and Percent Yield

Theoretical yield

- The maximum amount of product calculated using the balanced equation. (This is the amount from dimensional analysis)

Actual yield

- The amount of product obtained when the reaction takes place.

Percent yield

- The ratio of actual yield to theoretical yield.

$$\text{percent yield} = \frac{\text{actual yield (g)}}{\text{theoretical yield (g)}} \times 100$$



Calculating Percent Yield

To calculate the percent yield, the actual yield and theoretical yield are needed.

You prepared cookie dough to make 5 dozen cookies. The phone rings and you answer. While talking, a sheet of 12 cookies burn and you have to throw them out. The rest of the cookies are okay. What is the percent yield of edible cookies?

Theoretical yield 60 cookies possible

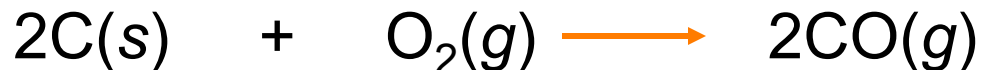
Actual yield 48 cookies to eat

Percent yield $\frac{48 \text{ cookies}}{60 \text{ cookies}} \times 100 = 80\% \text{ yield}$



Learning Check

Without proper ventilation and limited oxygen, the reaction of carbon and oxygen produces carbon monoxide.



What is the percent yield if 40.0 g CO are produced when 30.0 g O₂ are used?



Solution

theoretical yield of CO

$$\begin{aligned} & 30.0 \text{ g } \cancel{\text{O}_2} \times \frac{1 \text{ mol } \cancel{\text{O}_2}}{32.00 \text{ g } \cancel{\text{O}_2}} \times \frac{2 \text{ mol } \cancel{\text{CO}}}{1 \text{ mol } \cancel{\text{O}_2}} \times \frac{28.01 \text{ g CO}}{1 \text{ mol } \cancel{\text{CO}}} \\ & = 52.5 \text{ g CO (theoretical)} \end{aligned}$$

percent yield

$$\frac{40.0 \text{ g } \cancel{\text{CO}} \text{ (actual)}}{52.5 \text{ g } \cancel{\text{CO}} \text{ (theoretical)}} \times 100 = 76.2 \% \text{ yield}$$



Learning Check

When N_2 and 5.00 g H_2 are mixed, the reaction produces 16.0 g NH_3 . What is the percent yield for the reaction?





Solution



$$\begin{aligned} & 5.00 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.016 \text{ g H}_2} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol H}_2} \times \frac{17.03 \text{ g NH}_3}{1 \text{ mol NH}_3} \\ &= 28.2 \text{ g NH}_3 \text{ (theoretical)} \end{aligned}$$

$$\text{Percent yield} = \frac{16.0 \text{ g NH}_3}{28.2 \text{ g NH}_3} \times 100$$

$$= 56.7 \%$$