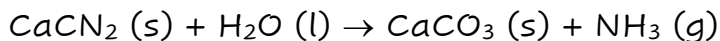


Stoichiometry Part 3: Limiting Reactant and Percent Yield

Consider the following chemical equation to answer the questions.



a) Check to see if the equation is balanced. If not, balance it.



b) Which is the limiting reagent if 23.25 g of CaCN_2 is reacted with 30.00 g of water? (show work)

First, determine the number of moles of CaCO_3 or NH_3 produced from each reactant. Here I use CaCO_3 .

$$23.25 \text{ g CaCN}_2 \times \frac{1 \text{ mol CaCN}_2}{80.102 \text{ g}} \times \frac{1 \text{ mol CaCO}_3}{1 \text{ mol CaCN}_2} = 0.2903 \text{ mol CaCO}_3$$

$$30.00 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.02 \text{ g}} \times \frac{1 \text{ mol CaCO}_3}{3 \text{ mol H}_2\text{O}} = 0.5549 \text{ mol CaCO}_3$$

CaCN_2 is the limiting reagent. Only 0.2903 mol CaCO_3 can be produced.

c) How many grams of CaCO_3 are produced?

mol \rightarrow g and 1 mole of $\text{CaCO}_3 = 100.0869 \text{ g}$

$$0.2903 \text{ mol CaCO}_3 \times \frac{100.0869 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = 29.06 \text{ g CaCO}_3$$

d) What is the percent yield if 27.34 g of CaCO_3 was recovered?

$$\% \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100 = \frac{27.34 \text{ g}}{29.06 \text{ g}} \times 100 = 94.1\%$$

e) How much water was left unreacted?

There are several ways to do this problem. I use mole ratios. I will use the mole ratio of CaCO_3 to H_2O to determine how much water is needed in the reaction. Then I subtract the amount of water required from the total amount given in the problem.

Mole Ratios: $\frac{3 \text{ mol H}_2\text{O}}{1 \text{ mol CaCO}_3}$ or $\frac{1 \text{ mol CaCO}_3}{3 \text{ mol H}_2\text{O}}$ and 1 mol $\text{H}_2\text{O} = 18.02 \text{ g}$

$$0.2903 \text{ mol CaCO}_3 \times \frac{3 \text{ mol H}_2\text{O}}{1 \text{ mol CaCO}_3} \times \frac{18.02 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 15.69 \text{ g H}_2\text{O needed for reaction}$$

$30.00 \text{ g H}_2\text{O} - 15.69 \text{ g H}_2\text{O} = \mathbf{14.31 \text{ g H}_2\text{O}}$ not reacted