Stoichiometry Math notes

Using the equation: $2H_2 + O_2 \rightarrow 2H_2O$

Mole Ratios

Mole ratios relate the amount of moles of any two substances in a balanced chemical equation.

$\frac{2 \text{ mol } H_2}{1 \text{ mol } O_2}$ or $\frac{1 \text{ mol } O_2}{2 \text{ mol } H_2}$ and $\frac{2 \text{ mol } H_2}{2 \text{ mol } H_2O}$ or $\frac{2 \text{ mol } H_2O}{2 \text{ mol } H_2}$ and $\frac{1 \text{ mol } O_2}{2 \text{ mol } H_2O}$ or $\frac{2 \text{ mol } H_2O}{1 \text{ mol } O_2}$

Mole → Mole Conversion

How many moles O_2 are consumed with 3.0 mole H_2?

given — mole ratio with desired on top, given on bottom

$$3.0 \text{ mol } H_2 \times \frac{1 \text{ mol } O_2}{2 \text{ mol } H_2} = 1.5 \text{ mol } O_2$$

Gram → Mole Conversion

How many moles O_2 are consumed with 4.0g H_2?

given — molar mass — mole ratio

$$4.0\text{g } H_2 \times \frac{1 \text{ mol } H_2}{2.0\text{g } H_2} \times \frac{1 \text{ mol } O_2}{2 \text{ mol } H_2} = 1.0 \text{ mol } O_2$$

Mole → Gram Conversion

How many grams O_2 are consumed with 2.0 mole H_2?

given — mole ratio — molar mass

$$2.0 \text{ mol } H_2 \times \frac{1 \text{ mol } O_2}{2 \text{ mol } H_2} \times \frac{32\text{g } O_2}{\text{mol } O_2} = 32\text{g } O_2$$

Gram → Gram Conversion

How many grams O_2 are consumed with 1.0 g H_2?

given — molar mass — mole ratio — molar mass

$$1.0\text{g } H_2 \times \frac{1 \text{ mol } H_2}{2.0\text{g } H_2} \times \frac{1 \text{ mol } O_2}{2 \text{ mol } H_2} \times \frac{32\text{g } O_2}{\text{mol } O_2} = 8.0\text{g } O_2$$

Percent Yield

What is the percent yield when 32.0g H_2O is formed from 2.00 mol H_2?

First, find theoretical yield.

$$2.00 \text{ mol } H_2 \times \frac{2 \text{ mol } H_2O}{2 \text{ mol } H_2} \times \frac{18\text{g } H_2O}{\text{mol } H_2O} = 36.0\text{g } H_2O$$

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\% = \frac{32.0\text{g } H_2O}{36.0\text{g } H_2O} \times 100\% = 88.9\%$$

Limiting Reactant

Stoichiometrically determine how much of reactant B is required to fully react reactant A. If the given amount of reactant A is greater than the calculated amount, A is in excess. If given amount of reactant A is less than the calculated amount, A is the limiting reactant.

Given 9.0 mol H_2 and 8.0 mol O_2, which is the limiting reactant?

$$9.0 \text{ mol } H_2 \times \frac{1 \text{ mol } O_2}{2 \text{ mol } H_2} = 4.5 \text{ mol } O_2$$

O_2 is in excess; H_2 is the limiting reactant.