

This chapter we look at the application & usefulness of balanced chemical equations.

Name **STURMAN KEY**

12.1 The Arithmetic of Equations

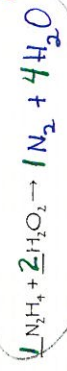
Stoichiometry is:

quantitative relationship between chemical formulas & chemical reactions.

Greek: stoichion = element & metron = measure

How much nitrogen and water will hydrazine (rocket fuel) and hydrogen peroxide make?

Step 1: Write the balanced chemical reaction.



Check: Am I incurred here??

Step 2: Interpret the balanced chemical reaction in terms of molecules and moles.

1 mole of hydrazine reacts w/ 2 moles of H_2O_2 to create 1 mole of nitrogen gas (molecules) & 4 moles of water (molecules).

Step 3: Convert the required number of moles to the required amount of mass.

Need M_r of all reactants & products

$1 \text{ mol N}_2\text{H}_4 = 32.06 \text{ g N}_2\text{H}_4$

$1 \text{ mol N}_2 = 28.02 \text{ g N}_2$

Step 4: Check to see if the conservation of mass law is obeyed.

$32.06 \text{ g} + 68.04 \text{ g} = 100.10 \text{ g}$
 $1 \text{ N}_2 + 2 \text{ O}_2 = 28.02 \text{ g} + 72.08 \text{ g} = 100.10 \text{ g}$

*What if you had only half the amount of moles, how much reactant would be produced?

Only half. (disregarding limiting reagent) < about later.

How many moles of ammonium nitrate is involved in its decomposition?



How many moles of nitrous oxide and water would be produced from 6.65 moles of ammonium nitrate? 3 methods

Method 1: Look at ratios

$1 : 1 : 2$
 $1 (6.65) = 6.65 \text{ mol N}_2\text{O}$
 $2 (6.65) = 13.30 \text{ mol H}_2\text{O}$

Method 2: Proportion

$\frac{1 \text{ mol NH}_4\text{NO}_3}{2 \text{ mol H}_2\text{O}} = \frac{6.65 \text{ mol NH}_4\text{NO}_3}{x \text{ mol H}_2\text{O}}$
 $x = 13.3 \text{ mol H}_2\text{O}$

Method 3: Dimensional Analysis

$\frac{6.65 \text{ mol NH}_4\text{NO}_3}{1} \cdot \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol NH}_4\text{NO}_3} = 13.3 \text{ mol H}_2\text{O}$

Remember $\text{Br}_2\text{I}_2\text{Cl}_2\text{H}_2\text{O}_2\text{F}_2$

Sample problems:

1. How many moles of HCl are needed to react with 2.30 moles of Zn?



$\frac{2.30 \text{ mol Zn}}{1} \cdot \frac{2 \text{ mol HCl}}{1 \text{ mol Zn}} = 4.60 \text{ mol HCl}$

2. How many moles of oxygen are needed to burn 0.520 moles of magnesium to produce magnesium oxide?



$\frac{0.520 \text{ mol Mg}}{2 \text{ mol Mg}} \cdot \frac{1 \text{ mol O}_2}{2 \text{ mol Mg}} = 0.13 \text{ mol O}_2$

3. How many moles of aluminum nitrate will be produced when 0.750 moles of silver nitrate reacts with aluminum?



$\frac{0.75 \text{ mol AgNO}_3}{3 \text{ mol AgNO}_3} \cdot \frac{1 \text{ mol Al(NO}_3)_3}{1 \text{ mol Al(NO}_3)_3} = 0.25 \text{ mol Al(NO}_3)_3$