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 for incorrect here??

$1N_2H_4 + 2H_2O_2 \rightarrow 1N_2 + 4H_2O$

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

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

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

Need μ of all reactants & products

$1\ mol\ N_2H_4 = 32.06\ g\ N_2H_4$

$1\ mol\ N_2 = 28.02\ g\ N_2$

$\frac{2\ mol\ H_2O_2}{1} \cdot \frac{34.02\ g}{1\ mol} = 68.04\ g\ H_2O_2$

$\frac{4\ mol\ H_2O}{1} \cdot \frac{18.02\ g}{1\ mol} = 72.08\ g\ H_2O$

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

$N_2H_4 + 2H_2O_2 \rightarrow 1N_2 + 4H_2O$

$32.06\ g + 68.04\ g = 100.10\ g$ ✓ $\quad 28.02\ g + 72.08\ g = 100.10\ g$ ✓

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

Only half. (disregarding limiting reagent) ← will talk about later.

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

$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

1 mole of NH_4NO_3 decomposes into 1 mole of nitrous oxide & 2 moles of H_2O.

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

$1(6.65) = 6.65\ mol\ N_2O$

$2(6.65) = 13.30\ mol\ H_2O$

Method 2: Proportion

$\frac{1\ mol\ NH_4NO_3}{2\ mol\ H_2O} = \frac{6.65\ mol\ NH_4NO_3}{x\ mol\ H_2O}$

$x = 13.3\ mol\ H_2O$

Method 3: Dimensional Analysis

$\frac{6.65\ mol\ NH_4NO_3}{1} \cdot \frac{2\ mol\ H_2O}{1\ mol\ NH_4NO_3} = 13.3\ mol\ H_2O$

Remember $Br_2I_2N_2Cl_2H_2O_2F_2$

Sample problems:

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

$2HCl + Zn \rightarrow ZnCl_2 + H_2$

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

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

$2Mg + O_2 \rightarrow 2MgO$

$\frac{0.520\ mol\ Mg}{1} \cdot \frac{1\ mol\ O_2}{2\ mol\ Mg} = .52\ mol\ O_2$

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

$3AgNO_3 + Al \rightarrow Al(NO_3)_3 + 3Ag$

$\frac{0.75\ mol\ AgNO_3}{1} \cdot \frac{1\ mol\ Al(NO_3)_3}{3\ mol\ AgNO_3} = .25\ mol\ Al(NO_3)_3$