Stoichiometry

study of the quantity relationships in chemical reactions

- use a concept called the MOLE RATIO

comes from the balanced equations

Balance the equation:

$1\ N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

means: 1 mol N_2 + 3 mol H_2 → 2 mol NH_3

what if: 2 mol N_2 + 6 mol H_2 → 4 mol NH_3

½ mol N_2 + 1½ mol H_2 → 1 mol NH_3

$$\text{mole ratio} = \frac{\text{moles unknown substance}}{\text{moles given substance}}$$

$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

Ex. given: H_2
unknown: NH_3

$$\text{mole ratio} = \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2}$$

given: N_2
unknown: H_2

$$\text{mole ratio} = \frac{3 \text{ mol } H_2}{1 \text{ mol } N_2}$$

given: NH_3
unknown: H_2

$$\text{mole ratio} = \frac{3 \text{ mol } H_2}{2 \text{ mol } NH_3}$$

Stoichiometry Problems

Ex) $16\,Fe(s) + 3\,S_8(s) \rightarrow 8\,Fe_2S_3(s)$

GIVEN ? ?

How many moles of iron (III) sulfide are produced from reacting 6.52 mol sulfur with excess iron? GIVEN

$$\frac{6.52\ \text{mol}\ S_8}{} \left| \frac{8\ \text{mol}\ Fe_2S_3}{3\ \text{mol}\ S_8} \right. = 17.4\ \text{mol}\ Fe_2S_3$$

mole ratio

Ex) given ?

$C_3H_8(l) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(g)$

How many moles of oxygen are needed to completely react with .864 mol propane (C_3H_8)? GIVEN

$$\frac{.864\ \text{mol}\ C_3H_8}{} \left| \frac{5\ \text{mol}\ O_2}{1\ \text{mol}\ C_3H_8} \right. = 4.32\ \text{mol}\ O_2$$

Ex) $2\,CrCl_3(aq) + 3\,Ca(s) \rightarrow 2\,Cr(s) + 3\,CaCl_2(aq)$

given ?

How many moles of chromium are produced from reacting 10.5 mol of calcium with excess chromium (III) chloride? GIVEN

$$\frac{10.5\ \text{mol}\ Ca}{} \left| \frac{2\ \text{mol}\ Cr}{3\ \text{mol}\ Ca} \right. = 7.00\ \text{mol}\ Cr$$

Ex) given ?

$2\,H_2SO_4(aq) + Pb(OH)_4(s) \rightarrow Pb(SO_4)_2(s) + 4\,H_2O$

How many moles of lead (IV) sulfate are produced from reacting 0.00505 mol of sulfuric acid with excess lead (IV) hydroxide? GIVEN

$$\frac{.00505\ \text{mol}\ H_2SO_4}{} \left| \frac{1\ \text{mol}\ Pb(SO_4)_2}{2\ \text{mol}\ H_2SO_4} \right. = .00253\ \text{mol}\ Pb(SO_4)_2$$