Chemistry   Name KEY

Unit   Study Guide (Ch-9: Stoichiometry)   Period ____ Date ________

Show all work!!!

Complete stoichiometric calculations between reactants and products, given a balanced chemical equation.

1. Answer the following questions based on the balanced chemical equation written below:

$$2\ C_8H_{18}\ (g)\ +\ 25\ O_2\ (g)\ \rightarrow\ 16\ CO_2\ (g)\ +\ 18\ H_2O\ (g)$$

a. If 0.38 moles of oxygen gas are consumed, then how many moles of carbon dioxide are produced?

$$(.38\ mol\ O_2)\left(\frac{16\ mol\ CO_2}{25\ mol\ O_2}\right) = .24\ mol\ CO_2$$

b. How many moles of fuel (C_8H_{18}) are required to produce 7.4 moles of water vapor?

$$(7.4\ mol\ H_2O)\left(\frac{2\ mol\ C_8H_{18}}{18\ mol\ H_2O}\right) = .82\ mol\ C_8H_{18}$$

c. What is the mole ratio between carbon dioxide and fuel (C_8H_{18})?

$$\frac{16\ mol\ CO_2}{2\ mol\ C_8H_{18}}$$

d. If 27.9 g of fuel (C_8H_{18}) is burned, then how many liters of CO_2 are produced after cooling to STP?

$$(27.9\ g\ C_8H_{18})\left(\frac{1\ mol\ C_8H_{18}}{114.2\ g}\right)\left(\frac{16\ mol\ CO_2}{2\ mol\ C_8H_{18}}\right)\left(\frac{22.4\ L}{1\ mol\ CO_2}\right) = 43.8\ L\ CO_2$$

e. How many moles of water vapor are produced if 7.14 x 10^{25} molecules of oxygen gas are consumed?

$$(7.14\times10^{25}\ molecules\ O_2)\left(\frac{1\ mol\ O_2}{6.02\times10^{23}\ molecules\ O_2}\right)\left(\frac{18\ mol\ H_2O}{25\ mol\ O_2}\right) = 85.4\ mol\ H_2O$$

f. How many liters of oxygen (at STP) are required to react with 350 g of fuel (C_8H_{18})?

$$(350\ g\ C_8H_{18})\left(\frac{1\ mol\ C_8H_{18}}{114.2\ g}\right)\left(\frac{25\ mol\ O_2}{2\ mol\ C_8H_{18}}\right)\left(\frac{22.4\ L}{1\ mol}\right) = 860\ L\ O_2$$

g. How many molecules of carbon dioxide are produced when 2.50 L of water vapor are produced at STP?

$$(2.50\ L\ H_2O)\left(\frac{1\ mol\ H_2O}{22.4\ L}\right)\left(\frac{16\ mol\ CO_2}{18\ mol\ H_2O}\right)\left(\frac{6.02\times10^{23}\ CO_2\ molecules}{1\ mol\ CO_2}\right)$$

$$= 5.97\times10^{22}\ CO_2\ molecules$$

Determine the limiting and excess reagent from a balanced chemical reaction

2. Given: $4\ NH_3\ (g) + 5\ O_2(g) \rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$

a. Determine the limiting and excess reagent when 3.5 moles of NH_3 are combined with 4.7 moles of oxygen gas.

$$\left(3.5\ \text{mol}\ NH_3\right)\left(\frac{4\ \text{mol NO}}{4\ \text{mol}\ NH_3}\right) = 3.5\ \text{mol NO}$$

$$\left(4.7\ \text{mol}\ O_2\right)\left(\frac{4\ \text{mol NO}}{5\ \text{mol}\ O_2}\right) = 3.8\ \text{mol NO}$$

3.5 mol < 3.8 mol ⇓ NH_3 is LRA

b. Based on your answer to (a), how many grams of NO can be produced when combining 3.5 moles of NH_3 with 4.7 moles of oxygen gas.

$$\left(3.5\ \text{mol NO}\right)\left(\frac{30.01\ \text{g NO}}{1\ \text{mol NO}}\right) = 110\ \text{g NO}$$

c. Based on your answer to (a) how much excess reagent is leftover when the reaction runs to completion:

$$\left(3.5\ \text{mol}\ NH_3\right)\left(\frac{5\ \text{mol}\ O_2}{4\ \text{mol}\ NH_3}\right) = 4.4\ \text{mol}\ O_2\ \text{(consumed)}$$

$$4.7\ \text{mol}\ O_2 - 4.4\ \text{mol}\ O_2 = .3\ \text{mol}\ O_2\ \text{leftover}$$

[Skill 6.c] Determine the percent yield of a product given the experimental yield.

3. Lithium and nitrogen react to produce lithium nitride:

$$6\ Li\ (s) + N_2\ (g) \rightarrow 2\ Li_3N\ (s)$$

a. Determine the theoretical yield of lithium nitride when 5.87 g of lithium is entirely consumed with excess nitrogen gas.

$$\left(5.87\ \text{g Li}\right)\left(\frac{1\ \text{mol Li}}{6.941\ \text{g}}\right)\left(\frac{2\ \text{mol}\ Li_3N}{6\ \text{mol Li}}\right)\left(\frac{34.83\ \text{g}\ Li_3N}{1\ \text{mol}\ Li_3N}\right) = 9.82\ \text{g}\ Li_3N$$

b. You run this reaction in the lab, reacting 5.87 g of lithium with excess nitrogen, and you recover an actual yield of 8.17 g lithium nitride. Determine the percent yield.

$$\%\ \text{yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

$$\%\ \text{yield} = \frac{8.17\ \text{g}}{9.82\ \text{g}} \times 100\% = 83.2\%$$