PRACTICE

What is the limiting reactant when 25.0 mole of iron (III) oxide reacts with 30.0 moles of carbon monoxide?

25.0 mol 30.0 mol

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

need have

$25.0\text{ m } Fe_2O_3 \times \frac{3\text{ mol CO}}{1\text{ mol } Fe_2O_3} = 75.0\text{ mol CO}$ 30.0 mol CO

LR

$30.0\text{ mol CO} \times \frac{1\text{ mol } Fe_2O_3}{3\text{ mol CO}} = 10.0\text{ mol } Fe_2O_3$ 25.0 mol Fe_2O_3

XS

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PRACTICE

H_2 - XS

N_2 - LR

What is the limiting reactant if 3.50 grams of hydrogen reacts with 5.00 grams of nitrogen?

3.50g 5.00g

$3H_2 + N_2 \rightarrow 2NH_3$

need

$3.50\text{g } H_2 \times \frac{1\text{ mol } H_2}{2\text{ g } H_2} \times \frac{1\text{ mol } N_2}{3\text{ mol } H_2} \times \frac{28\text{g } N_2}{1\text{ mol } N_2} = 16.3\text{g } N_2$

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HOW MUCH PRODUCT IS FORMED?

To find the amount of product formed:

- Start your calculation with the amount of the limiting reactant given in the problem
- Limiting reactants always determine the amount of product formed.

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PRACTICE:

LR XS

$6\ CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

10.0 mol *12.2 mol*

a. What is the limiting reactant?

need have

$10.0\ mol\ CO_2 \times \frac{6\ mol\ H_2O}{6\ mol\ CO_2} =$ 10.0 mol H_2O 12.2 mol H_2O

2.2 mol H_2O in XS

b. How many moles of glucose will be produced by this reaction?

$10.0\ mol\ CO_2 \times \frac{1\ mol\ C_6H_{12}O_6}{6\ mol\ CO_2} = 1.67\ mol\ C_6H_{12}O_6$

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PRACTICE:

LR XS

P_4 (s) + 5 O_2 (g) --> P_4O_{10} (s)

2.10 mol *11.8 mol*

a. What is the limiting reactant?

need have

$2.10\ mol\ P_4 \times \frac{5\ mol\ O_2}{1\ mol\ P_4} = 10.5\ mol\ O_2$ $11.8\ mol\ O_2$

b. How many grams of P_4O_{10} will be produced by this reaction?

$2.10\ mol\ P_4 \times \frac{1\ mol\ P_4O_{10}}{1\ mol\ P_4} \times \frac{284\ g\ P_4O_{10}}{1\ mol\ P_4O_{10}} = 596\ g\ P_4O_{10}$

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Percent Yield:

- Not all chemical reactions go smoothly or as planned
- Because of this, we have a mathematical way to calculate the efficiency of a reaction.

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Percent Yield:

Actual Yield: the amount that you end up with in the lab (what is actually produced)

↖ lab data

Theoretical Yield: the amount that you *could* end up with (calculated amount)

↖ stoich

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Percent Yield:

Equation:

from Lab

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

from calculations (stoich)

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Practice:

Antacids often contain aluminum hydroxide to neutralize stomach acid (HCl). If a tablet contains 14.0g of aluminum hydroxide, determine the theoretical yield of $AlCl_3$ produced in the reaction with stomach acid.

$Al(OH)_3 + 3HCl \rightarrow 3HOH + AlCl_3$

14.0 g; X g

$14.0\,g\,Al(OH)_3 \times \frac{1\,mol\,Al(OH)_3}{78\,g\,Al(OH)_3} \times \frac{1\,mol\,AlCl_3}{1\,mol\,Al(OH)_3} \times \frac{132\,g\,AlCl_3}{1\,mol\,AlCl_3} = 23.7\,g\,AlCl_3$

If the actual yield of aluminum chloride is 22.0 g, what is the percent yield?

$\frac{22.0\,g\,AlCl_3}{23.7\,g\,AlCl_3} \times 100 = 92.8\%$

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Practice:

Ethanol (C_2H_5OH) is produced from the fermentation of sucrose in the presence of enzymes. Determine the theoretical and percent yields of ethanol if 684 g of sucrose undergoes fermentation and 349 g of ethanol is obtained.

$C_{12}H_{22}O_{11}(aq) + H_2O(l) \rightarrow 4C_2H_5OH(l) + 4CO_2(g)$

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