CH 221 Limiting Reactant Example

Hexane (C_6H_{14}) burns in air (O_2) to give CO_2 and H_2O.

- Write a balanced equation for this reaction.
- If 215 g of C_6H_{14} is mixed with 215 g of O_2, what masses of CO_2 and H_2O are produced in the reaction?
- What mass of excess reactant remains at the end of the reaction?
- If 151.3 g of CO_2 are collected, what is the percent yield of CO_2?

$2\ C_6H_{14}(\ell) + 19\ O_2(g) \rightarrow 12\ CO_2(g) + 14\ H_2O(g)$

215 g C_6H_{14} * (mol/86.18 g) * (12 mol CO_2 / 2 mol C_6H_{14}) * 44.01 g/mol = 658 g CO_2

215 g O_2 * (mol/32.00 g) * (12 mol CO_2 / 19 mol O_2) * 44.01 g/mol = 187 g CO_2 (**Theo. yield)**

Excess Reactant = C_6H_{14}, ***Limiting Reactant = O_2***

$$215\text{ g } O_2 * (\text{mol}/32.00\text{ g}) \cdot \frac{12\text{ mol } CO_2}{19\text{ mol } O_2} \cdot \frac{44.01\text{ g}}{1\text{ mol } CO_2} = \mathbf{187\text{ g } CO_2}$$

$$215\text{ g } O_2 * (\text{mol}/32.00\text{ g}) \cdot \frac{14\text{ mol } H_2O}{19\text{ mol } O_2} \cdot \frac{18.02\text{ g}}{1\text{ mol } H_2O} = \mathbf{89.2\text{ g } H_2O}$$

$$215\text{ g } O_2 * (\text{mol}/32.00\text{ g}) \cdot \frac{2\text{ mol } C_6H_{14}}{19\text{ mol } O_2} \cdot \frac{86.18\text{ g}}{1\text{ mol } C_6H_{14}} = \mathbf{60.9\text{ g } C_6H_{14}\text{ used}}$$

215 g C_6H_{14} available – 60.9 g C_6H_{14} used = **154 g C_6H_{14} remains**

%yield = (151.3 / 187) * 100% = **80.9% CO_2**

Try it yourself:

Calcium oxide and ammonium chloride can be combined to give ammonia (NH_3), water and calcium chloride.

- Write a balanced equation for this reaction.
- If 112 g of calcium oxide is mixed with 224 g of ammonium chloride, what mass of NH_3 should be produced in the reaction?
- What mass of excess reactant remains at the end of the reaction?
- If only 16.3 g of NH_3 are collected, what is the percent yield of NH_3?

Answers appear on the next page.

CH 221 Limiting Reactant Example - *Answers*

Calcium oxide and ammonium chloride can be combined to give ammonia (NH_3), water and calcium chloride.

- Write a balanced equation for this reaction.

  $CaO(s) + 2\ NH_4Cl(aq) \rightarrow 2\ NH_3(g) + H_2O(g) + CaCl_2(s)$

- If 112 g of calcium oxide is mixed with 224 g of ammonium chloride, what mass of NH_3 should be produced in the reaction?

  Theoretical yield of NH_3 = 68.0 g

- What mass of excess reactant remains at the end of the reaction?

  10. g of excess reactant remains at the end of the reaction.

- If only 16.3 g of NH_3 are collected, what is the percent yield of NH_3?

  Percent yield = 24.0%