

Pre-AP Chemistry  
Unit #9 Stoichiometry

Limiting Reactants/Limiting Reagents

1. Convert mass to moles
2. Convert moles to moles
3. Compare Available to Needed moles to determine Limiting Reactant/Limiting Reagent.
4. Determine the theoretical yield/maximum amount/maximum yield of each product produced from the limiting reactant/limiting reagent from the chemical reaction.



A student was given 10.0 grams of methane gas and oxygen gas to react in a laboratory experiment. Unfortunately, the reaction didn't go as smoothly as expected. One of the reactants ran out before the reaction could go to completion. Determine the limiting reactant/limiting reagent for the reaction, and what is the maximum amount of the products produced for this combustion reaction?

$$\text{CH}_4 = 10.0 \text{ g CH}_4 \frac{1 \text{ mol CH}_4}{16.043 \text{ g CH}_4} = 0.623 \text{ mol CH}_4 \frac{2 \text{ mol O}_2}{1 \text{ mol CH}_4} = 1.246 \text{ mol O}_2$$

**AVAILABLE**

**NEEDED**

$$\text{O}_2 = 10.0 \text{ g O}_2 \frac{1 \text{ mol O}_2}{31.998 \text{ g O}_2} = 0.313 \text{ mol O}_2 \frac{1 \text{ mol CH}_4}{2 \text{ mol O}_2} = 0.156 \text{ mol CH}_4$$

Available > Needed ----- EXCESS

Available < Needed ----- LIMITING

Maximum Yield/Theoretical Yield of Carbon Dioxide

$$\frac{0.313 \text{ mol O}_2 \left| \frac{1 \text{ mol CO}_2}{2 \text{ mol O}_2} \right| 44.009 \text{ grams CO}_2}{1 \text{ mol CO}_2} = 6.887 \text{ g CO}_2$$

Maximum Yield/Theoretical Yield of Water

$$\frac{0.313 \text{ mol O}_2 \left| \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol O}_2} \right| 18.015 \text{ grams H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 5.639 \text{ g H}_2\text{O}$$