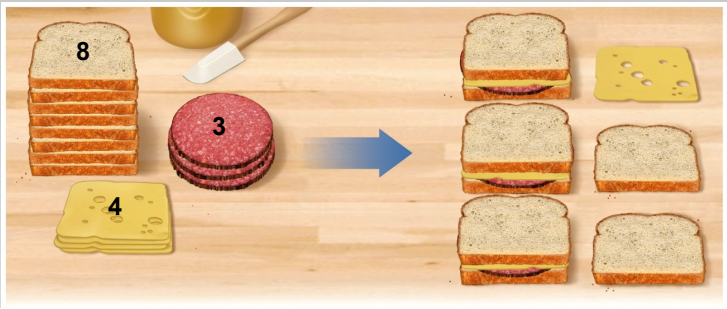
Limiting Reactants



Limiting Ingredient:
Salami

Theoretical Yield:
3 Sandwiches

Limiting Reactant:
Methane

Theoretical Yield:
2 CO_2 Molecules
(4 H_2O Molecules)

The limiting reagent is the substance in a chemical reaction that is totally consumed.

The theoretical yield is the amount of product predicted by a stoichiometric calculation based on the number of moles of all reactants present.

Limiting Reagent and Theoretical Yield

Example 1: Ammonia, NH_3, can be synthesized by the reaction

$$2NO(g) + 5H_2(g) \rightarrow 2\ NH_3(g) + 2\ H_2O\ (l)$$

Starting with 86.3 g NO and 25.6 g H_2, find the theoretical yield of ammonia in grams.

1). Calculate the number of moles NO and H_2 available

2). Determine the number of moles NH_3 produced based upon the number of moles NO and H_2 available and identify the limiting reagent.

3). Calculate the theoretical yield of ammonia in grams

Limiting Reagent, Theoretical Yield and Percent Yield

Example 2: We can obtain titanium metal from its oxide according to the following balanced equation

$$TiO_2(s) + 2C(s) \rightarrow Ti(s) + 2\,CO(g)$$

When 28.6 kg of C reacts with 88.2 kg of TiO_2, 42.8 kg of Ti is produced. Find the limiting reactant, theoretical yield (in kg) and percent yield.

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

1). Calculate the number of moles TiO_2 and C available

2). Determine the number of moles Ti produced based upon the number of moles TiO_2 and C available and identify the limiting reagent.

3). Calculate the theoretical yield of titanium in grams

4). Calculate the precent yield

Limiting Reagent, Theoretical Yield and Percent Yield

Example 3: Mining companies use the reaction of iron(III)oxide with carbon monoxide to obtain iron

$$Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3\ CO_2(g)$$

The reaction of 167 g F_2O_3 with 85.8 g CO produces 72.3 g Fe. What is the percent yield of this reaction?