

## Limiting Reactants

In the real world there is often not the correct amount of reactants for each to be totally used in the reaction.

**excess reactant** – some of this reactant remains after the reaction is finished

**limiting reactant** - this reactant is completely used – stopping the reaction

Because there is “less” of the limiting reactant it limits how much of the other reactant is used and thus how much product is produced.

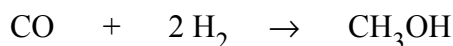
For example...if you are going to make peanut butter sandwiches (really just peanut butter – no jelly) you need bread and peanut butter. The number of sandwiches is limited by how much of each reactant you have. If you have 2,500 slices of bread and two small jars of peanut butter...you can't make 1,250 sandwiches even though you have enough bread. You will run out of peanut butter before you use all the bread. Peanut butter is the limiting reactant and bread is the excess reactant.

Example: 152.5 kg of carbon monoxide is combined with 24.50 kilograms of hydrogen gas. These two combine to make methanol,  $\text{CH}_3\text{OH}$ ; how much methanol can be produced?

To solve this problem you must identify the limiting and excess reactants before you do the stoichiometry.

To find the limiting reactant:

1. Write a balanced equation.



2. Find the number of moles of each reactant.

24.50 Kg $\text{H}_2$	1000 g	1 mole $\text{H}_2$ =	12,250 Mol $\text{H}_2$
	1 Kg	2.00 g $\text{H}_2$	

3. Calculate how much of first reactant would be needed to react with all of second reactant.

12250 mol $\text{H}_2$	1 mol CO =	6125 mol CO
	2 mol $\text{H}_2$	

4. Compare this with how much you actually have.

This calculation means that 6,125 mol of CO is needed to react with all of the H<sub>2</sub> present. Only 5,446 mol of CO is available. There is NOT enough CO.

Thus: CO is the limiting reactant

H<sub>2</sub> is the excess reactant

Now use CO as the “given” quantity and solve the stoichiometry problem.

5446 mol CO	1 mol CH <sub>3</sub> OH	32 g CH <sub>3</sub> OH	= 174272 g CH <sub>3</sub> OH
	1 mol CO	1 mol CH <sub>3</sub> OH	

Round to 174,200 grams of CH<sub>3</sub>OH

### Percent Yield

The ratio of actual yield (from an experiment) of a product to the theoretical (calculated or predicted) yield, multiplied by 100

$$\frac{\text{Actual (get)}}{\text{Theoretical (want)}} \times 100$$

*In an experiment, we predicted that 22 grams of AgCl would be produced. When we did the experiment, we actually got 18 grams. What is the percent yield?*