**THE LIMITING REAGENT**

* The **limiting reactant** will be the reactant that is exhausted first in the chemical reaction.
* The **excess reactant** will be the reactant that is not completely exhausted during the chemical reaction.

\*\*The amount of product obtained in the reaction **will always depend on the amount of limiting reactant**\*\*

**SUPER BASIC EXAMPLE TO UNDERSTAND:**

The "equation" to prepare a ham sandwich can be represented as follows:

**1 HAM + 2 SLICES OF BREAD --> 1 "HAM Sandwich"**

If you have 15 pieces of ham and 38 slices of bread, how many ham sandwiches can be prepared? Are there any left over? How many?

Who limited the production of ham sandwiches; the ham or bread?

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**Process in general:**

1. If you have been given more than one amount of reactant (in mol or gram). This is a clue that you will be asked about the limiting reactive and the excess reactant.

For this type of question, stoichiometry has to be done TWICE. Solve *to the SAME* product TWICE. USUALLY, the problem TELLS you to which product to solve. If it doesn't tell you, then it is your choice. Usually it is necessary to do the conversion from mole to mole or gram to gram.

2. Compare your two amounts you just calculated. The smallest number is the amount of product that is formed AND the reactant that gave you that smallest amount is the limiting reactant.

\*\*If you are asked how much in excess there was\*\*

Use your LIMITING reactant and stoichiometry to calculate how much **EXCESS reactant was used**. Once you have the value, then subtract this answer with the initial amount that the problem gave you.

**MOL-MOL**

What is the limiting reactant when 0.552 mol is Al and 0.887 mol is Cl2 are used? How many moles of AlCl3 were formed? What is the excess reagent? For the excess substance, how many moles were not used?

What is the limiting reactant when using 7. 5 moles of Zn and 9.3 moles of HF? How many moles of H2 were formed? What is the excess reagent? For the excess substance, how many moles were not used?

**GRAM-GRAM:** Use reactions to determine:

Zn + 2HF ZnF2 🡪+ H2

1. How many grams of H2  are formed when 79.1 g of Zn react with 163.1 g of HF?
2. What is the limiting reagent?
3. What is the excess reagent? For the substance in excess, how many grams were not used?

CH4 + 2O2 🡪 CO2 + 2 H2 O

10 g 10g

1. How many grams of CO2 are formed?
2. What is the limiting reagent?
3. What is the excess reagent? For the substance in excess, how many grams were not used?

*Theoretical yield* is the maximum yield of product you can get based on the limiting reagent.

*Actual yield* is the amount of product that is formed based on doing the experiment in a laboratory. It can be affected by human error, presence of impurities, defective equipment etc.

*Percentage yield* is the comparison of the theoretical yield vs the actual yield. A percentage of yield should be low a number because that shows that the experiment produced a close amount to the amount that should have been produced.



**EXAMPLES:**

The responsibility of a chemist in the Bayer company was to create aspirin in his laboratory. This chemical had to create 75 g of aspirin with the reagents provided. But, this chemical kept part of the reactants and nomas was creating 50 g. What is the percentage yield of this chemical?

C6H6 + Cl2 🡪 C6H5Cl +HCl

When 36.8 g of C6H6 reacts with Cl2 which is in excess, the actual yield of C6H 5Cl is 38.8 g. What is the percentage yield of C6H5Cl?

The percentage yield of the reaction PCl3 + Cl2 🡪PCl5 is 83.12%. What will be the current mass of PCl5 if we use 73.7 g of PCl3 with Cl2 in excess?