

Limiting Reactants

Limiting Reactant

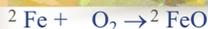
- If it takes 500 bricks and 1000 boards to make a house, how many houses can you make from 1600 bricks and 2000 boards?
- 2 houses, there are enough bricks for 3.2 houses, but only boards for 2 with our plans (reaction).
- In this analogy, the boards would be the limiting reactant.
- We can't make another house without the boards.
- You may be able to make something else with the bricks, like a fire pit, but that would require a different set of plans (a different reaction).

Definition

- Limiting reactant- the reactant that determines the amount of product that can be produced because of the amount of that reactant present.
- Whichever reactant yields the LEAST amount of product is the limiting reactant. This will be completely used up in the reaction.
- After the reaction is complete, there will be product, and unused excess reactant.



- If you have 87 g of Fe and 130 g of O₂ how much iron (II) oxide can be produced?
- Balance it first, then do the problem like before for both iron and oxygen.



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87 g Fe	1 mol Fe	2 mol FeO	71.85 g FeO	=110 g
	55.85 g Fe	2 mol Fe	1 mol FeO	FeO
130 g O ₂	1 mol O ₂	2 mol FeO	71.85 g FeO	=580 g
	32 g O ₂	1 mol O ₂	1 mol FeO	FeO

Why the answer is 110 g FeO

- We have enough oxygen to make 580 g FeO but enough iron to make 110 g, therefore we can only make 110 g.
- The rest of the oxygen is excess (leftovers)
- Iron is our limiting reactant
- We can't make more iron (II) oxide without more iron, regardless of how much oxygen we have.

Another Example

- $\text{NH}_3 + \text{O}_2 \rightarrow \text{NO} + \text{H}_2\text{O}$
- How much NO can be produced from 52 g of NH₃ and 79 g of O₂?

Another Example

- $4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}$
- How much NO can be produced from 52 g of NH₃ and 79 g of O₂?

52 g NH ₃	1 mol NH ₃	4 mol NO	30.01 g NO	=30 g
	17.034 g NH ₃	4 mol NH ₃	1 mol NO	NO
79 g O ₂	1 mol O ₂	4 mol NO	30.01 g NO	=59 g
	32 g O ₂	5 mol O ₂	1 mol NO	NO

BCA Tables

- BCA or before change after tables are used for tabulating the amounts of everything present in a stoichiometry reaction.

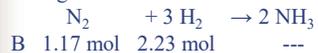
Problem

- $N_2 + 3 H_2 \rightarrow 2 NH_3$
- If 33 g of nitrogen are reacted with 4.5 g of hydrogen, how much ammonia is produced, how much limiting reactant is left?

Convert to moles for BCA table

- $33 \text{ g } N_2 \times 1 \text{ mol}/28.02 \text{ g} = 1.17 \text{ mol } N_2$
- $4.5 \text{ g } H_2 \times 1 \text{ mol}/2.016 = 2.23 \text{ mol } H_2$
- $N_2 + 3 H_2 \rightarrow 2 NH_3$
- B 1.17 mol 2.23 mol ---
- C
- A

Change



- Change will be based off moles of reaction. Which will be the moles of each component divided by the coefficient.
- $1.17 \text{ mol } N_2 / 1 = 1.17 \text{ mol reaction}$
- $2.23 \text{ mol } H_2 / 3 = .74 \text{ mol reaction}$
- Hydrogen is my limiting reactant, nitrogen is excess

Convert to moles for BCA table

- $N_2 + 3 H_2 \rightarrow 2 NH_3$ for .74 mol rxn
- B 1.17 mol 2.23 mol ---
- C -.74 mol -2.23 mol 1.49 mol
- A .43 mol ----- 1.49 mol
- Change is the change from the reaction, after is what is present afterwards.

Finish the problem

- $N_2 + 3 H_2 \rightarrow 2 NH_3$
- If 33 g of nitrogen are reacted with 4.5 g of hydrogen, how much ammonia is produced, how much limiting reactant is left?
- $N_2 + 3 H_2 \rightarrow 2 NH_3$ for .74 mol rxn
- B 1.17 mol 2.23 mol ---
- C -.74 mol -2.23 mol 1.49 mol
- A .43 mol ----- 1.49 mol
- We have moles of nitrogen and ammonia. This can be converted to other units if necessary.