Limiting Reagent Walk-Through – Example #1

|  |
| --- |
| **N2 + 3H2 🡪 2NH3 *You start with 115.0g of N2 and 15.00g of H2*** |
| ***How many grams of product can you make, and how many grams of the excess (XS) reagent do you have left when done?*** |

**STEP #1 - Grams to Moles**

|  |  |  |
| --- | --- | --- |
| 15.00 g H2 | 1 mol H2 | = 7.426 moles H2 |
|  | 2.02 g H2 |  |

*Use molar masses to convert from grams to moles:*

|  |  |  |
| --- | --- | --- |
| 115.0 g N2 | 1 mol N2 | = 4.106 moles N2 |
|  | 28.01 g N2 |  |

**STEP #2 – Have versus Need**

*Make a little chart showing how many moles of each chemical you have versus how many moles of each chemical you would need. Pick one of your starting values (doesn’t matter which one – I like to just pick the first one so I’m consistent), do dimensional analysis to figure out how many moles of the other chemical you would need to have in order to complete the reaction.*

N2 + 3H2 🡪 2NH3

|  |  |  |
| --- | --- | --- |
| 4.106 mol N2 | 3 mol H2 | = 12.318 moles H2 |
|  | 1 mol N2 | would be needed |
|  |  | to use up all the N2 |
|  |  |  |

HAVE: 4.106 mol 7.426 mol

NEED: 12.318 mol

**STEP #3 – Identify Limiting**

*Compare the amount you have with the amount you need to see which chemical you don’t have enough of, and which chemical you will have extra left over of.*

You can see here that you only have 7.426 mol of H2, but you would need 12.318 mol to use up all the N2 you have. So you do not have enough. That means the H2 is the Limiting Reagent, and N2 is the excess reagent.

If you had more than you needed that would mean it was the excess reagent and the other was the limiting. That means that you only need to do one calculation to determine which is limiting and which is excess because you can use the answer to one calculation to conceptually explain either result!

N2 + 3H2 🡪 2NH3

HAVE: 4.106 mol 7.426 mol

NEED: 12.318 mol

**STEP #4 – Do Stoich with Limiting**

**R-30**

*Convert from moles of limiting reactant to desired unit of unknown substance asked for in the problem – use mole highway to determine where to start and end. It is now just a normal stoichiometry problem once you know which number to use!  
 Example pathway: moles of A 🡪 moles of B 🡪 grams of B*

XS LR

N2 + 3H2 🡪 2NH3

HAVE: 4.106 mol **7.426 mol**

NEED: 12.318 mol

|  |  |  |  |
| --- | --- | --- | --- |
| 7.426 mol H2 | 2 mol NH3 | 17.03 g NH3 | = 84.31 g NH3 made during the rxn |
|  | 3 mol H2 | 1 mol NH3 |  |

**STEP #5 – Find XS left**

*Use moles of Limiting Reagent and mole ratio to calculate how many moles of Excess Reagent are needed to use up all the limiting reagent during the reaction. Add this value to the little chart that you already made. Then, just subtract to find how many moles of XS are left over.*

XS LR

|  |  |  |
| --- | --- | --- |
| 7.426 mol H2 | 1 mol N2 | = 2.475 moles of N2 |
|  | 3 mol H2 | will be needed during the |
|  |  | rxn to use up all the LR |

N2 + 3H2 🡪 2NH3

HAVE: 4.106 mol **7.426 mol**

NEED: 2.475 mol 12.318 mol  
  
  
LEFT: 4.106 mol   
 - 2.475 mol   
 = 1.631 mol of N2 left as excess

*Convert your answer into whatever unit is asked for – if it doesn’t specify then it is ok to leave it in moles.*

|  |  |  |
| --- | --- | --- |
| 1.631 mol N2 left over | 28.01 g N2 | = 45.68 g of N2 left over |
|  | 1 mol N2 |  |