Limiting Reagent Walk-Through

|  |
| --- |
| **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**

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

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

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

**STEP #2 - Check Mole Ratios**

*Put the bigger mole ratio coefficient on the top divided by the smaller one   
(Doesn’t really matter but most people find it easier):*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Needed Ratio Amounts from Balanced Equation* |  | *Ratio with actual molar amounts in the problem* |  | *Simplified ratio from actual molar amounts for easier comparison* |
| 3 mol H2 |  | 7.426 moles H­2 |  | 1.809 moles H2 |
| 1 mol N2 |  | 4.106 moles N2 |  | 1 mole N2 |

*Compare the needed ratio amounts with the actual ratio of what you have:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 3 mol H2 |  | 7.426 moles H­2 |  | 1.809 moles H2 |
| 1 mol N2 |  | 4.106 moles N2 |  | 1 mole N2 |

*You can see that you do not have the amount of H2 that you would need! That means H2 is your Limiting Reagent (LR) and N2 is in excess (XS).*

**STEP #3 - Dimensional Analysis with Limiting Reagent**

*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.   
Example: moles of A 🡪 moles of B 🡪 grams of B*

N2 + 3H2 🡪 2NH3

XS LR

7.426 moles H2

|  |  |  |  |
| --- | --- | --- | --- |
| 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 #4 - XS Left: Mole Ratio and then Subtract**

*Use moles of Limiting Reagent and mole ratio to calculate how many moles of Excess Reagent are used up during the reaction:*

N2 + 3H2 🡪 2NH3

XS LR

4.106 7.426mol N2 mol H2

|  |  |  |
| --- | --- | --- |
| 7.426 mol H2 | 1 mol N2 | = 2.475 moles of N2 used during the rxn |
|  | 3 mol H2 |  |

*Subtract moles of Excess Reagent you used from the amount of Excess Reagent you started with to determine how much is left over.*

4.106 moles N2 when reaction started

– 2.475 moles of N2 used during the rxn

= 1.631 moles N2 left over

**STEP #5 - XS Left: Convert to desired unit if needed**

*Use molar mass to convert from moles to grams (most common unit asked for – if not asking for grams then use mole highway to find a pathway to the desired unit)*

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