Limiting Reagent Walk-Through

$N_2 + 3H_2 \rightarrow 2NH_3$

You start with 115.0g of N_2 and 15.00g of H_2

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:

$$115.0 \text{ g } N_2 \left| \frac{1 \text{ mol } N_2}{28.01 \text{ g } N_2} \right. = 4.106 \text{ moles } N_2$$

$$15.00 \text{ g } H_2 \left| \frac{1 \text{ mol } H_2}{2.02 \text{ g } H_2} \right. = 7.426 \text{ moles } H_2$$

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*
$\frac{3 \text{ mol } H_2}{1 \text{ mol } N_2}$	$\frac{7.426 \text{ moles } H_2}{4.106 \text{ moles } N_2}$	$\frac{1.809 \text{ moles } H_2}{1 \text{ mole } N_2}$

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

$\frac{3 \text{ mol } H_2}{1 \text{ mol } N_2}$	$\frac{7.426 \text{ moles } H_2}{4.106 \text{ moles } N_2}$	$\frac{1.809 \text{ moles } H_2}{1 \text{ mole } N_2}$

You can see that you do not have the amount of H_2 that you would need! That means H_2 is your Limiting Reagent (LR) and N_2 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

$N_2 + 3H_2 \rightarrow 2NH_3$

XS LR

7.426 moles H_2

$$\frac{7.426 \text{ mol } H_2}{} \left| \frac{2 \text{ mol } NH_3}{3 \text{ mol } H_2} \right| \frac{17.03 \text{ g } NH_3}{1 \text{ mol } NH_3} = 84.31 \text{ g } NH_3 \text{ made during the rxn}$$

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:

N_2	+	$3H_2$	→	$2NH_3$
XS		LR		
4.106 mol N_2		7.426 mol H_2		

$$\frac{7.426 \text{ mol } H_2}{} \left| \frac{1 \text{ mol } N_2}{3 \text{ mol } H_2} \right. = 2.475 \text{ moles of } N_2 \text{ used during the rxn}$$

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 N_2 when reaction started
– 2.475 moles of N_2 used during the rxn
= 1.631 moles N_2 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)

$$\frac{1.631 \text{ mol } N_2 \text{ left over}}{} \left| \frac{28.01 \text{ g } N_2}{1 \text{ mol } N_2} \right. = 45.68 \text{ g of } N_2 \text{ left over}$$