Nitrogen combines with hydrogen to form ammonia. What mass of ammonia can be formed from a gas mixture containing 3.106 g of nitrogen and 2.554 g of hydrogen?

nitrogen + hydrogen → ammonia

(LIMITING) (EXCESS)

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

3.106 g 2.554 g ? g

$g N_2 \rightarrow mol N_2 \rightarrow mol NH_3 \rightarrow g NH_3$

$$\frac{3.106\ g\ N_2}{1}\left(\frac{1\ mol\ N_2}{28.02\ g\ N_2}\right)\left(\frac{2\ mol\ NH_3}{1\ mol\ N_2}\right)\left(\frac{17.034\ g\ NH_3}{1\ mol\ NH_3}\right)$$

$= 3.776\ g\ NH_3$ ✓

$g H_2 \rightarrow mol H_2 \rightarrow mol NH_3 \rightarrow g NH_3$

$$\frac{2.554\ g\ H_2}{1}\left(\frac{1\ mol\ H_2}{2.016\ g\ H_2}\right)\left(\frac{2\ mol\ NH_3}{3\ mol\ H_2}\right)\left(\frac{17.034\ g\ NH_3}{1\ mol\ NH_3}\right)$$

$= 14.39\ g\ NH_3$ ✗

NH_3

$1 \times 14.01 = 14.01$

$3 \times 1.008 = 3.024$

17.034

What mass of hydrogen will be left over at the end of the reaction?

CONSERVATION OF MASS:

	N_2	H_2	NH_3	TOTAL
BEFORE	3.106 g	2.554 g	0.000 g	5.660 g
AFTER	0.000 g	X	3.776 g	5.660 g

$$X + 3.776\,g = 5.660\,g$$

$$X = 5.660\,g - 3.776\,g$$

$$X = 1.884\,g$$

STOICHIOMETRY

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

3.106 g ? g (used)

$g\,N_2 \longrightarrow mol\,N_2 \longrightarrow mol\,H_2 \longrightarrow g\,H_2$

$$\frac{3.106\ g\ N_2}{1}\left(\frac{1\ mol\ N_2}{28.029\ g\ N_2}\right)\left(\frac{3\ mol\ H_2}{1\ mol\ N_2}\right)\left(\frac{2.016\ g\ H_2}{1\ mol\ H_2}\right)$$

$= 0.670\ g\ H_2$ (used)

2.554 g H_2 (available)

− 0.670 g H_2 (used)

1.884 g H_2 (remaining)

If the reaction produced 2.763 g of NH_3 what is the theoretical yield of the reaction?

$$100\% \left(\frac{2.763\ \cancel{g}}{3.776\ \cancel{g}} \right) = 73.17\%$$