

Answer on Question#40485-Chemistry-Other

Question

Given the following chemical equation: $2\text{H}_2\text{O}_2(\text{l}) + \text{N}_2\text{H}_4(\text{l}) \rightarrow 4\text{H}_2\text{O}(\text{g}) + \text{N}_2(\text{g})$

Determine how many grams of N_2 are produced by 8.49 g of H_2O_2 and 5.72 g of N_2H_4 .

Solution

$M(\text{H}_2\text{O}) = 18 \text{ g/mol}$, $M(\text{N}_2\text{H}_4) = 32 \text{ g/mol}$, $M(\text{N}_2) = 28 \text{ g/mol}$.

Number of moles of the reactants:

$$n(\text{H}_2\text{O}) = m(\text{H}_2\text{O})/M(\text{H}_2\text{O}) = 8.49 / 18 = 0.47 \text{ mol}$$

$$n(\text{N}_2\text{H}_4) = m(\text{N}_2\text{H}_4)/M(\text{N}_2\text{H}_4) = 5.72 / 32 = 0.18 \text{ mol}$$

The actual molar ratio of the reactants:

$$n(\text{H}_2\text{O})/n(\text{N}_2\text{H}_4) = 0.47 / 0.18 = 2.61 / 1$$

As is clear from the chemical equation the theoretical molar ratio $n(\text{H}_2\text{O})/n(\text{N}_2\text{H}_4) = 2 / 1$.

So, water is taken in excess and some of it remains unreacted. That is why the mass of N_2 produced must be calculated based on the amount of N_2H_4 not H_2O .

As is clear from the chemical equation the molar ratio $n(\text{N}_2)/n(\text{N}_2\text{H}_4) = 1 / 1$, i.e. $n(\text{N}_2) = 0.18 \text{ mol}$.

$$\text{Mass of } \text{N}_2 \text{ produced: } m(\text{N}_2) = n(\text{N}_2) \cdot M(\text{N}_2) = 0.18 \cdot 28 = 5.04 \text{ g}$$

Answer: 5.04 g