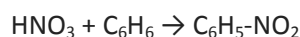


Question #58366, Chemistry / General Chemistry |

Identify the limiting reagent in the reaction of 28.0 g of nitric acid with 72 g of benzene

Answer:

Nitration of benzene leads to the formation of nitrobenzene and *m*-1,3-dinitrobenzene (when the excess of nitric acid used). Thus, the equation for the nitrobenzene:



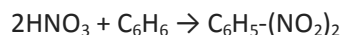
The amount of nitric acid and benzene are calculated (where *m* – the given masses and *M* – the molecular weight):

$$v(\text{HNO}_3) = m(\text{HNO}_3)/M(\text{HNO}_3) = 28.0 \text{ g}/63 \text{ g mol}^{-1} = 0.444 \text{ mol}$$

$$v(\text{C}_6\text{H}_6) = m(\text{C}_6\text{H}_6)/M(\text{C}_6\text{H}_6) = 72 \text{ g}/78 \text{ g mol}^{-1} = 0.923 \text{ mol}$$

Since one molecule of nitric acid reacts with one molecule of benzene or 0.444 mol of nitric acid reacts with 0.444 mol of benzene, the amount of benzene, which remains, is: $v(\text{C}_6\text{H}_6) = 0.923 \text{ mol} - 0.444 \text{ mol} = 0.479 \text{ mol}$. **Therefore the limiting reagent is nitric acid. It is consumed completely.**

Considering the formation of dinitrobenzene:



Two molecules of nitric acid react with one molecule of benzene. Hence, 0.444 mol of nitric acid reacts with 0.222 mol of benzene. The number of moles of remaining benzene is:

$$v(\text{C}_6\text{H}_6) = 0.923 \text{ mol} - 0.222 \text{ mol} = 0.701 \text{ mol}. \text{ **Thus, the limiting reagent is nitric acid too.}**$$