

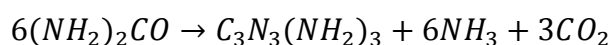
## Answer on the question #62388, Chemistry / General Chemistry

### Question:

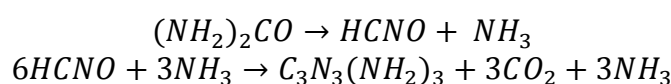
Melamine,  $C_3N_3(NH_2)_3$ , is used in adhesives and resins. It is manufactured in a two-step process in which urea,  $CO(NH_2)_2$ , is the sole starting material, isocyanic acid,  $HNCO$ , is an intermediate, and ammonia,  $NH_3$ , and carbon dioxide,  $CO_2$ , gases are byproducts. 1) What mass of melamine,  $C_3N_3(NH_2)_3$ , will be obtained from 103.5 kg of urea,  $CO(NH_2)_2$ , if the yield of the overall reaction is 76.0 % ?

### Solution:

Synthesis reaction of melamine is:



The two steps that were mentioned are:



The overall reaction gives the relation of the number of the moles of urea and of melamine:

$$\frac{n((NH_2)_2CO)}{6} = n(C_3N_3(NH_2)_3)$$

Number of the moles can be calculated as the ratio of mass and molar mass:

$$n = \frac{m}{M}$$

Then, let's find the mass of melamine that is formed theoretically:

$$\begin{aligned}m(C_3N_3(NH_2)_3) &= n(C_3N_3(NH_2)_3) \cdot M(C_3N_3(NH_2)_3) \\ m(C_3N_3(NH_2)_3) &= \frac{n((NH_2)_2CO)}{6} \cdot 126.12(g/mol) \\ m(C_3N_3(NH_2)_3) &= \frac{m((NH_2)_2CO)}{6 \cdot M((NH_2)_2CO)} \cdot 126.12(g/mol) \\ m(C_3N_3(NH_2)_3) &= \frac{103.5 \cdot 10^3(g)}{6 \cdot 60.06(g/mol)} \cdot 126.12(g/mol) \\ m(C_3N_3(NH_2)_3) &= 36.22 \cdot 10^3(g) = 36.22(kg)\end{aligned}$$

The yield of overall reaction is 76.0%. So, we should multiply the theoretical yield by 0.760 to find the experimental one:

$$m(C_3N_3(NH_2)_3) = 36.22(kg) \cdot 0.760 = 27.5(kg)$$