

4.48. Ammonia is burned to form nitric oxide in the following reaction:



- (a) Calculate the ratio (lb-mole  $\text{O}_2$  react/lb-mole NO formed).  
 (b) If ammonia is fed to a continuous reactor at a rate of  $100.0 \text{ kmol NH}_3/\text{h}$ , what oxygen feed rate (kmol/h) would correspond to 40.0% excess  $\text{O}_2$ ?  
 (c) If  $50.0 \text{ kg}$  of ammonia and  $100.0 \text{ kg}$  of oxygen are fed to a batch reactor, determine the limiting reactant, the percentage by which the other reactant is in excess, and the extent of reaction (mol) and mass of NO produced (kg) if the reaction proceeds to completion.

c)  
 $m_{\text{NH}_3} = 50 \text{ kg}$   
 $m_{\text{O}_2} = 100 \text{ kg}$   
 100% conv.  
 of limiting  
 Limiting?  
 % excess?  
 $f = ?$  (mol)  
 $m_{\text{NO}} = ?$  (kg)



a)  $\frac{n_{\text{O}_2}}{n_{\text{NO}}} = \frac{5}{4} = 1.25 \text{ lb-mol/lb-mol}$



% excess =  $\frac{\text{Feed} - \text{St.}}{\text{St.}}$



$0.4 = \frac{n_1 - 125}{125}$   $n_1 = 175 \text{ kmol/h}$



$4 \times 5 \quad \text{st.} = \frac{100 \times 5}{4} = 125 \text{ kmol/h}$   
 $100 \times \text{st.}$

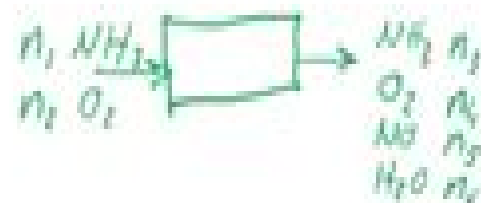
$n_1 = \frac{m_{\text{O}_2}}{M_{\text{O}_2}} = \frac{50}{16 \times 2} = 1.56 \text{ kmol}$

$n_2 = \frac{m_{\text{O}_2}}{M_{\text{O}_2}} = \frac{100}{32} = 3.125$

$\text{NH}_3: \frac{n_1}{\nu_1} = \frac{1.56}{4} = 0.39$

$\text{O}_2: \frac{n_2}{\nu_2} = \frac{3.125}{5} = 0.625$

% excess =  $\frac{n_1 - \text{St.}}{\text{St.}}$



$\rightarrow \text{O}_2 \text{ is limiting}$

# Relevant Problems For Chemical Principles

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