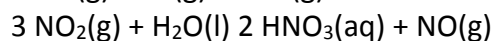
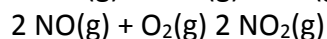
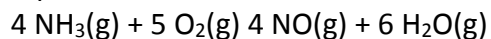


## Answer on Question#51491, Chemistry, Organic Chemistry

### Question:

Nitric acid is produced commercially by the Ostwald process, represented by the following equations.



What mass in kg of  $\text{NH}_3$  must be used to produce  $1.2 \times 10^6$  kg  $\text{HNO}_3$  by the Ostwald process, assuming 100% yield in each reaction? Show all work

### Solution:

The ratio of  $\text{NH}_3:\text{NO} = 1:1$  (first equation)

The ratio of  $\text{NO}:\text{NO}_2 = 1:1$  (second equation)

The ratio of  $\text{NO}_2:\text{HNO}_3 = 3:2$  (third equation)

Therefore, 3 moles of  $\text{NH}_3$  will produce 2 moles of  $\text{HNO}_3$

$$n(\text{HNO}_3) = 1.2 \times 10^6 \text{ (kg)} \cdot 1000 \text{ (g} \cdot \text{kg}^{-1}) / 63 \text{ (g} \cdot \text{mol}^{-1}) = 1.9 \cdot 10^7 \text{ (mol)}$$

$$n(\text{NH}_3) = 1.9 \cdot 10^7 \text{ (mol)} \cdot (3/2) = 2.85 \cdot 10^7 \text{ (mol)}$$

$$m(\text{NH}_3) = 2.85 \cdot 10^7 \text{ (mol)} \cdot 17 \text{ (g} \cdot \text{mol}^{-1}) = 4.85 \cdot 10^8 \text{ (g)}$$

**Answer:**  $4.85 \cdot 10^5$  kg of  $\text{NH}_3$ .