

1) Calculate the molar mass of  $(\text{NH}_4)_3\text{AsO}_4$ .

$$\begin{array}{l} 4 \times 16.00 \\ 1 \times 74.92 \\ 12 \times 1.008 \\ 3 \times 14.01 \end{array} \quad \underline{\hspace{1cm}} \quad 193.05 \text{ g/mol}$$

2) Calculate the number of moles in 17.8 g of the antacid magnesium hydroxide,  $\text{Mg}(\text{OH})_2$ .

$$\frac{17.8 \text{ g}}{58.266 \text{ g/mol}} = 0.305 \text{ mol}$$

3) Calculate the number of oxygen atoms in 29.34 g of sodium sulfate,  $\text{Na}_2\text{SO}_4$ .

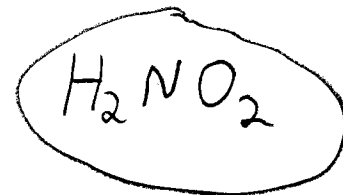
$$\frac{29.34 \text{ g Na}_2\text{SO}_4}{142.05 \text{ g/mol Na}_2\text{SO}_4} = 0.2065 \text{ mol Na}_2\text{SO}_4 \quad \times \quad 4 \text{ mol O} = 0.826 \text{ mol O} \quad \times \quad 6.02 \times 10^{23} \text{ atoms/mol} = 4.974 \times 10^{23} \text{ atoms O}$$

4) Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass % O. Determine its empirical formula.

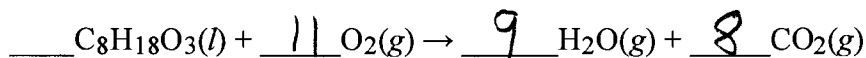
$$\text{N: } \frac{29.17 \text{ g}}{14.01 \text{ g/mol}} = 2.082 \div 2.082 = 1$$

$$\text{H: } \frac{4.20 \text{ g}}{1.008 \text{ g/mol}} = 4.17 \div 2.082 = 2$$

$$\text{O: } \frac{66.63 \text{ g}}{16.00 \text{ g/mol}} = 4.16 \div 2.082 = 2$$



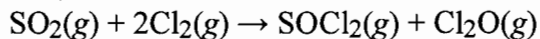
5) Balance the following equation:



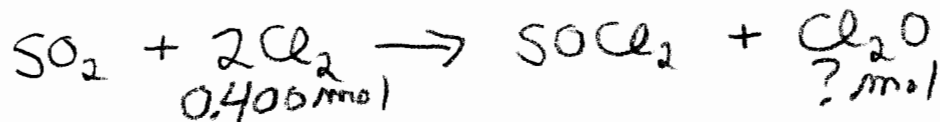
$$\begin{array}{r} \uparrow \\ 9 + 16 = 25 \\ \rightarrow - 3 \\ \hline 22 \end{array}$$

# Key

- 6) Sulfur dioxide reacts with chlorine to produce thionyl chloride (used as a drying agent for inorganic halides) and dichlorine oxide (used as a bleach for wood, pulp, and textiles).

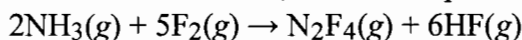


If 0.400 mol of  $\text{Cl}_2$  reacts with excess  $\text{SO}_2$ , how many moles of  $\text{Cl}_2\text{O}$  are formed?



$$\frac{0.400 \text{ mol } \cancel{\text{Cl}_2} \left| \frac{1 \text{ mol } \text{Cl}_2\text{O}}{2 \text{ mol } \cancel{\text{Cl}_2}} \right.}{1} = 0.200 \text{ mol } \text{Cl}_2\text{O}$$

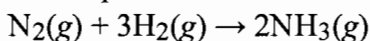
- 7) Ammonia will react with fluorine to produce dinitrogen tetrafluoride and hydrogen fluoride (used in production of aluminum, in uranium processing, and in frosting of light bulbs).



How many moles of  $\text{NH}_3$  are needed to react completely with 13.6 mol of  $\text{F}_2$ ?

$$\frac{13.6 \text{ mol } \cancel{\text{F}_2} \left| \frac{2 \text{ mol } \text{NH}_3}{5 \text{ mol } \cancel{\text{F}_2}} \right.}{1} = 5.44 \text{ mol } \text{NH}_3$$

- 8) Ammonia, an important source of fixed nitrogen that can be metabolized by plants, is produced using the Haber process in which nitrogen and hydrogen combine.



How many grams of nitrogen are needed to produce 325 grams of ammonia?

$$\frac{325 \text{ g } \cancel{\text{NH}_3} \left| \frac{\cancel{\text{mol } \text{NH}_3}}{17.034 \text{ g } \cancel{\text{NH}_3}} \right| \frac{1 \text{ mol } \text{N}_2}{2 \cancel{\text{mol } \text{NH}_3}} \left| \frac{28.02 \text{ g } \text{N}_2}{1 \cancel{\text{mol } \text{N}_2}} \right.}{1} = 267 \text{ g } \text{NH}_3$$