

⊗ Give answers to 3 s.f.

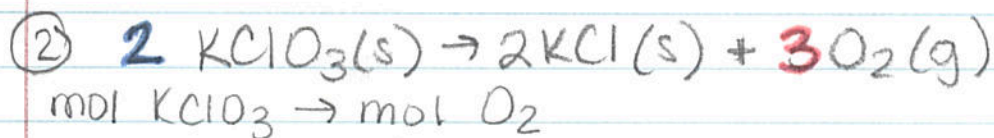
Key Stoichiometry: Mass-Mass, volume-volume, Mass-Volume Problems

→ Mass-Mass Problems

① moles $\text{KClO}_3 \rightarrow \text{g KClO}_3$

$$4.00 \text{ mol KClO}_3 \times \frac{122.6 \text{ g}}{1 \text{ mol}} = 490.4 \text{ g}$$

} gfm $\text{KClO}_3 = 122.6 \text{ g/mol}$
⌞ \uparrow 3sf = 490. g



$$4.00 \text{ mol KClO}_3 \times \frac{3 \text{ mol O}_2}{2 \text{ mol KClO}_3} = \text{6.00 mol O}_2$$

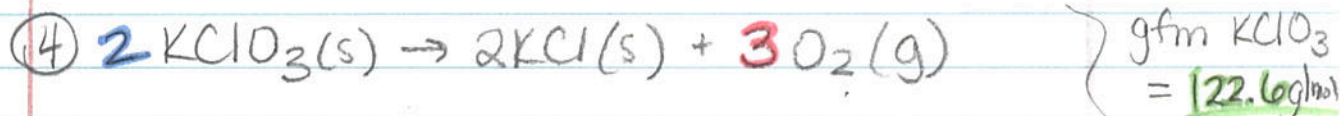
mole ratio from balanced equation

③ from problem 2, 6.00 mol O_2 formed

mol $\text{O}_2 \rightarrow \text{g O}_2$

$$6.00 \text{ mol O}_2 \times \frac{32.0 \text{ g}}{1 \text{ mol}} = \text{192 g O}_2$$

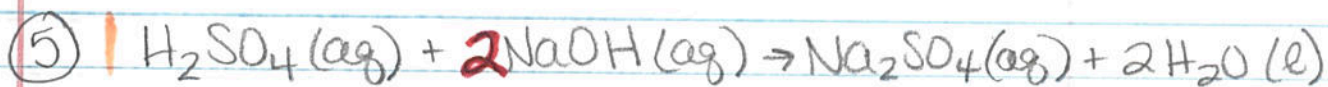
} gfm $\text{O}_2 = 32.0 \text{ g/mol}$



g $\text{KClO}_3 \rightarrow \text{mol KClO}_3 \rightarrow \text{mol O}_2 \rightarrow \text{g O}_2$

$$61.5 \text{ g KClO}_3 \times \frac{1 \text{ mol KClO}_3}{122.6 \text{ g KClO}_3} \times \frac{3 \text{ mol O}_2}{2 \text{ mol KClO}_3} \times \frac{32.0 \text{ g O}_2}{1 \text{ mol O}_2} = \text{24.1 g O}_2$$

mole ratio from balanced eq.



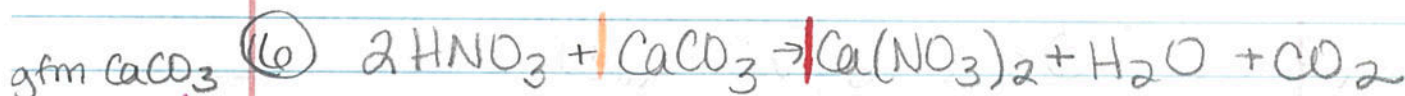
$$\begin{aligned} \text{gfm NaOH} \\ = 40.0 \text{ g/mol} \end{aligned}$$

$$\text{g NaOH} \rightarrow \text{mol NaOH} \rightarrow \text{mol H}_2\text{SO}_4 \rightarrow \text{g H}_2\text{SO}_4$$

$$120. \text{g NaOH} \times \frac{1 \text{ mol NaOH}}{40.0 \text{ g NaOH}} \times \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol NaOH}} \times \frac{98.1 \text{ g H}_2\text{SO}_4}{1 \text{ mol H}_2\text{SO}_4} = \boxed{147 \text{ g}}$$

$$\begin{aligned} \text{gfm H}_2\text{SO}_4 \\ = 98.1 \text{ g/mol} \end{aligned}$$

mole ratio
from balanced
equation



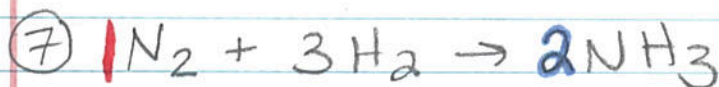
$$\begin{aligned} \text{gfm CaCO}_3 \\ = 100.1 \text{ g/mol} \end{aligned}$$

$$\text{g CaCO}_3 \rightarrow \text{mol CaCO}_3 \rightarrow \text{mol Ca}(\text{NO}_3)_2 \rightarrow \text{g Ca}(\text{NO}_3)_2$$

$$\begin{aligned} \text{gfm Ca}(\text{NO}_3)_2 \\ = 164.1 \text{ g/mol} \end{aligned}$$

$$20.0 \text{ g CaCO}_3 \times \frac{1 \text{ mol CaCO}_3}{100.1 \text{ g CaCO}_3} \times \frac{1 \text{ mol Ca}(\text{NO}_3)_2}{1 \text{ mol CaCO}_3} \times \frac{164.1 \text{ g Ca}(\text{NO}_3)_2}{1 \text{ mol Ca}(\text{NO}_3)_2}$$

$$\text{mole ratio from balanced eq.} = \boxed{32.8 \text{ g Ca}(\text{NO}_3)_2}$$



$$\begin{aligned} \text{gfm NH}_3 \\ = 17.0 \text{ g/mol} \end{aligned}$$

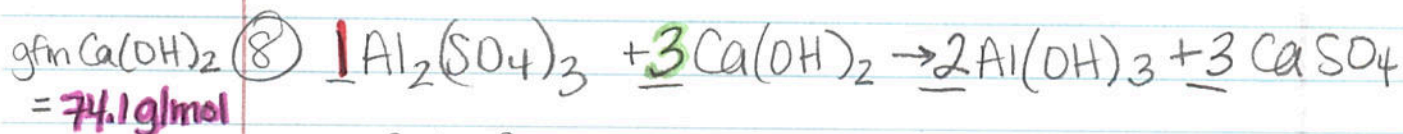
$$\text{g NH}_3 \rightarrow \text{mol NH}_3 \rightarrow \text{mol N}_2 \rightarrow \text{g N}_2$$

$$\begin{aligned} \text{gfm N}_2 \\ = 28.0 \text{ g/mol} \end{aligned}$$

$$3.40 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3} \times \frac{1 \text{ mol N}_2}{2 \text{ mol NH}_3} \times \frac{28.0 \text{ g N}_2}{1 \text{ mol N}_2}$$

mole ratio from
balanced eq.

$$= \boxed{2.8 \text{ g N}_2}$$



gfm $\text{Al}_2(\text{SO}_4)_3$ = 342.3 g/mol

$148 \text{ g Ca(OH)}_2 \rightarrow \text{mol Ca(OH)}_2 \rightarrow \text{mol Al}_2(\text{SO}_4)_3 \rightarrow \text{g Al}_2(\text{SO}_4)_3$

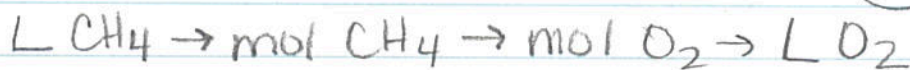
$$148 \text{ g Ca(OH)}_2 \times \frac{1 \text{ mol Ca(OH)}_2}{74.1 \text{ g Ca(OH)}_2} \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{3 \text{ mol Ca(OH)}_2} \times \frac{342.3 \text{ g Al}_2(\text{SO}_4)_3}{1 \text{ mol Al}_2(\text{SO}_4)_3} = 228 \text{ g Al}_2(\text{SO}_4)_3$$

mole ratio

→ Volume-Volume Problems

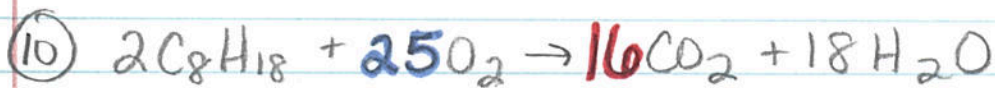


1 mol = 22.4 L
of any gas

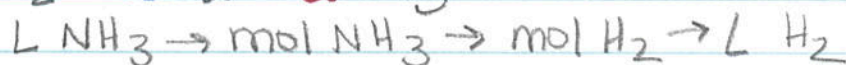


$$44.8 \text{ L CH}_4 \times \frac{1 \text{ mol CH}_4}{22.4 \text{ L CH}_4} \times \frac{2 \text{ mol O}_2}{1 \text{ mol CH}_4} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = 89.6 \text{ L O}_2$$

mole ratio

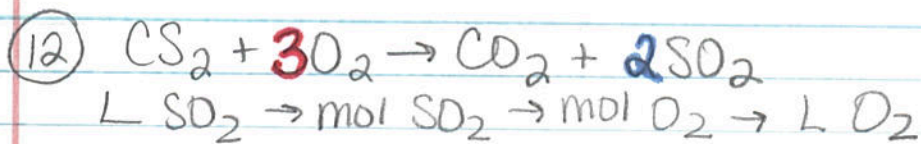


$$5.00 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \times \frac{16 \text{ mol CO}_2}{25 \text{ mol O}_2} \times \frac{22.4 \text{ L CO}_2}{1 \text{ mol CO}_2} = 3.2 \text{ L CO}_2$$

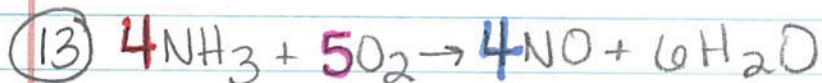


100.1

$$100. \text{ L NH}_3 \times \frac{1 \text{ mol NH}_3}{22.4 \text{ L NH}_3} \times \frac{3 \text{ mol H}_2}{2 \text{ mol NH}_3} \times \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} = 150. \text{ L H}_2$$



$$10.0 \text{ L SO}_2 \times \frac{1 \text{ mol SO}_2}{22.4 \text{ L SO}_2} \times \frac{3 \text{ mol O}_2}{2 \text{ mol SO}_2} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = \boxed{15.0 \text{ L O}_2}$$



• w/ 8.00 L NH_3 :

$$\text{L NH}_3 \rightarrow \text{mol NH}_3 \rightarrow \text{mol NO} \rightarrow \text{L NO}$$

$$8.00 \text{ L NH}_3 \times \frac{1 \text{ mol NH}_3}{22.4 \text{ L NH}_3} \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} \times \frac{22.4 \text{ L NO}}{1 \text{ mol NO}} = \underline{8.00 \text{ L NO}}$$

• w/ 2.00 L O_2 :

$$\text{L O}_2 \rightarrow \text{mol O}_2 \rightarrow \text{mol NO} \rightarrow \text{L NO}$$

$$2.00 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \times \frac{4 \text{ mol NO}}{5 \text{ mol O}_2} \times \frac{22.4 \text{ L NO}}{1 \text{ mol NO}} = \frac{1.60 \text{ L NO}}{\text{NO}}$$

Max. Amount
of NO that can
be produced is
1.60 L.

* O_2 is the
limiting
reactant.

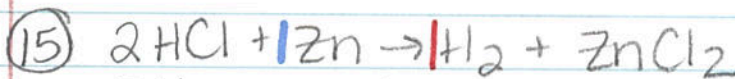
→ Mass-Volume Problems



$$\text{g H}_2\text{O} \rightarrow \text{mol H}_2\text{O} \rightarrow \text{mol O}_2 \rightarrow \text{L O}_2$$

$$\frac{180\text{g H}_2\text{O}}{180} \times \frac{1\text{mol H}_2\text{O}}{18.0\text{g H}_2\text{O}} \times \frac{1\text{mol O}_2}{2\text{mol H}_2\text{O}} \times \frac{22.4\text{L O}_2}{1\text{mol O}_2} = 112\text{L O}_2$$

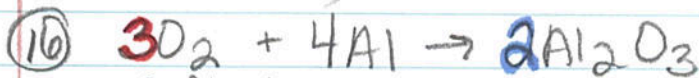
$$\left. \begin{array}{l} \text{gfm H}_2\text{O} \\ = 18.0\text{g/mol} \end{array} \right\}$$



$$\text{L H}_2 \rightarrow \text{mol H}_2 \rightarrow \text{mol Zn} \rightarrow \text{g Zn}$$

$$11.2\text{L H}_2 \times \frac{1\text{mol H}_2}{22.4\text{L H}_2} \times \frac{1\text{mol Zn}}{1\text{mol H}_2} \times \frac{65.4\text{g Zn}}{1\text{mol Zn}} = 32.7\text{g Zn}$$

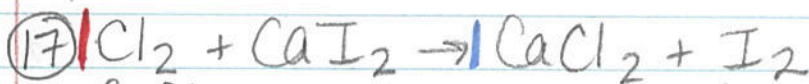
$$\left. \begin{array}{l} \text{gfm Zn} \\ = 65.4\text{g/mol} \end{array} \right\}$$



$$\text{g Al}_2\text{O}_3 \rightarrow \text{mol Al}_2\text{O}_3 \rightarrow \text{mol O}_2 \rightarrow \text{L O}_2$$

$$\frac{408\text{g Al}_2\text{O}_3}{408} \times \frac{1\text{mol Al}_2\text{O}_3}{102.0\text{g Al}_2\text{O}_3} \times \frac{3\text{mol O}_2}{2\text{mol Al}_2\text{O}_3} \times \frac{22.4\text{L O}_2}{1\text{mol O}_2} = 134\text{L O}_2$$

$$\left. \begin{array}{l} \text{gfm Al}_2\text{O}_3 \\ = 102.0\text{g/mol} \end{array} \right\}$$



$$\text{g CaCl}_2 \rightarrow \text{mol CaCl}_2 \rightarrow \text{mol Cl}_2 \rightarrow \text{L Cl}_2$$

$$\frac{222\text{g CaCl}_2}{222} \times \frac{1\text{mol CaCl}_2}{111.1\text{g CaCl}_2} \times \frac{1\text{mol Cl}_2}{1\text{mol CaCl}_2} \times \frac{22.4\text{L Cl}_2}{1\text{mol Cl}_2} = 44.8\text{L}$$

$$\left. \begin{array}{l} \text{gfm CaCl}_2 \\ = 111.1\text{g/mol} \end{array} \right\}$$