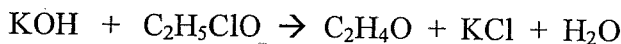






7. How many grams of ethylene oxide,  $C_2H_4O$ , (44.05 g/mol) will be produced from  $6.73 \times 10^7$  g of KOH (56.11 g/mol) reacting with  $9.75 \times 10^7$  g ethylene chlorohydrin,  $C_2H_5ClO$ , (80.51 g/mol) as shown in the equation below? What is the limiting reactant?



$3.91 \times 10^7$  g potassium hydroxide +  $9.75 \times 10^7$  g ethylene chlorohydrin  $\rightarrow$  ? g ethylene oxide + potassium chloride +  $H_2O$

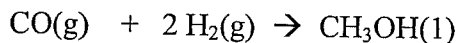
$$\frac{3.91 \times 10^7 \text{ g KOH}}{56.11 \text{ g KOH}} \times \frac{1 \text{ mol KOH}}{1 \text{ mol KOH}} \times \frac{1 \text{ mol } C_2H_4O}{1 \text{ mol KOH}} \times \frac{44.05 \text{ g } C_2H_4O}{1 \text{ mol } C_2H_4O} = 3.07 \times 10^7 \text{ g } C_2H_4O$$

LR KOH is L.R.

$$\frac{9.75 \times 10^7 \text{ g } C_2H_5ClO}{80.51 \text{ g } C_2H_5ClO} \times \frac{1 \text{ mol } C_2H_5ClO}{1 \text{ mol } C_2H_5ClO} \times \frac{1 \text{ mol } C_2H_4O}{1 \text{ mol } C_2H_5ClO} \times \frac{44.05 \text{ g } C_2H_4O}{1 \text{ mol } C_2H_4O} = 5.33 \times 10^7 \text{ g } C_2H_4O$$

8. Carbon monoxide (28.01 g/mol) can be combined with hydrogen to produce methanol,  $CH_3OH$ . Methanol is used as an industrial solvent, as a reactant in synthesis, and as a clean-burning fuel for some racing cars. If you had 4.71 mg CO and .664 mg  $H_2$ , how many grams of  $CH_3OH$  (32.04 g/mol) would be produced?

carbon monoxide + hydrogen  $\rightarrow$  methanol



$$17.5 \text{ mg } \quad .386 \text{ mg } \quad ? \text{ g}$$

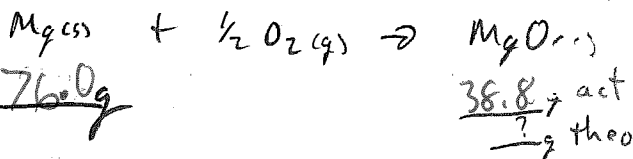
$$\frac{17.5 \text{ mg CO}}{1000 \text{ mg CO}} \times \frac{1 \text{ g CO}}{1 \text{ g CO}} \times \frac{1 \text{ mol CO}}{28.01 \text{ g CO}} \times \frac{1 \text{ mol } CH_3OH}{1 \text{ mol CO}} \times \frac{32.04 \text{ g } CH_3OH}{1 \text{ mol } CH_3OH} = .0200 \text{ g } CH_3OH$$

$$\frac{.386 \text{ mg } H_2}{1000 \text{ mg } H_2} \times \frac{1 \text{ g } H_2}{1 \text{ g } H_2} \times \frac{1 \text{ mol } H_2}{2.016 \text{ g } H_2} \times \frac{1 \text{ mol } CH_3OH}{2 \text{ mol } H_2} \times \frac{32.04 \text{ g } CH_3OH}{1 \text{ mol } CH_3OH} = .00307 \text{ g } CH_3OH$$

LR

9. When 57.0 g of magnesium metal are burned in excess oxygen (32.00 g/mol), 49.9 g of magnesium oxide (40.31 g/mol) are produced. What is the percent for this reaction?

magnesium + oxygen  $\rightarrow$  magnesium oxide



$$\% Y = \frac{\text{act}}{\text{theo}} \times 100$$

$$= \frac{38.8}{126} \times 100$$

$$\frac{57.0 \text{ g Mg}}{24.31 \text{ g Mg}} \times \frac{1 \text{ mol Mg}}{1 \text{ mol Mg}} \times \frac{1 \text{ mol } MgO}{1 \text{ mol Mg}} \times \frac{40.31 \text{ g } MgO}{1 \text{ mol } MgO} = 126 \text{ g } MgO$$

$$30.8\%$$

10. When aluminum metal is placed into a solution of copper (II) sulfate the aluminum replaces the copper to form an aluminum sulfate solution and copper metal. If 40.19 g of aluminum is placed into the solution and only 75.0 g of copper were formed, what is the percent yield for this reaction?

75.1

aluminum + copper(II) sulfate  $\rightarrow$  aluminum sulfate + copper



54.1 g

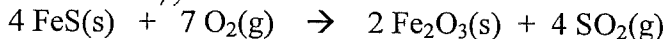
58.5 act  
191 theo

$$\frac{54.1}{26.98} \times \frac{1 \text{ mol Al}}{2 \text{ mol Al}} \times \frac{3 \text{ mol Cu}}{2 \text{ mol Al}} \times \frac{63.55 \text{ g Cu}}{1 \text{ mol Cu}} = 191 \text{ g Cu}$$

$$\% Y = \frac{\text{act}}{\text{theo}} \times 100 = \frac{58.5}{191} \times 100 = 30.6\%$$

11. Burning 114.7 g of iron(II) sulfide (87.92 g/mol) produces 5.502 g of solid product. What is the percent yield for this reaction? ( $\text{Fe}_2\text{O}_3$  - 159.7 g/mol)

iron(II) sulfide + oxygen  $\rightarrow$  iron(III) oxide + sulfur dioxide



153.6 g

4.283 act  
139.5 theo

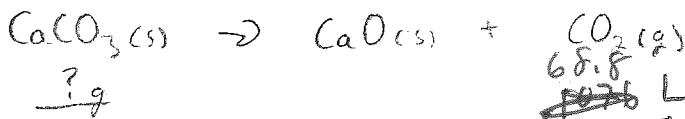
$$\frac{153.6}{87.92} \times \frac{1 \text{ mol FeS}}{4 \text{ mol FeS}} \times \frac{2 \text{ mol Fe}_2\text{O}_3}{4 \text{ mol FeS}} \times \frac{159.7 \text{ g Fe}_2\text{O}_3}{1 \text{ mol Fe}_2\text{O}_3} = \frac{139.5}{506.7} \text{ g Fe}_2\text{O}_3$$

$$\% Y = \frac{\text{act}}{\text{theo}} \times 100 = \frac{4.283}{139.5} \times 100 = 3.070\%$$

12. A chemist is studying reactions that evolve carbon dioxide gas. One reaction is calcium carbonate (100.09 g/mol) decomposing into calcium oxide (56.08 g/mol) and carbon dioxide (44.01 g/mol). How many grams of calcium carbonate are needed to produce enough carbon dioxide to fill the dual air bags on my truck with a total volume of 1.076 L? The density of carbon dioxide is 1.961 g/L.

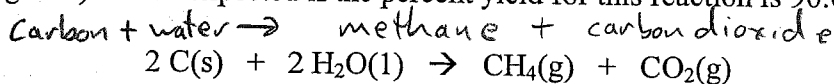
10.76 L

Calcium carbonate  $\rightarrow$  calcium oxide + carbon dioxide



$$\frac{68.8}{1.961} \text{ L CO}_2 \times \frac{1.961 \text{ g CO}_2}{1 \text{ L CO}_2} \times \frac{1 \text{ mol CO}_2}{44.01 \text{ g CO}_2} \times \frac{1 \text{ mol CaCO}_3}{1 \text{ mol CO}_2} \times \frac{100.09 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = 307 \text{ g CaCO}_3$$

13.  $8.79 \times 10^{-11}$  g of carbon react with excess water. How many grams of methane (16.04 g/mol) can be expected if the percent yield for this reaction is 90.0%?



$$\frac{8.79 \times 10^{-11} \text{ g}}{12.01 \text{ g/mol}} \times \frac{1 \text{ mol CH}_4}{2 \text{ mol C}} \times \frac{16.04 \text{ g CH}_4}{1 \text{ mol CH}_4} = 5.81 \times 10^{-11} \text{ g CH}_4$$

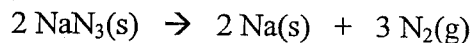
90.0%  
 $\frac{? \text{ g theo}}{? \text{ g act}}$

$$\frac{8.79 \times 10^{-11} \text{ g C}}{12.01 \text{ g/mol}} \times \frac{1 \text{ mol CH}_4}{2 \text{ mol C}} \times \frac{16.04 \text{ g CH}_4}{1 \text{ mol CH}_4} = 5.81 \times 10^{-11} \text{ g CH}_4$$

theo  $\times$  % = act  
 $(5.81 \times 10^{-11} \text{ g}) (0.900) = 5.23 \times 10^{-11} \text{ g CH}_4$

14. The air bag in a car needs 7.72 L of nitrogen to inflate properly. How many grams of sodium will also be produced from this reaction if there is enough nitrogen gas to fill this air bag? Nitrogen gas has a density of 1.251 g/L at this temperature.

sodium azide  $\rightarrow$  sodium + nitrogen

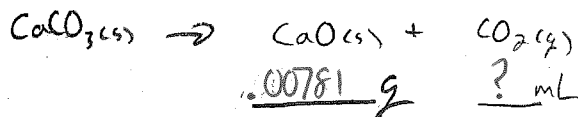


$\frac{? \text{ g}}{44.9 \text{ L}}$

$$\frac{44.9 \text{ L N}_2}{1 \text{ L N}_2} \times \frac{1.251 \text{ g N}_2}{1 \text{ L N}_2} \times \frac{1 \text{ mol N}_2}{28.02 \text{ g N}_2} \times \frac{2 \text{ mol Na}}{3 \text{ mol N}_2} \times \frac{22.99 \text{ g Na}}{1 \text{ mol Na}} = 30.7 \text{ g Na}$$

15. Calcium oxide, which is used in cement, can be derived by decomposing the calcium carbonate that occurs naturally in limestone. How many milliliters of  $\text{CO}_2$  (44.01 g/mol) will be liberated when .014 g of  $\text{CaO}$  (56.08 g/mol) have been produced? The density of  $\text{CO}_2$  is 1.997 g/L.

calcium carbonate  $\rightarrow$  calcium oxide + carbon dioxide

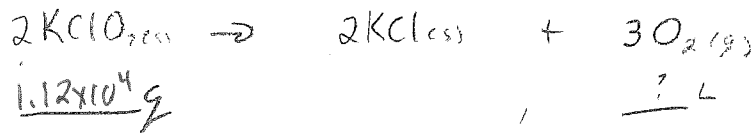


$$\frac{.014 \text{ g CaO}}{56.08 \text{ g CaO}} \times \frac{1 \text{ mol CaO}}{1 \text{ mol CaO}} \times \frac{44.01 \text{ g CO}_2}{1 \text{ mol CO}_2} \times \frac{1 \text{ L CO}_2}{1.997 \text{ g CO}_2} \times \frac{1000 \text{ mL CO}_2}{1 \text{ L CO}_2} = 3.07 \text{ mL CO}_2$$

55

16. How many liters of oxygen will evolve from the decomposition of  $1.93 \times 10^4$  grams potassium chlorate (122.55 g/mol)? The density of oxygen is 1.429 g/L. The other product is potassium chloride.

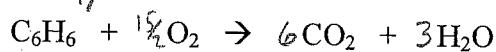
potassium chlorate  $\rightarrow$  potassium chloride + oxygen



$$\frac{1.12 \times 10^4 \text{ g KClO}_3}{\quad\quad\quad} \times \frac{1 \text{ mol KClO}_3}{122.55 \text{ g KClO}_3} \times \frac{3 \text{ mol O}_2}{2 \text{ mol KClO}_3} \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} \times \frac{1 \text{ L O}_2}{1.429 \text{ g O}_2} = \underline{3070 \text{ L O}_2}$$

17. How many liters of air must react  $5.44 \times 10^6$  mL of benzene (78.11 g/mol) in order for combustion to occur completely? The percentage of oxygen in air is 20.9%. The density of benzene is 0.8787 g/mL and oxygen's density is 1.331 g/L.

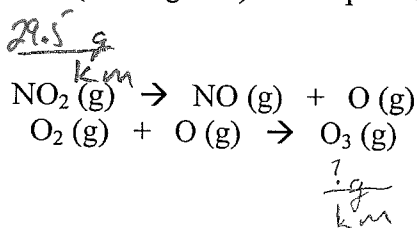
Benzene + oxygen  $\rightarrow$  carbon dioxide + water



$\frac{3.16 \times 10^6 \text{ mL}}{\quad\quad\quad}$   $\frac{? \text{ L}}{\quad\quad\quad}$

$$\frac{3.16 \times 10^6 \text{ mL C}_6\text{H}_6}{\quad\quad\quad} \times \frac{0.8787 \text{ g C}_6\text{H}_6}{1 \text{ mL C}_6\text{H}_6} \times \frac{1 \text{ mol C}_6\text{H}_6}{78.11 \text{ g C}_6\text{H}_6} \times \frac{15/2 \text{ mol O}_2}{1 \text{ mol C}_6\text{H}_6} \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} \times \frac{1 \text{ L O}_2}{1.331 \text{ g O}_2} \times \frac{100 \text{ L air}}{20.9 \text{ L O}_2} = \underline{3.07 \times 10^7 \text{ L air}}$$

18. A truck emits  $\text{NO}_2$  (46.1 g/mol) at a rate of 50.6 g/km. From the equations below, determine how much ozone (48.00 g/mol) can be produced per kilometer of travel by this vehicle.



$$\frac{29.5 \text{ g NO}_2}{\text{km}} \times \frac{1 \text{ mol NO}_2}{46.1 \text{ g NO}_2} \times \frac{1 \text{ mol O}}{1 \text{ mol NO}_2} \times \frac{1 \text{ mol O}_3}{1 \text{ mol O}} \times \frac{48.0 \text{ g O}_3}{1 \text{ mol O}_3} = \underline{\frac{30.7 \text{ g O}_3}{\text{km}}}$$