

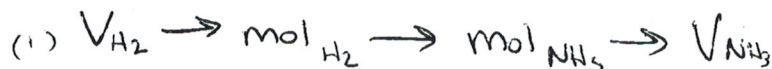
Name: SOLUTIONS
 Hour: _____ Date: _____

Stoichiometry with gases

1.) How many liters of ammonia could form if 24.2 liters of hydrogen gas were reacted with excess nitrogen gas?

a. Write the balanced chemical equation: $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

b. Use the road map to go from volume of one substance to volume of another:



$$\frac{24.2 \text{ L H}_2}{22.4 \text{ L H}_2} \times \frac{1 \text{ mol H}_2}{3 \text{ mol H}_2} \times \frac{2 \text{ mol NH}_3}{1 \text{ mol NH}_3} \times \frac{22.4 \text{ L NH}_3}{1 \text{ mol NH}_3} = \boxed{16.1 \text{ L NH}_3}$$

2.) How many molecules of carbon dioxide are formed when 6.35 liters of propane, C_3H_8 , burn in the presence of excess oxygen?

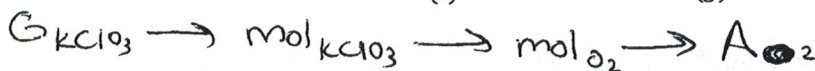
a. Write the balanced chemical equation: $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$

b. Use the road map to go from volume of one substance to volume of another:



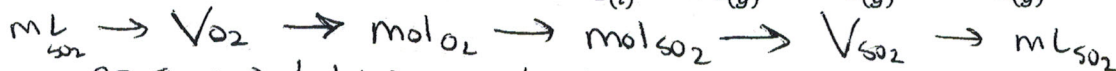
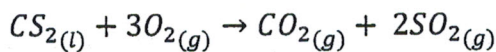
$$\frac{6.35 \text{ L C}_3\text{H}_8}{22.4 \text{ L C}_3\text{H}_8} \times \frac{1 \text{ mol C}_3\text{H}_8}{1 \text{ mol C}_3\text{H}_8} \times \frac{3 \text{ mol CO}_2}{1 \text{ mol C}_3\text{H}_8} \times \frac{6.02 \times 10^{23} \text{ molecules CO}_2}{1 \text{ mol CO}_2} = \boxed{5.11 \times 10^{23} \text{ molecules CO}_2}$$

3.) How many molecules of oxygen are produced by the decomposition of 6.54 g of potassium chlorate (KClO_3)?



$$\frac{6.54 \text{ g KClO}_3}{122.55 \text{ g KClO}_3} \times \frac{1 \text{ mol KClO}_3}{2 \text{ mol KClO}_3} \times \frac{3 \text{ mol O}_2}{1 \text{ mol KClO}_3} \times \frac{6.02 \times 10^{23} \text{ molecules O}_2}{1 \text{ mol O}_2} = \boxed{1.93 \times 10^{22} \text{ molecules O}_2 \text{ gas will be formed}}$$

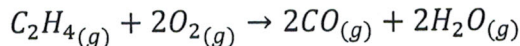
4.) Calculate the volume of sulfur dioxide, in milliliters, produced when 27.9 mL O_2 reacts with carbon disulfide. (Recall that 1000 mL = 1 L).



$$\frac{27.9 \text{ mL O}_2}{1000 \text{ mL O}_2} \times \frac{1 \text{ L O}_2}{22.4 \text{ L O}_2} \times \frac{1 \text{ mol O}_2}{3 \text{ mol O}_2} \times \frac{2 \text{ mol SO}_2}{1 \text{ mol SO}_2} \times \frac{22.4 \text{ L SO}_2}{1 \text{ L SO}_2} \times \frac{1000 \text{ mL SO}_2}{1 \text{ L SO}_2} = \boxed{18.6 \text{ mL SO}_2}$$

Part II: Limiting reagents

5.) The equation below shows the incomplete combustion of ethane:



If 2.70 mol C_2H_4 is reacted with 6.30 mol O_2 ,

a. Calculate the moles of water produced given the amounts of *each* reactant present (DO TWO CALCULATIONS!). (1) mol $\text{C}_2\text{H}_4 \rightarrow$ mol H_2O

$$\frac{2.70 \text{ mol C}_2\text{H}_4 \left| \frac{2 \text{ mol H}_2\text{O}}{1 \text{ mol C}_2\text{H}_4} \right.}{1 \text{ mol C}_2\text{H}_4} = \boxed{5.40 \text{ mol H}_2\text{O}}$$

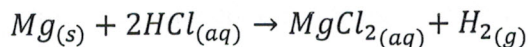
(2) mol $\text{O}_2 \rightarrow$ mol H_2O

$$\frac{6.30 \text{ mol O}_2 \left| \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol O}_2} \right.}{2 \text{ mol O}_2} = 6.30 \text{ mol H}_2\text{O}$$

b. Identify the limiting reagent based on your calculations in a.

Only 5.40 mol H_2O can be produced b/c C_2H_4 will run out after that $\therefore \text{C}_2\text{H}_4$ is the limiting reagent.

6.) Hydrogen gas can be produced by the reaction of magnesium metal with hydrochloric acid.



Identify the limiting reagent when 6.00 g HCl reacts with 5.00 g Mg

(Hint: Calculate the amount of one of the products that will be produced if you had 6.00 g HCl and plenty of Mg and then repeat the calculation for the amount of Mg given assuming you have plenty of HCl).

(1) Pick either product to calculate for if one isn't assigned? I'll pick $\text{H}_2(g)$

(2) $\text{G}_{\text{HCl}} \rightarrow \text{mol}_{\text{HCl}} \rightarrow \text{mol}_{\text{H}_2}$

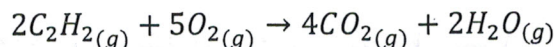
$$\frac{6.00 \text{ g HCl} \left| \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} \right| \left| \frac{1 \text{ mol H}_2}{2 \text{ mol HCl}} \right.}{2 \text{ mol HCl}} = \boxed{0.0823 \text{ mol H}_2}$$

HCl is the limiting reagent b/c it will make less product.

(3) $\text{G}_{\text{Mg}} \rightarrow \text{mol}_{\text{Mg}} \rightarrow \text{mol}_{\text{H}_2}$

$$\frac{6.00 \text{ g Mg} \left| \frac{1 \text{ mol Mg}}{24.3 \text{ g Mg}} \right| \left| \frac{1 \text{ mol H}_2}{1 \text{ mol Mg}} \right.}{1 \text{ mol Mg}} = 0.247 \text{ mol H}_2$$

7.) The heat from an acetylene torch is produced by burning acetylene (C_2H_2) in oxygen:



How many grams of water can be produced by the reaction of 2.40 mol C_2H_2 with 7.40 mol O_2 ?

(1) mol $\text{C}_2\text{H}_2 \rightarrow$ mol $\text{H}_2\text{O} \rightarrow \text{G}_{\text{H}_2\text{O}}$

$$\frac{2.40 \text{ mol C}_2\text{H}_2 \left| \frac{2 \text{ mol H}_2\text{O}}{2 \text{ mol C}_2\text{H}_2} \right| \left| \frac{18.0152 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right.}{1 \text{ mol H}_2\text{O}} = \boxed{43.2 \text{ g H}_2\text{O}}$$

C_2H_2 is the limiting reagent.

(2) mol $\text{O}_2 \rightarrow$ mol $\text{H}_2\text{O} \rightarrow \text{G}_{\text{H}_2\text{O}}$

$$\frac{7.40 \text{ mol O}_2 \left| \frac{2 \text{ mol H}_2\text{O}}{5 \text{ mol O}_2} \right| \left| \frac{18.0152 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \right.}{1 \text{ mol H}_2\text{O}} = 53.3 \text{ g H}_2\text{O}$$