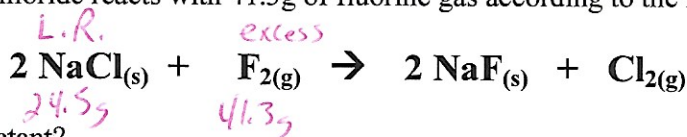


Name: _____ Date: _____ Hr: _____

Stoichiometry 3.5 Limiting Reactant Worksheet

A 24.5g sample of sodium chloride reacts with 41.3g of fluorine gas according to the following chemical equation:



a. What is the limiting reactant?

$$\frac{24.5\text{g NaCl}}{1} \times \frac{1 \text{ mol NaCl}}{58.443\text{g NaCl}} \times \frac{1 \text{ mol F}_2}{2 \text{ mol NaCl}} \times \frac{37.996\text{g F}_2}{1 \text{ mol F}_2} = \boxed{7.96\text{g F}_2} \quad \begin{matrix} \text{NaCl} \\ \text{L.R.} \end{matrix}$$

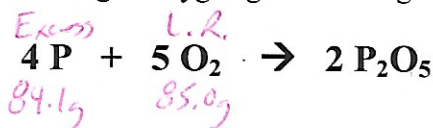
b. How many liters of chlorine gas are produced?

$$\frac{24.5\text{g NaCl}}{1} \times \frac{1 \text{ mol NaCl}}{58.443\text{g NaCl}} \times \frac{1 \text{ mol Cl}_2}{2 \text{ mol NaCl}} \times \frac{70.906\text{g Cl}_2}{1 \text{ mol Cl}_2} = 14.86\text{g Cl}_2$$

wrong

$$\times \frac{22.4 \text{ L Cl}_2}{1 \text{ mol Cl}_2} = \boxed{4.70 \text{ L Cl}_2}$$

2) A 84.1g sample of phosphorus reacts with 85.0g of oxygen gas according to the following chemical equation:



a. Find the limiting reagent.

$$\frac{84.1\text{g P}}{1} \times \frac{1 \text{ mol P}}{30.974\text{g P}} \times \frac{5 \text{ mol O}_2}{4 \text{ mol P}} \times \frac{31.998\text{g O}_2}{1 \text{ mol O}_2} = \boxed{108.6\text{g O}_2} \quad \begin{matrix} \text{O}_2 \text{ is} \\ \text{L.R.} \end{matrix}$$

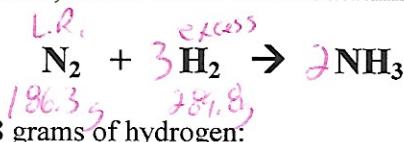
b. How many grams of P₂O₅ are produced in theory?

$$\frac{85.0\text{g O}_2}{1} \times \frac{1 \text{ mol O}_2}{31.998\text{g O}_2} \times \frac{2 \text{ mol P}_2\text{O}_5}{5 \text{ mol O}_2} \times \frac{141.943\text{g P}_2\text{O}_5}{1 \text{ mol P}_2\text{O}_5} = \boxed{150.8\text{g P}_2\text{O}_5}$$

c. If only 123 g of P₂O₅ are produced, what is the percent yield?

$$\frac{123\text{g P}_2\text{O}_5}{150.8\text{g P}_2\text{O}_5} \times 100 = \boxed{81.6\%}$$

3) Most nitrogen exists in a gaseous state. Plants require a soluble form of nitrogen so they can absorb it from the ground. Ammonia is a good fertilizer, as the mass percent of nitrogen in ammonia is very high. The following reaction is used to convert gaseous nitrogen into ammonia, which can be used as fertilizer.



If 186.3 grams of nitrogen react with 289.8 grams of hydrogen:

a) Which reactant is limiting?

$$\frac{186.3\text{g N}_2}{1} \times \frac{1 \text{ mol N}_2}{28.02\text{g N}_2} \times \frac{3 \text{ mol H}_2}{1 \text{ mol N}_2} \times \frac{2.0158\text{g H}_2}{1 \text{ mol H}_2} = \boxed{40.21\text{g H}_2} \quad \begin{matrix} \text{N}_2 \\ \text{L.R.} \end{matrix}$$

b) What is the theoretical yield of ammonia?

$$\frac{186.3 \text{ g N}_2}{1} \times \frac{1 \text{ mol N}_2}{28.02 \text{ g N}_2} \times \frac{2 \text{ mol NH}_3}{1 \text{ mol N}_2} \times \frac{17.03 \text{ g NH}_3}{1 \text{ mol NH}_3} = 226.5 \text{ g NH}_3$$

c) If this reaction is known to have a 73.8% yield, what mass of ammonia could you expect to produce?

$$\frac{A}{T} = 0.738$$

$$\frac{A}{(226.5 \text{ g})} = .738$$

$$A = .738(226.5)$$

$$A = 167 \text{ g NH}_3$$

4) A 5.75g sample of silicone dioxide reacts with 5.50g of sodium hydroxide according to the following equation:



a) How many grams of Na₂SiO₃ are produced?

$$\frac{5.75 \text{ g SiO}_2}{1} \times \frac{1 \text{ mol SiO}_2}{60.084 \text{ g SiO}_2} \times \frac{2 \text{ mol NaOH}}{1 \text{ mol SiO}_2} \times \frac{39.997 \text{ g NaOH}}{1 \text{ mol NaOH}} = 7.65 \text{ g NaOH}$$

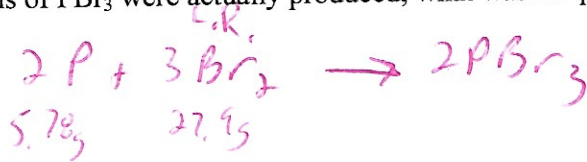
Need

$$\frac{5.50 \text{ g NaOH}}{1} \times \frac{1 \text{ mol NaOH}}{39.997 \text{ g NaOH}} \times \frac{1 \text{ mol Na}_2\text{SiO}_3}{2 \text{ mol NaOH}} \times \frac{122.062 \text{ g Na}_2\text{SiO}_3}{1 \text{ mol Na}_2\text{SiO}_3} = 8.39 \text{ g Na}_2\text{SiO}_3$$

b) What is the percent yield if only 7.24g Na₂SiO₃ are produced?

$$\frac{7.24 \text{ g Na}_2\text{SiO}_3}{8.39 \text{ g Na}_2\text{SiO}_3} \times 100 = 86.3\% \text{ yield}$$

5) In a synthesis reaction between phosphorus and liquid bromine, 5.78g of phosphorus and 27.9g of liquid bromine were poured in a beaker. After the reaction was complete, what were the COMPLETE contents inside the beaker (think hard about everything)? If 22.3 grams of PBr₃ were actually produced, what was the percent yield of PBr₃?



$$\frac{5.78 \text{ g P}}{1} \times \frac{1 \text{ mol P}}{30.974 \text{ g P}} \times \frac{3 \text{ mol Br}_2}{2 \text{ mol P}} \times \frac{159.808 \text{ g Br}_2}{1 \text{ mol Br}_2} = 44.73 \text{ g Br}_2$$

Need

$$\frac{27.9 \text{ g Br}_2}{1} \times \frac{1 \text{ mol Br}_2}{159.808 \text{ g Br}_2} \times \frac{2 \text{ mol PBr}_3}{3 \text{ mol Br}_2} \times \frac{270.686 \text{ g PBr}_3}{1 \text{ mol PBr}_3} = 31.51 \text{ g PBr}_3$$

$$\frac{27.9 \text{ g Br}_2}{1} \times \frac{1 \text{ mol Br}_2}{151.808 \text{ g Br}_2} \times \frac{2 \text{ mol P}}{3 \text{ mol Br}_2} \times \frac{30.974 \text{ g P}}{1 \text{ mol P}} = 3.61 \text{ g P}$$

$$\frac{31.51}{22.3 \text{ g PBr}_3}$$

$$\frac{22.3 \text{ g PBr}_3}{31.51 \text{ g}} = 70.8\% \text{ yield}$$

$$\begin{matrix} 31.51 \text{ g PBr}_3 \\ 3.61 \text{ g P} \end{matrix}$$