

1) Methanol ( $\text{CH}_3\text{OH}$ ) is the one carbon alcohol. It is synthesized by the reaction of hydrogen and carbon monoxide.

A) Balanced EQ:  $2\text{H}_2(\text{g}) + \text{CO}(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{l})$

B) If 500. mol of CO and 750. mol of hydrogen gas are present, which is the limiting reactant?

$$500. \text{ mol CO} \left( \frac{1 \text{ mol CH}_3\text{OH}}{1 \text{ mol CO}} \right) = 500. \text{ mol CH}_3\text{OH} \quad \text{H}_2$$

$$\text{LR } 750. \text{ mol H}_2 \left( \frac{1 \text{ mol CH}_3\text{OH}}{2 \text{ mol H}_2} \right) = 375. \text{ mol CH}_3\text{OH} \quad \text{less product}$$

C) Based on your LR, how many **moles** of methanol can be theoretically produced?

$$375. \text{ mol CH}_3\text{OH max}$$

2) In the lab, silver nitrate was reacted with copper metal to produce copper (II) nitrate and silver metal

a) write balanced EQ:  $2\text{AgNO}_3 + \text{Cu} \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$

LR b) If you react 1.24 g of  $\text{AgNO}_3$  and 1.24 g of Cu, which reactant is the limiting reactant?

$$1.24 \text{ g AgNO}_3 \left( \frac{1 \text{ mol AgNO}_3}{169.88 \text{ g}} \right) \left( \frac{2 \text{ mol Ag}}{2 \text{ mol AgNO}_3} \right) \left( \frac{107.87 \text{ g}}{1 \text{ mol Ag}} \right) = 0.796 \text{ g Ag} \approx 0.787 \text{ g Ag}$$

$$1.24 \text{ g Cu} \left( \frac{1 \text{ mol Cu}}{63.55 \text{ g}} \right) \left( \frac{2 \text{ mol Ag}}{1 \text{ mol Cu}} \right) \left( \frac{107.87 \text{ g}}{1 \text{ mol Ag}} \right) = 4.21 \text{ g Ag}$$

less

c) Based on your answer from (b), how many grams of Ag could you theoretically produce?

$$0.787 \text{ g Ag max}$$

d) If you actually performed this reaction in the lab with the exact reactant amounts given in (b) and produced 0.69 g Ag, find your **percent yield**.

$$\% \text{ yield} = \frac{0.69 \text{ g}}{0.787 \text{ g}} \times 100 = 88\% \text{ Y}$$

3) Zinc metal reacts with hydrochloric acid to produce zinc (II) chloride and hydrogen gas.



B) If 0.30 mol of zinc is added to 0.52 mol HCl, how many moles of hydrogen gas are produced? (this is a LR problem)

$$0.30 \text{ mol Zn} \left( \frac{1 \text{ mol H}_2}{1 \text{ mol Zn}} \right) = 0.30 \text{ mol H}_2$$

$$\text{LR } 0.52 \text{ mol HCl} \left( \frac{1 \text{ mol H}_2}{2 \text{ mol HCl}} \right) = 0.26 \text{ mol H}_2 \leftarrow \text{max you could produce}$$

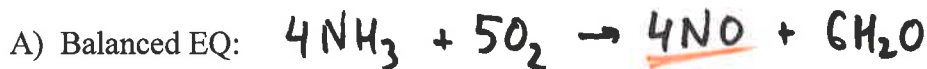
less

C) If you run the experiment using the exact molar amounts in (B) and produce 0.50 grams of hydrogen gas, what was your percent yield?

$$0.26 \text{ mol H}_2 \left( \frac{2.02 \text{ g}}{1 \text{ mol H}_2} \right) = 0.5252 = \underline{0.53 \text{ g H}_2 \text{ theo}}$$

$$\% Y = \frac{0.50 \text{ g}}{0.53 \text{ g}} \times 100 = \underline{94\% \text{ yield}}$$

4) Ammonia (NH<sub>3</sub>) can be burned (combined with oxygen) in the presence of a platinum catalyst to create nitric oxide (NO) and water.



B) Suppose a vessel contains 2.045 g ammonia and 4.48 g oxygen gas. Which is the limiting reactant? *read part B first* ✓

$$2.045 \text{ g NH}_3 \left( \frac{1 \text{ mol NH}_3}{17.04 \text{ g}} \right) \left( \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} \right) = 0.1200 \text{ mol NO}$$

$$\text{LR } 4.48 \text{ g O}_2 \left( \frac{1 \text{ mol O}_2}{32.00 \text{ g}} \right) \left( \frac{4 \text{ mol NO}}{5 \text{ mol O}_2} \right) = \underline{0.112 \text{ mol NO}} \text{ less}$$

C) Based on your B calculation, how many moles of NO can be theoretically obtained?

$$0.112 \text{ mol NO}$$