

**Hand In Assignment # 11 –
Excess Quantity and % Yield**

Name key
Date _____

Mark _____/33

1. Given the following balanced chemical equation, answer the question below it.



- a. What mass of MgCO_3 will react completely with 25.0 mL of 3.0 M HCl? (2 marks)

$$x \text{ g MgCO}_3 = 0.025 \text{ L} \times \frac{3 \text{ mol HCl}}{\text{L}} \times \frac{1 \text{ MgCO}_3}{2 \text{ HCl}} \times \frac{84.3 \text{ g}}{1 \text{ MgCO}_3} = 3.16125$$

Answer 3.2 g MgCO₃

- b. Calculate the volume of 0.60 M HCl which would be needed to react completely with 122.235 grams of magnesium carbonate. (2 marks)

$$x \text{ L HCl} = 122.235 \text{ g} \times \frac{1 \text{ MgCO}_3}{84.3 \text{ g}} \times \frac{2 \text{ HCl}}{1 \text{ MgCO}_3} \times \frac{1 \text{ L}}{0.60 \text{ mol HCl}} = 4.833$$

Answer 4.8 L HCl

- c. If 150.0 mL of 0.50 M HCl reacts with an excess of MgCO_3 , what volume of CO_2 would be produced at STP? (2 marks)

$$x \text{ L CO}_2 = \frac{0.150 \text{ L}}{0.150 \text{ L}} \times \frac{0.5 \text{ mol}}{1 \text{ L}} \times \frac{1 \text{ CO}_2}{2 \text{ HCl}} \times \frac{22.4 \text{ L}}{1 \text{ CO}_2} = \frac{1.736 \text{ L}}{0.84 \text{ L}}$$

Answer 0.84 L CO₂

2. Given the following balanced equation, answer the questions below it.



- a. If 16.5 mL of 0.200 M $\text{Ba}(\text{OH})_2$ is required to react completely with 25.0 mL of a solution of AlCl_3 , find the $[\text{AlCl}_3]$. (2 marks)

$$x \text{ mol Ba}(\text{OH})_2 = \frac{0.2 \text{ mol}}{\text{L}} \times 0.0165 = 3.3 \times 10^{-3} \text{ mol Ba}$$

$$x \text{ mol AlCl}_3 = 3.3 \times 10^{-3} \text{ mol Ba}(\text{OH})_2 \times \frac{2 \text{ AlCl}_3}{3 \text{ Ba}(\text{OH})_2} = 2.2 \times 10^{-3}$$

$$* \frac{\text{mol AlCl}_3}{\text{L}} = \frac{2.2 \times 10^{-3}}{0.025}$$

Answer 0.088 M AlCl_3

- b. What volume of 0.200 M $\text{Ba}(\text{OH})_2$ would be required to produce 171.6 grams of aluminum hydroxide? (2 marks)

$$x \text{ L Ba}(\text{OH})_2 = 171.6 \text{ Al}(\text{OH})_3 \times \frac{1 \text{ mol}}{78 \text{ g}} \times \frac{3 \text{ Ba}(\text{OH})_2}{2 \text{ Al}(\text{OH})_3} \times \frac{1 \text{ L}}{0.20 \text{ mol}} = 16.5$$

Answer 16.5 L $\text{Al}(\text{OH})_3$

3. Given the following balanced equation, answer the questions below it.



- a. If 254.0 grams of Cu are placed into 609.0 grams of HNO_3 , determine which reactant is in excess. (2 marks)

$$x \text{ mol NO} = 254 \text{ g Cu} \times \frac{1 \text{ mol}}{63.5 \text{ g}} \times \frac{2 \text{ NO}}{3 \text{ Cu}} = 2.67 \text{ mol}$$

$$x \text{ mol NO} = 609 \text{ g HNO}_3 \times \frac{1 \text{ mol}}{63 \text{ g}} \times \frac{2 \text{ NO}}{8 \text{ HNO}_3} = 2.416$$

Answer Cu in excess

- b. If the reaction in 3(a) is carried out, what mass of NO will be formed? (2 marks)

$$x \text{ g NO} = 2.416 \text{ mol NO} \times \frac{30 \text{ g}}{1 \text{ mol}} = 72.5 \text{ g NO}$$

Answer 72.5 g NO

4. Given the following balanced equation, answer the questions below it.



a. If 306.16 g of C_6H_{14} is mixed with 1120.0 grams of oxygen gas, which reactant is in excess? (2 marks)

$$x \text{ mol CO}_2 = 306.16 \text{ g C}_6\text{H}_{14} \times \frac{1 \text{ mol C}_6\text{H}_{14}}{86 \text{ g}} \times \frac{12 \text{ CO}_2}{2 \text{ C}_6\text{H}_{14}} = 21.36 \text{ mol CO}_2$$

$$x \text{ mol CO}_2 = 1120 \text{ g O}_2 \times \frac{1 \text{ mol O}_2}{32 \text{ g}} \times \frac{12 \text{ CO}_2}{19 \text{ O}_2} = 22.1 \text{ mol CO}_2$$

Answer O₂ in excess

b. If the reaction in 4(a) is carried out, what volume of CO_2 would be formed assuming conditions were brought to STP? (2 marks)

$$x \text{ L CO}_2 = 21.36 \text{ mol CO}_2 \times \frac{22.4 \text{ L}}{1 \text{ mol}} =$$

Answer 495 L CO₂

c. If the reaction in 4(a) is carried out, what mass of H_2O would be formed? (2 marks)

$$x \text{ g H}_2\text{O} = 306.16 \text{ g C}_6\text{H}_{14} \times \frac{1 \text{ mol}}{86 \text{ g}} \times \frac{14 \text{ H}_2\text{O}}{2 \text{ C}_6\text{H}_{14}} \times \frac{18 \text{ g}}{1 \text{ mol}} =$$

Answer 448.6 g H₂O

5. Given the balanced equation: $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightarrow 2\text{NH}_{3(g)}$,

When 190.4 grams of N_2 are added to an excess of H₂, a reaction occurs in which 104.04 grams of NH_3 are formed.

a. Calculate the *theoretical* yield of NH_3 in grams. (2 marks)

$$x \text{ g NH}_3 = 190.4 \text{ g N}_2 \times \frac{1 \text{ mol}}{28 \text{ g N}_2} \times \frac{2 \text{ NH}_3}{1 \text{ N}_2} \times \frac{17 \text{ g}}{1 \text{ NH}_3} = 231.2 \text{ g}$$

Answer 231.2 g NH₃

b. Calculate the *percentage* yield of NH_3 . (2 marks)

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$$\frac{104.04}{231.2} \times 100$$

Answer 45%



Under certain conditions, reacting 227.4 g of LiAlH_4 with an excess of BF_3 yields 93.84 g of B_2H_6 .

a. Calculate the *theoretical yield* of B_2H_6 . (2 marks)

$$x \text{ g B}_2\text{H}_6 = 227.4 \text{ g LiAlH}_4 \times \frac{1 \text{ mol}}{37.9 \text{ g}} \times \frac{2 \text{ B}_2\text{H}_6}{3 \text{ LiAlH}_4} \times \frac{27.6 \text{ g}}{1 \text{ mol}} =$$

Answer 110.4 g B_2H_6

b. What is the *actual yield* of B_2H_6 ? (1 mark)

93.84g

Answer 93.84g

c. Calculate the *percentage yield* of B_2H_6 . (2 marks)

$$\frac{93.84}{110.4} \times 100$$

Answer 85%

7. When reacting NH_3 with O_2 according to the reaction:



Using 92.48 grams of NH_3 with an excess of O_2 produces a 70% yield of NO .

a. Calculate the *theoretical yield* of NO in grams. (2 marks)

$$x \text{ g NH}_3 = 92.48 \text{ g NH}_3 \times \frac{1 \text{ mol}}{17 \text{ g NH}_3} \times \frac{4 \text{ NO}}{4 \text{ NH}_3} \times \frac{30 \text{ g}}{1 \text{ NO}} = 163.2$$

Answer 163.2 g NO

b. Calculate the *actual yield* of NO in grams. (2 marks)

$$\frac{\text{Actual}}{163.2} \times 0.7$$

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Answer 114.2 g NO