

Name

KEY

Date

Due Date

Mark

33 / 33

Correct and Hand in Again by

Chemistry 11

Hand In Assignment # 11 - Molarity, Excess and Percent Yield Problems

This Assignment will be marked and you are allowed to do one set of corrections. Show all of your work, including units in your work and answers.

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)

$$\text{mol HCl} = 3.0\text{M} \times 0.0250\text{L}$$

$$= 0.0750\text{ mol HCl} \times \frac{1\text{ mol MgCO}_3}{2\text{ mol HCl}} \times \frac{84.3\text{ g MgCO}_3}{1\text{ mol MgCO}_3} =$$

Answer

3.16 g MgCO_3

- 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)

$$122.235\text{ g MgCO}_3 \times \frac{1\text{ mol MgCO}_3}{84.3\text{ g MgCO}_3} \times \frac{2\text{ mol HCl}}{1\text{ mol MgCO}_3} = 2.90\text{ mol HCl}$$

$$L = \frac{\text{mol}}{M} = \frac{2.90\text{ mol}}{0.60\text{ M}} = 4.833\text{ L}$$

Answer

4.83 L (4833 mL)

- 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)

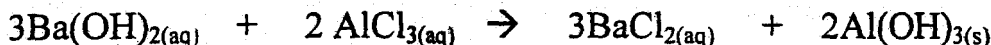
$$\text{mol HCl} = 0.50\text{ M} \times 0.150\text{ L} = 0.0750\text{ mol HCl}$$

$$0.0750\text{ mol HCl} \times \frac{1\text{ mol CO}_2}{2\text{ mol HCl}} \times \frac{22.4\text{ L CO}_2(\text{STP})}{1\text{ mol CO}_2}$$

Answer

= 0.84 L CO_2

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



a. If 16.5 mL of 0.200 M Ba(OH)₂ is required to react completely with 25.0 mL of a solution of AlCl₃, find the [AlCl₃]. (2 marks)

$$0.200\text{ M} \times 0.0165\text{ L} = 0.0033\text{ mol Ba}(\text{OH})_2 \times \frac{2\text{ mol AlCl}_3}{3\text{ mol Ba}(\text{OH})_2} = 0.0022\text{ mol AlCl}_3$$

2) $[\text{AlCl}_3] = \frac{0.0022\text{ mol}}{0.0250\text{ L}} = 0.0880\text{ M}$

Answer 0.0880 M

b. What volume of 0.200 M Ba(OH)₂ would be required to produce 171.6 grams of aluminum hydroxide? (2 marks)

2) $171.6\text{ g Al}(\text{OH})_3 \times \frac{1\text{ mol Al}(\text{OH})_3}{78.0\text{ g Al}(\text{OH})_3} \times \frac{3\text{ mol Ba}(\text{OH})_2}{2\text{ mol Al}(\text{OH})_3} = 3.30\text{ mol Ba}(\text{OH})_2$

$$L = \frac{\text{mol}}{\text{M}} = \frac{3.30\text{ mol}}{0.200\text{ M}} = 16.5\text{ L}$$

Answer 16.5 L

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 HNO₃, determine which reactant is in excess. (2 marks)

$$254.0\text{ g Cu} \times \frac{1\text{ mol Cu}}{63.5\text{ g Cu}} = 4.00\text{ mol Cu}$$

2) $609.0\text{ g HNO}_3 \times \frac{1\text{ mol}}{63.0\text{ g}} = 9.67\text{ mol}$

4.00 mol \rightarrow 12.00 moles (need)
 9.67 (moles have)
 3Cu + 8HNO₃
 Excess LR

Answer Cu

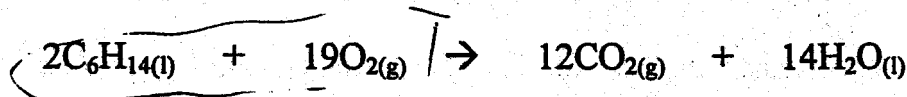
b. If the reaction in 3(a) is carried out, what mass of NO will be formed? (2 marks)

2) $9.67\text{ mol HNO}_3 \times \frac{2\text{ mol NO}}{8\text{ mol HNO}_3} \times \frac{30.0\text{ g NO}}{1\text{ mol NO}} = 72.53\text{ g}$

Answer 72.53 g

8

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)

$$306.16 \text{ g } \text{C}_6\text{H}_{14} \times \frac{1 \text{ mol } \text{C}_6\text{H}_{14}}{86.0 \text{ g } \text{C}_6\text{H}_{14}} = 3.56 \text{ mole}$$

$$1120 \text{ g } \text{O}_2 \times \frac{1 \text{ mol}}{32.0 \text{ g}} = 35 \text{ mole}$$

$$3.56 \text{ mol } \xrightarrow{19/2} 33.82 \text{ mol (need)}$$

$$2 \text{C}_6\text{H}_{14} + 19 \text{O}_2$$

L.R. Excess

Answer O₂

- 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)

$$3.56 \text{ mol } \text{C}_6\text{H}_{14} \times \frac{12 \text{ mol } \text{CO}_2}{2 \text{ mol } \text{C}_6\text{H}_{14}} \times \frac{22.4 \text{ L } \text{CO}_2}{1 \text{ mol } \text{CO}_2} = 478.5 \text{ L}$$

Answer 478.5 L

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

$$3.56 \text{ mol } \text{C}_6\text{H}_{14} \times \frac{14 \text{ mol } \text{H}_2\text{O}}{2 \text{ mol } \text{C}_6\text{H}_{14}} \times \frac{18.0 \text{ g } \text{H}_2\text{O}}{1 \text{ mol } \text{H}_2\text{O}} = 448.56 \text{ g}$$

Answer 448.56 g H₂O

5. Given the balanced equation: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$,

When 190.4 grams of N_2 are added to an excess of H_2 , 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)

$$190.4 \text{ g } \text{N}_2 \times \frac{1 \text{ mol } \text{N}_2}{28.0 \text{ g } \text{N}_2} \times \frac{2 \text{ mol } \text{NH}_3}{1 \text{ mol } \text{N}_2} \times \frac{17.0 \text{ g } \text{NH}_3}{1 \text{ mol } \text{NH}_3} = 231.2 \text{ g } \text{NH}_3$$

Answer 231.2 g NH₃

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

$$\% \text{Y} = \frac{\text{AY}}{\text{TY}} = \frac{104.04 \text{ g}}{231.2 \text{ g}} \times 100\% = 45\%$$

$$\frac{10}{10}$$

Answer 45% yield

6. Consider the balanced equation: $3 \text{LiAlH}_4 + 4 \text{BF}_3 \rightarrow 3 \text{LiF} + 3 \text{AlF}_3 + 2 \text{B}_2\text{H}_6$

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)

$$227.4 \text{ g LiAlH}_4 \times \frac{1 \text{ mol LiAlH}_4}{37.9 \text{ g LiAlH}_4} \times \frac{2 \text{ mol B}_2\text{H}_6}{3 \text{ mol LiAlH}_4} \times \frac{27.6 \text{ g B}_2\text{H}_6}{1 \text{ mol B}_2\text{H}_6} = 110.4 \text{ g B}_2\text{H}_6$$

Answer

110.4 g B_2H_6

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

Answer

93.84 g B_2H_6

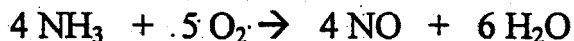
c. Calculate the *percentage yield* of B_2H_6 . (2 marks)

$$\% \text{Y} = \frac{\text{AY}}{\text{TY}} \times 100 = \frac{93.84}{110.4} \times 100 = 85\%$$

Answer

85% yield

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)

$$92.48 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3} \times \frac{4 \text{ mol NO}}{4 \text{ mol NH}_3} \times \frac{30.0 \text{ g NO}}{1 \text{ mol NO}} = 163.2 \text{ g NO}$$

Answer

163.2 g NO

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

$$163.2 \text{ g} \times 0.70 = 114.24 \text{ g}$$

Answer

114.2 g