

Midterm I.

1. An aqueous solution is made from 0.834 g of potassium permanganate, KMnO_4 . If the volume of solution is 50.0 mL, what is the molarity of KMnO_4 in the solution? ($A_{\text{K}} = 39 \text{ g/mol}$, $A_{\text{O}} = 16 \text{ g/mol}$, $A_{\text{Mn}} = 55 \text{ g/mol}$)

0.106 M

2. How many grams of potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$, should be added to a 50.0-mL volumetric flask to prepare 0.025 M $\text{K}_2\text{Cr}_2\text{O}_7$ solution when the flask is filled to the mark with water? ($A_{\text{K}} = 39 \text{ g/mol}$, $A_{\text{O}} = 16 \text{ g/mol}$, $A_{\text{Cr}} = 52 \text{ g/mol}$)

0.3675 g

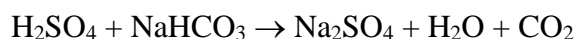
3. What volume of 0.120 M sodium hydroxide, NaOH , is required to give 0.150 mol NaOH ?

1250 cm³

4. An experiment calls for 0.0353 g of potassium hydroxide, KOH . How many milliliters of 0.0176 M KOH are required? ($A_{\text{K}} = 39 \text{ g/mol}$, $A_{\text{O}} = 16 \text{ g/mol}$, $A_{\text{H}} = 1 \text{ g/mol}$)

35.8 cm³

5. How many milliliters of 0.150 M H_2SO_4 (sulfuric acid) are required to react with 1.87 g of sodium hydrogen carbonate, NaHCO_3 , according to the following equation?



(Remember to balance the equation first!)

($A_{\text{C}} = 12 \text{ g/mol}$, $A_{\text{O}} = 16 \text{ g/mol}$, $A_{\text{H}} = 1 \text{ g/mol}$, $A_{\text{Na}} = 23 \text{ g/mol}$, $A_{\text{S}} = 32 \text{ g/mol}$)

74 cm³

6. To what final volume should 25 cm³ of 2.4 M potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7$, be diluted to give a solution that is 0.10 M $\text{K}_2\text{Cr}_2\text{O}_7$?

600 cm³

7. Describe how would you prepare 1.00 L 0.120 M NaOH from a 1.20 M NaOH solution.

By mixing of 100 cm³ of 1.2 M NaOH and 900 cm³ of distilled water.

8. What is the molarity of a 25 m/m% ammonia solution ($\text{MM} = 17 \text{ g/mol}$, density = 0.91 g/cm³)?

13.39 M

9. How many grams of sodium chloride ($\text{MM} = 58.5 \text{ g/mol}$) are needed to react completely with a sulfuric acid solution to produce 225 cm³ of a HCl solution ($\text{MM} = 36.5 \text{ g/mol}$) that has a density of 1.2 g/cm³ and has a 33.5 m/m% concentration?

145,0 g

10. 10 cm^3 of a concentrated 37 m/m% hydrochloric acid solution (density = 1.25 g/cm^3) will be diluted to a final concentration of 0.8 M. *MM (hydrochloric acid) = 36.5 g/mol*

- a, What is the m/V% of the concentrated hydrochloric acid solution? **46.25m/V%**
b, How many cm^3 of 0.8 M hydrochloric acid can be prepared from the 37 m/m% solution? **158.4 cm^3**
c, How many cm^3 of water should be used for the dilution? **148.4 cm^3**

11.) 200 cm^3 of a 1.0 M potassium hydroxide reacts with a 96 m/m% sulfuric acid solution (density = 1.84 g/cm^3). *MM (sulfuric acid) = 98 g/mol, MM (salt) = 142 g/mol*

- a) Write a balanced equation for the neutralization reaction! **$2\text{KOH} + \text{H}_2\text{SO}_4 = \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$**
b) How many cm^3 of concentrated sulfuric acid (96 m/m%) solution are needed for the neutralization? **5.55 cm^3**
c) How many grams of salt are produced? **14.2 g**

Midterm II.

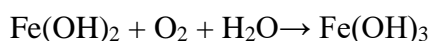
1. 4.89 g of metallic copper (AM = 63.5 g/mol) is added to 4.15 cm^3 67 m/m% nitric acid solution (*MM = 63 g/mol, density = 1.4 g/cm^3*).

- A. Write and balance the equation
B. Which of the reactants is the limiting reactant? **nitric acid**
C. How many cm^3 of gas is produced at STP (101.3 kPa and $25 \text{ }^\circ\text{C}$)? **756.9 cm^3**
D. How many grams of salt are produced in the reaction? **2.90 g**
E. What is the m/m% of the resulting salt? **31.25%**

2. 1.05 g of metallic zinc (AM = 65.4 g/mol) react with 0.4 cm^3 37 m/m% hydrochloric acid (*MM = 36.5 g/mol, density = 1.2 g/cm^3*).

- A. Write and balance the equation
B. Which of the reactants is the limiting reactant? **hydrochloric acid**
C. In which % was applied the reactant in excess? **560%**
D. How many cm^3 of gas is produced at 82 kPa and $35 \text{ }^\circ\text{C}$? **76.0 cm^3**
E. What is the m/m% of the resulting salt? **21.76%**

3. Iron(II) hydroxide is a precipitate that can be oxidized on air according to the following equation:



- A. Balance the equation.

B. How many cm^3 of oxygen gas are needed for the oxidation of 2 g $\text{Fe}(\text{OH})_2$ ($MM=89.85 \text{ g/mol}$) at 131 kPa and 50 °C? **114.1 cm^3**

C. How many cm^3 of 37 m/m% HCl ($MM = 36.5 \text{ g/mol}$, $density = 1.2 \text{ g/cm}^3$) are needed to dissolve the iron(III) hydroxide formed? **5.49 cm^3**

4. Carbon dioxide resulting by thermal decomposition of 2.53 g of magnesium carbonate ($MM = 84.3 \text{ g/mol}$) is totally absorbed in 25 g NaOH solution ($density = 1.4 \text{ g/cm}^3$)

A. Write the equation of thermal decomposition of magnesium carbonate

B. Write the equation between carbon dioxide and sodium hydroxide

C. What is the m/V% of the resulting salt solution? ($MM_{salt} = 106 \text{ g/mol}$) **17.81%**

5. How many g of potassium permanganate ($MM= 158 \text{ g/mol}$) and how many cm^3 of hydrochloric acid are needed to produce 2 dm^3 chlorine gas at 95 kPa and 50 °C in the stoichiometric reaction of potassium permanganate with concentrated hydrochloric acid

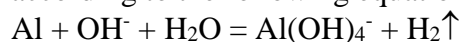
(38 m/m%, $MM_{hydrochloric\ acid} = 36.5 \text{ g/mol}$, $d=1.20 \text{ g/cm}^3$)?

Balance the equation first!



4.47 g KMnO_4 and 18.13 cm^3 HCl

6. 0.8 g of metallic aluminium ($AM = 27 \text{ g/mol}$) is dissolved in a 52 m/m% KOH solution according to the following equation:



A. Balance the equation

B. How many cm^3 of gas is formed at STP (101.3 kPa and 25 °C)? **1090 cm^3**

C. How many cm^3 of 56 m/m% KOH ($MM = 56 \text{ g/mol}$ and $density = 1.52 \text{ g/cm}^3$) are needed for the reaction if it is used in a 20% excess? **2.34 cm^3**

7. 3.4 g sodium nitrate ($MM = 85 \text{ g/mol}$) is reduced to ammonia with metallic zinc and sodium hydroxide. The evolving ammonia gas is absorbed in a 65 m/M % nitric acid solution.

A. Write and balance the chemical equation corresponding to the reduction.

B. How many cm^3 of 65 m/m% nitric acid solution ($MM = 63 \text{ g/mol}$, $density = 1.4 \text{ g/cm}^3$) are needed to react completely with the evolving ammonia? **2.80 cm^3**

Midterm III.

1. What is the pH of a 1.0 m/m% HCl solution ($MM = 36.5 \text{ g/mol}$, $density = 1.1 \text{ g/cm}^3$)? **0.52**

2. 200 cm^3 of a 1.2 M sodium hydroxide solution are mixed with 7 mL of a 30 m/m% nitric acid solution ($MM = 63 \text{ g/mol}$ and $density = 1.17 \text{ g/cm}^3$). What is the pH of the solution after mixing? **14.00**

3. What is the pH of:

A. solution A: a 0.20M ammonia solution ($K_b = 1.75 \times 10^{-5}$) **11.27**

B. solution B: a 0.365g/100 cm^3 hydrochloric acid solution ($MM_{\text{HCl}} = 36.5 \text{ g/mol}$)? **1.00**

C. solution C: a mixture of 100 cm^3 of solution A+ 50 cm^3 of solution B? **9.72**

D. How does the pH change, if we add 1 cm^3 1M sodium hydroxide solution to solution C? **9.85**

4. What is the pH of:

A. a 0.06M sodium acetate solution? ($K_a = 2 \times 10^{-5}$)

8.74

B. a mixture of 10 cm³ of the initial solution + 10 cm³ of a 0.02M HCl solution?

5.00

C. How does the pH change, if we add 100 cm³ water to the above mixture?

no change

