MidtermI.

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_K = 39 g/mol, A_O = 16 g/mol, A_{Mn} = 55 g/mol) **0.106 M**

2. How many grams of potassium dichromate, $K_2Cr_2O_7$, should be added to a 50.0-mL volumetric flask to prepare 0.025 M $K_2Cr_2O_7$ solution when the flask is filled to the mark with water? (A_K = 39 g/mol, A_O = 16 g/mol, A_{Cr} = 52 g/mol) **0.3675 g**

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

1250 cm^3

4. An experiment calls for 0.0353 g of potassium hydroxide, KOH. How many milliliters of 0.0176 M KOH are required? (A_K = 39 g/mol, A_O = 16 g/mol, A_H = 1 g/mol) **35.8 cm^3**

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?

$H_2SO_4 + NaHCO_3 \rightarrow Na_2SO_4 + H_2O + CO_2$

(Remember to balance the equation first!)

(A_C = 12 g/mol, A_O = 16 g/mol, A_H = 1 g/mol, A_{Na} = 23 g/mol, A_S = 32 g/mol) **74 cm^3**

6. To what final volume should 25 cm^3 of 2.4 M potassium dichromate, $K_2Cr_2O_7$, be diluted to give a solution that is 0.10 M $K_2Cr_2O_7$? **600 cm^3**

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

By mixing of 100 cm^3 of 1.2 M NaOH and 900 cm^3 of distilled water.

8. What is the molarity of a 25 m/m% ammonia solution (MM = 17 g/mol, density = 0.91 g/cm^3)?

13.39 M

9. How many grams of sodium chloride (MM = 58.5 g/mol) are needed to react completely with a sulfuric acid solution to produce 225 cm^3 of a HCl solution (MM = 36.5 g/mol) that has a density of 1.2 g/cm^3 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! **$2KOH + H_2SO_4 = K_2SO_4 + 2H_2O$**

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 ºC)? **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 ºC? **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:

$Fe(OH)_2 + O_2 + H_2O \rightarrow Fe(OH)_3$

A. Balance the equation.

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

C. How many cm^3 of 37 m/m% HCl (*MM = 36.5 g/mol, density = 1.2 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 g/mol*) is totally absorbed in 25 g NaOH solution (density = 1.4 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 g/mol*) **17.81%**

5. How many g of potassium permanganate (MM= 158 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 g/mol, d=1.20 g/cm^3*)?

Balance the equation first! **$2KMnO_4 + 16HCl = 2MnCl_2 + 2KCl + 5Cl_2 + 8H_2O$**

4.47 g $KMnO_4$ and 18.13 cm^3 HCl

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

$Al + OH^- + H_2O = Al(OH)_4^- + H_2\uparrow$

A. Balance the equation

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

C. How many cm^3 of 56 m/m% KOH (*MM = 56 g/mol and density = 1.52 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 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 g/mol, density = 1.4 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 g/mol, density = 1.1 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 g/mol and density = 1.17 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 (*$K_b = 1.75\times10^{-5}$*) **11.27**

B. solution B: a 0.365g/100 cm^3 hydrochloric acid solution (*MM_{HCl} = 36.5 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 cm^3 of the initial solution + 10 cm^3 of a 0.02M HCl solution? **5.00**

C. How does the pH change, if we add 100 cm^3 water to the above mixture? **no change**