Worksheet #17 Solution Stoichiometry

1. In a laboratory study of this process, 50.0 mL of sulfuric acid reacts with 24.4 mL of a 2.20 mol/L ammonia solution to produce the ammonium sulfate solution. From this evidence, calculate the concentration of the sulfuric acid.

$H_2SO_4 + NH_3 \rightarrow (NH_4)_2SO_4$

Answer: 0.537 mol/L

2. Calculate the volume of 0.0250 mol/L calcium hydroxide solution required to react completely with 25.0 mL of 0.125 mol/L aluminum sulfate solution.

$Ca(OH)_2 + Al_2(SO_4)_3 \rightarrow CaSO_4 + Al(OH)_3$

Answer: 376 mL

3. Determine the volume of 0.10 mol/L stomach acid (HCl) that can be neutralized by 912 mg of aluminum hydroxide in an antacid tablet.

$HCl + Al(OH)_3 \rightarrow AlCl_3 + H_2O$

Answer: 351 mL

4. Limestone ($CaCO_3$) reacts with nitric acid by the following reaction:
$CaCO_3(s) + 2\ HNO_3(aq) \rightarrow H_2O(l) + CO_2(g) + Ca(NO_3)_2(aq)$

Calculate the mass of limestone that would react with 4.50 L of 0.000250 mol/L nitric acid.

Answer: 0.0563 g

5. Copper metal reacts with nitric acid to produce nitrogen dioxide, aqueous copper (II) nitrate and water. What mass of copper would react with 100. mL of 2.00 mol/L nitric acid?

Answer: 3.18 g

$Cu + HNO_3 \rightarrow Cu(NO_3)_2 + NO_2 + H_2O$

6. Copper metal reacts with silver nitrate solution in a single replacement reaction. Given that a 22.24 g piece of copper is placed in 250 mL of 0.100 mol/L silver nitrate solution:
   a) identify the limiting and excess reactants — Answer: $AgNO_3$, Cu
   b) calculate the mass of the precipitate produced — Answer: 2.70 g
   c) calculate the amount of excess species that remains after reaction. — Answer: 21.45 g

$Cu + AgNO_3 \rightarrow Cu(NO_3)_2 + Ag$

7. Copper (II) sulfate reacts with sodium hydroxide to form a bluish-black precipitate. What is the maximum mass of precipitate formed if 100 mL of 0.250 mol/L $CuSO_4$ reacts with 100. mL of 0.100 mol/L NaOH?

Answer: 0.488 g

$CuSO_4 + NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$

Worksheet #18
Gases and Molar Volume

1. How many moles of fluorine gas are found in 86.4 L of the gas at STP?
2. What volume will 8.98 mol of carbon dioxide occupy at STP?
3. What volume will 18.7 g of carbon dioxide occupy at STP?
4. What mass will 86.4 L of fluorine gas have at STP?
5. 5.66 g of a gas occupies 3552 L at STP. What is the molar mass of the gas?
6. 0.041 g of a gas occupies 45.5 mL at STP. What is the molar gas of the gas? Which noble gas it is?

Gas Stoichiometry

1. Assuming STP conditions, what mass of zinc would have to react with excess hydrochloric acid to produce 18.0 L of hydrogen gas?

$Zn + HCl \rightarrow ZnCl_2 + H_2$

4. Assuming STP conditions, what volume of oxygen gas is formed from the complete decomposition of 35.0 g of mercury (II) oxide?

$HgO \rightarrow Hg + O_2$

5. Consider the following reaction for the decomposition of ozone in the upper atmosphere:

$$2\ O_{3(g)} \rightarrow 3\ O_{2(g)}$$

What volume of oxygen gas (at STP) can be produced from the decomposition of 40 kg of ozone?

6. Methanol can be produced according to the following equation:

$$CO_{(g)} + 2\ H_{2(g)} \rightarrow CH_3OH_{(l)}$$

At STP, 16.0 L of hydrogen and 25.0 L of carbon monoxide are sealed in the reactor. If 5.30 g of methanol is produced, what is the percent yield for the reaction.