CHEM-1105 STOICHIOMETRY

1. A portable hydrogen generator utilizes the following reaction. How many grams of hydrogen gas can be produced by a 50.0 g cartridge of CaH_2? **[4.80 g]**

$$CaH_2(s) + 2\ H_2O(l) \rightarrow Ca(OH)_2\ (s) + 2\ H_2(g)$$

2. How many grams of $KClO_3$ must be decomposed to 3.50 g of $O_2(g)$. The reaction is: **[8.94 g]**

$$2\ KClO_3(s) \rightarrow 2\ KCl(s) + 3\ O_2(g)$$

3. An impure sample of Al is treated with an excess of H_2SO_4. If 0.0852 g of H_2 is produced from a 0.780 g of the sample, what is the percent purity of the sample? The reaction is: **[97.3%]**

$$2\ Al(s) + 3\ H_2SO_4(aq) \rightarrow Al_2(SO4)_3(aq) + 3\ H_2(g)$$

4. Zinc is produced from its principal ore sphalerite, ZnS, by the two step process. How many kg of zinc can be produced from 2.00 kg of ore that is 80.5% ZnS and the yield of each reaction is 90.0%? **[0.875 kg]**

$$2\ ZnS(S) + 3\ O_2(g) \rightarrow 2\ ZnO(s) + 2\ SO_2(g)$$
$$ZnO(s) + C(s) \rightarrow Zn(s) + CO(g)$$

5. Diborane, B_2H_6, can be prepared by the reaction of $NaBH_4$ and BF_3. If 3.20 g of $NaBH_4$ and 5.42 g of BF_3 are reacted, calculate the amount of B_2H_6. **[LR is BF_3, 1.106 g B_2H_6]**

$$3\ NaBH_4 + 4\ BF_3 \rightarrow 3\ NaBH_4 + 2\ B_2H_6$$

6. Ethyl bromide, C_2H_5Br, can be prepared by reacting ethyl alcohol, C_2H_5OH, and phosphorous tribromide, PBr_3.

a) Calculate the amount of ethyl bromide formed by the reaction of 34.0 g ethyl alcohol and 59.0 g of PBr_3. The reaction is **[71.2 g]**

$$3\ C_2H_5OH(l) + PBr_3(l) \rightarrow 3\ C_2H_5Br(l) + H_3PO_3(l)$$

b) If the actual yield is 26.0 g, what is the percent yield? **[36.5%]**
c) How many grams of which reactant, if any, remain unreacted? **[4.0 g]**

7. Chlorine can be prepared in the lab by the following reaction:

$$2\ NaCl(aq) + MnO_2(s) + 3\ H_2SO_4(aq) \rightarrow 2\ NaHSO_4(aq) + MnSO_4(aq) + Cl_2(g) + 2\ H_2O(l)$$

To a solution containing 5.85 g of NaCl and excess of MnO_2 is added 1.50 L of 0.200 M H_2SO_4.

a) Which is the limiting reagent? **[NaCl]**

b) How many grams of Cl_2 can be prepared? **[3.55 g]**

8. An alloy of iron and carbon was treated with sulfuric acid, in which only iron reacts. If a sample of an alloy weighing 2.358 g gave 0.1228 g of $H_2(g)$, what is the percent of iron in the sample? **[95.8%]**

$$2\ Fe(s) + 3\ H_2SO_4(aq) \rightarrow Fe_2(SO_4)_3(aq) + 3\ H_2(g)$$

9. An alloy of aluminum and magnesium was treated with NaOH in which only Al reacts. If a sample of an alloy weighing 1.118 g gave 0.1068 g of $H_2(g)$, what is the percent of Al in the sample? The reaction is: **[85.2%]**

$$2\ Al(s) + 2\ NaOH(aq) + 6\ H_2O(l) \rightarrow 2\ NaAl(OH)_4(aq) + 3\ H_2(g)$$

10. Calculate the molarity of a NaOH solution if 18.65 mL of the NaOH solution were used to titrate 25.0 mL of 0.1085 M succinic acid, $H_2C_4H_4O_4$. **[0.291 M]**

$$2\ NaOH(aq) + H_2C_4H_4O_4(aq) \rightarrow Na_2C_4H_4O_4(aq) + 2\ H_2O(l)$$

11. 35.00 mL of 0.100 M H_3PO_4 required 60.00 mL of KOH for complete neutralization. Calculate the molarity of KOH. The reaction is: **[0.175 M]**

$$H_3PO_4(aq) + 3\ KOH(aq) \rightarrow K_3PO_4(aq) + 3\ H_2O(l)$$

12. In a titration of 0.3825 g of phthalic acid 28.55 mL of 0.1613 M NaOH are needed to reach the equivalence point. Calculate the molar mass of phthalic acid. **[166 g/mol]**

$$\text{Phthalic acid}(aq) + 2\ NaOH(aq) \rightarrow Na_2\text{phthalate}(aq) + 2\ H_2O(l)$$