STOICHIOMETRIC PROBLEMS

SHEET #3: VOLUME ==> AMOUNT ==> AMOUNT ==> VOLUME

1. Quicklime, CaO is prepared by heating limestone, $CaCO_3$. The equation for the reaction is :

$$CaCO_3 \Longrightarrow CaO + CO_2$$

   a) Calculate the mass of quicklime that can be obtained by heating 1 kg of limestone.
   b) Calculate the volume of carbon dioxide gas that forms at S.T.P. when 1 kg of limestone is reacted?

2. When grape sugar ($C_6H_{12}O_6$) ferments the products are ethyl alcohol (C_2H_5OH) and carbon dioxide. If 1.00 lbs. (454 g) of grape sugar ferments, calculate:
   a) the mass of ethyl alcohol produced.
   b) the volume of carbon dioxide produced at 27 °C and 1 atm. pressure

3. The oxidation of NH_3 is an important reaction in the preparation of nitric acid. The equation is:

$$4NH_3 + 5O_2 \Longrightarrow 6H_2O + 4NO$$

   a) How many liters of oxygen gas at S.T.P. are needed to react with 2500 g of NH_3?
   b) What mass of NO is formed when 2500 g of NH_3 reacts?

4. When MoO_3 ==> and Zn are heated together, they react as follows:

$$3Zn + 2MoO_3 \Longrightarrow Mo_2O_3 + 3ZnO$$

   What mass of Mo_2O_3 and what mass of ZnO is formed when 20.0 g of MoO_3 reacts?

5. Carbon dioxide is produced in the reaction between calcium carbonate and hydrochloric acid. How many grams of calcium carbonate would be needed to react completely with 15.0 g of hydrochloric acid? How many grams of carbon dioxide would be produced in this experiment?

6. When black gunpowder explodes, potassium nitrate, carbon and sulphur react with each other to form nitrogen, carbon dioxide and potassium sulphide. If the original mixture contains 50.0 g of potassium nitrate, what is the total volume of gases produced in this reaction? Assume S.T.P. conditions.

7. When ammonia (NH_3) is passed over hot calcium, calcium hydride (CaH_2) and nitrogen gas are produced. If 30 L of nitrogen are recovered at S.T.P., what mass of calcium was originally used?

8. The combustion of propane (C_3H_8) is a very common method of home heating. Write a reaction for the combustion of propane. Using the stoichiometry of this equation, determine the ratio of the volume of propane to the volume of air required for optimum performance. Hint: air contains 21.0 % oxygen by volume.

Answers:
1. a) 560 g CaO, b) 224 L CO_2
2. a) 232 g C_2H_5OH, b) 124 L CO_2
3. a) 4111 L O_2, b) 4403 g NO
4. 16.7 g Mo_2O_3, 17.0 g ZnO
5. 20.6 g $CaCO_3$, 9.05 g CO_2
6. 22.2 L gas
7. 161 g Ca
8. propane : air = 1 : 23.8