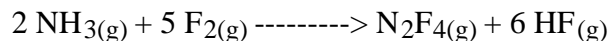


## Chemistry 105 - Fundamental Chemistry

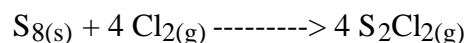
Fall Semester 1997 - Limiting Reactant

1) Dinitrogen tetrafluoride,  $\text{N}_2\text{F}_4$ , can be produced by the reaction of  $\text{NH}_3$  with  $\text{F}_2$ .



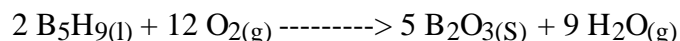
If 4.00 g of  $\text{NH}_3$ , and 14.0g of  $\text{F}_2$ , are allowed to react, which reagent is in excess and by how much? How many grams of  $\text{N}_2\text{F}_4$  and  $\text{HF}$  are produced? **1.49g  $\text{NH}_3$ , 7.66g  $\text{N}_2\text{F}_4$ , 8.84g  $\text{HF}$**

2) Disulfur dichloride,  $\text{S}_2\text{Cl}_2$ , is used to vulcanize rubber. It can be made by treating molten sulfur with gaseous chlorine.



If you begin with 32.0 g of sulfur and 71.0 g of  $\text{Cl}_2$ , how many grams of  $\text{S}_2\text{Cl}_2$  can be produced? What quantity of which starting material will remain after the maximum amount of  $\text{S}_2\text{Cl}_2$  has been formed? **67.4g  $\text{S}_2\text{Cl}_2$ , 35.6g  $\text{Cl}_2$  in excess**

3) The *Starship Enterprise* on *Star Trek* really used  $\text{B}_5\text{H}_9$  and  $\text{O}_2$  as a fuel. The two react according to the following balanced equation.

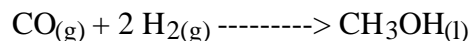


(a) If one fuel tank holds 126 kg of  $\text{B}_5\text{H}_9$ , and the other fuel tank holds 192 kg of liquid  $\text{O}_2$ , which fuel tank will be emptied first?  **$\text{O}_2$**

(b) When one fuel tank is emptied, how much will remain in the other tank? **62.9 kg  $\text{B}_5\text{H}_9$**

(c) When the reaction has gone as far as possible, how much water has been formed? **81.1kg  $\text{H}_2\text{O}$**

4) Methyl alcohol,  $\text{CH}_3\text{OH}$ , is a clean burning, easily handled fuel. Under catalytic conditions it can be made by the direct reaction of  $\text{CO}$  and  $\text{H}_2$  (obtained from coal and water).

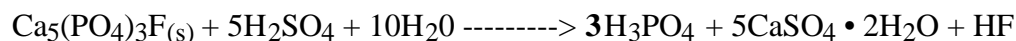


Assume you start with 12.0 g of  $\text{H}_2$  and 74.5 g of  $\text{CO}$ .

(a) Which of the reactants is in excess? What mass (in grams) of this reagent is left after reaction is complete? **1.3g  $\text{H}_2$  in excess**

(b) How many grams of methyl alcohol can be obtained theoretically? **85.2g**

5) Phosphoric acid ( $\text{H}_3\text{PO}_4$ ) is made in enormous quantities every year by treating phosphate rock with acid. For example,



(a) Starting with 1.00ton of phosphate rock, how many grams of phosphoric acid can be obtained?

(b) If the amount of acid actually obtained is  $2.50 \times 10^5$  g, what is the percent yield of  $\text{H}_3\text{PO}_4$ ?

(c) If the ton of phosphate rock had been treated with 1 ton of sulfuric acid, which is the limiting reagent? **a)  $5.28 \times 10^5$ g b) 47.3% c) phosphate rock**

