Chemistry Chapter 10 Stoichiometry Worksheet#1
(Extra Problems)
Limiting Reactant Problem
Page 2

B. 25.8 grams of oxygen gas are added to 65.4 grams of hydrogen chloride gas in the following reaction: $4\,HCl_{(g)} + 1\,O_{2\,(g)} \rightarrow 2\,Cl_{2\,(g)} + 2\,H_2O_{(g)}$

a. Determine the limiting reactant
b. Mass (in grams) of the two products that is formed in this reaction
c. Determine the excess reactant and how many grams are left after the reaction.

a.

Step 2 $mm\,O_2 = 2(16g) = \frac{32g\,O_2}{1\,m.u\,O_2}$ $mm\,HCl = 1(1g) + 1(35.5g) = \frac{36.5g\,HCl}{1\,m.u\,HCl}$

$= \frac{37g\,HCl}{1\,m.u\,HCl}$

O_2: $25.8g\left(\frac{1\,m.u\,O_2}{32g\,O_2}\right) = 0.8062\,m.u\,O_2$

HCl: $65.4g\,HCl\left(\frac{1\,m.u\,HCl}{37g\,HCl}\right) = 1.767\,m.u\,HCl$

Assume: O_2 goes to completion. $= (0.8062\,m.u\,O_2)\left(\frac{4\,m.u\,HCl}{1\,m.u\,O_2}\right) = 3.225\,m.u\,HCl$ is needed to react all O_2.

Since we need 3.225 mol HCl to completely react all O_2 and we only have 1.7675 mol HCl so HCl is limiting reactant

b. $(1.7675\,m.u\,HCl)\left(\frac{2\,m.u\,Cl_2}{4\,m.u\,HCl}\right)\left(\frac{71g\,Cl_2}{1\,m.u\,Cl_2}\right) = 62.74g\,Cl_2$

$= \boxed{62.7g\,Cl_2}$

$mm\,Cl_2 = 2(35.5g) = \frac{71g\,Cl_2}{1\,m.u\,Cl_2}$

$(1.7675\,m.u\,HCl)\left(\frac{2\,m.u\,H_2O}{4\,m.u\,HCl}\right)\left(\frac{18g\,H_2O}{1\,m.u\,H_2O}\right) = \frac{15.90g\,H_2O}{15.9g\,H_2O}$

$mm\,H_2O = 2(1g) + 1(16g) = \frac{18g\,H_2O}{1\,m.u\,H_2O}$

c. Initial − Reacted = left over (O_2 is in excess)

O_2 reacted: $(1.7675\,m.u\,HCl)\left(\frac{1\,m.u\,O_2}{4\,m.u\,HCl}\right) = 0.4418\,m.u\,O_2$ reacted

$0.8062\,m.u\,O_{2\,initial} - 0.4418\,mol\,O_{2\,reacted} = 0.3644\,m.u\,O_2$ left over

$(0.3644\,m.u\,O_2)\left(\frac{32g\,O_2}{1\,m.u\,O_2}\right) = 11.66g\,O_2 = \boxed{11.7g\,O_2\text{ left over}}$