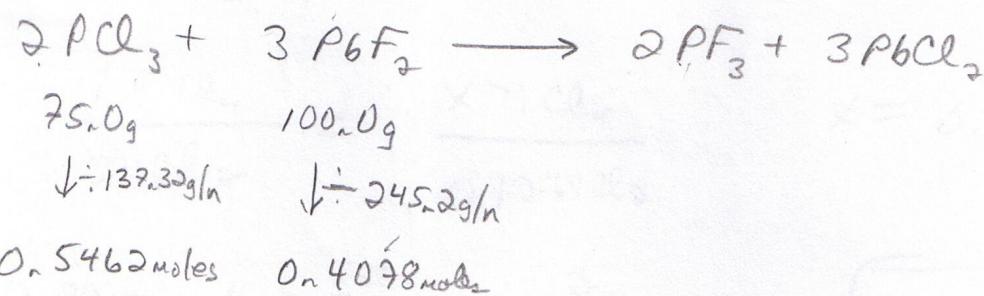


# Chapter 11 - Extra Limiting Reagent Problem



$$\frac{2 \text{PCl}_3}{3 \text{PbF}_2} = \frac{x \text{ moles PCl}_3 \text{ needed}}{0.4078 \text{ moles PbF}_2 \text{ used}}$$

$$x = 0.2719 \text{ moles PbCl}_2 \text{ needed}$$

$\therefore \text{PbF}_2$  is limiting reagent

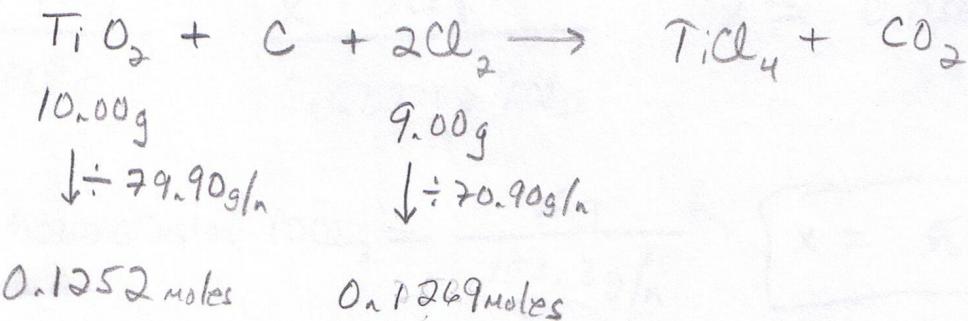
$$\frac{2 \text{PF}_3}{3 \text{PbF}_2} = \frac{x \text{ moles PF}_3 \text{ produced}}{0.4078 \text{ moles PbF}_2 \text{ used}}$$

$$x = 0.2719 \text{ moles PF}_3 \text{ produced}$$

$$0.2719 \text{ moles} = \frac{x \text{ g}}{87.97 \text{ g/n}}$$

$$x = 23.9 \text{ g PF}_3 \text{ formed}$$

2.)



$$\frac{1 \text{TiO}_2}{2 \text{Cl}_2} = \frac{x \text{ TiO}_2}{0.1269 \text{ Cl}_2}$$

$$x = 0.06345 \text{ moles TiO}_2 \text{ needed}$$

To react with all of  $\text{Cl}_2 \rightarrow$

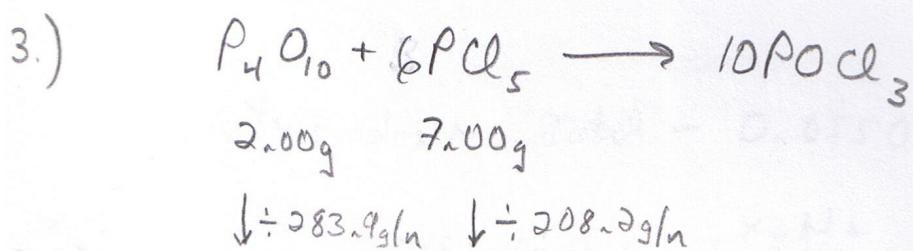
There is more than that amount of  $TiO_2$  present and  $\therefore Cl_2$  is the limiting reagent.

$$\frac{1 \text{ TiCl}_4}{2 \text{ Cl}_2} = \frac{x \text{ TiCl}_4}{0.1269 \text{ Cl}_2}$$

$$x = 0.06345 \text{ mole TiCl}_4 \text{ Formed}$$

$$0.06345 \text{ mole TiCl}_4 = \frac{x \text{ g}}{189.7 \text{ g/mole}}$$

$$x = 12.075 \text{ g TiCl}_4 \text{ Formed}$$



$$0.007045 \text{ moles } P_4O_{10} \quad 0.03362 \text{ moles}$$

$$\frac{1 \text{ P}_4\text{O}_{10}}{6 \text{ PCl}_5} = \frac{x \text{ P}_4\text{O}_{10}}{0.03362 \text{ PCl}_5}$$

$$x = 0.005603 \text{ mole } P_4O_{10} \text{ needed}$$

$\text{to react with all of PCl}_5$

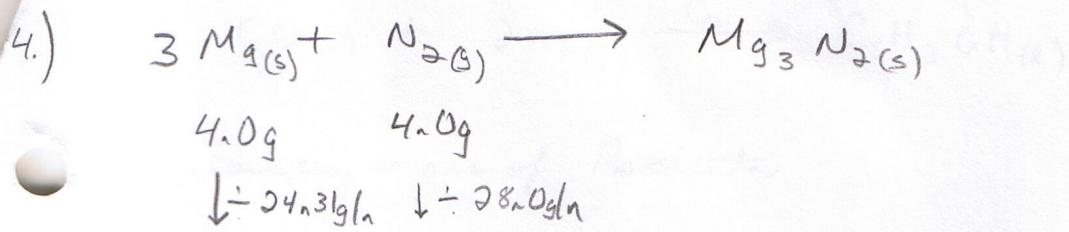
$\therefore PCl_5$  is limiting

$$\frac{10 \text{ POCl}_3}{6 \text{ PCl}_5} = \frac{x \text{ POCl}_3}{0.03362 \text{ PCl}_5}$$

$$x = 0.05603 \text{ mole POCl}_3 \text{ produced}$$

$$0.05603 \text{ moles POCl}_3 = \frac{x \text{ g}}{153.3 \text{ g/mole}}$$

$$x = 8.59 \text{ g POCl}_3 \text{ Produced}$$



0.165 moles N<sub>2</sub> used

(a.) By inspection, Mg is limiting

(b.)  $\frac{1 \text{ N}_2}{3 \text{ Mg}} = \frac{x \text{ N}_2 \text{ used}}{0.165 \text{ Mg used}}$        $x = 0.0550 \text{ moles N}_2 \text{ used}$

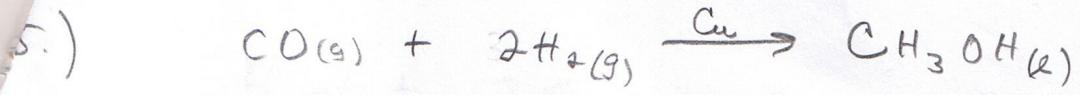
0.143 moles N<sub>2</sub> Total - 0.0550 moles N<sub>2</sub> used = 0.088 moles N<sub>2</sub> Remaining

0.088 moles N<sub>2</sub> =  $\frac{x \text{ g N}_2}{28.0\text{g/l}}$        $x = 2.5 \text{ g N}_2 \text{ leftover}$

(c.) The number of moles of Mg<sub>3</sub>N<sub>2</sub> formed is the same as the number of moles of N<sub>2</sub> used ∴ 0.0550 moles Mg<sub>3</sub>N<sub>2</sub> formed

0.0550 moles Mg<sub>3</sub>N<sub>2</sub> =  $\frac{x \text{ g}}{101\text{g/l}}$

$x = 5.6 \text{ g Mg}_3\text{N}_2 \text{ formed}$

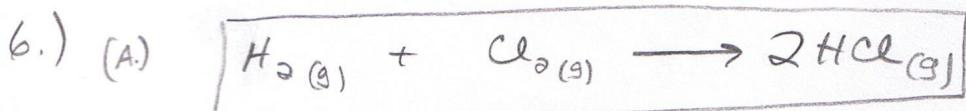


Assume any mass of Reactants

$$\begin{array}{ll} 10\text{ g} & 10\text{ g} \\ \downarrow \div 28.0\text{ g/mole} & \downarrow \div 2.0\text{ g/mole} \end{array}$$

0.357 moles CO    5.0 moles H<sub>2</sub>

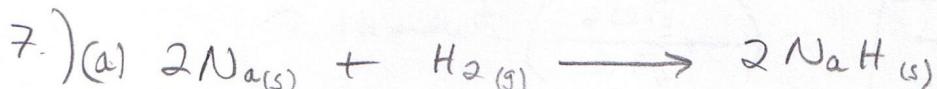
From the balanced equation, there must be two times as many moles of H<sub>2</sub> as CO. In this case there is H<sub>2</sub> in Excess



(B) H<sub>2</sub> is limiting

(C) If all 10.0 moles of H<sub>2</sub> is used then 20.0 moles HCl is produced

(D) 2 moles of Cl<sub>2</sub> remain



$$\begin{array}{ll} 6.75\text{ g} & 3.03\text{ g} \\ \downarrow \div 23.0\text{ g/mole} & \downarrow \div 2.0\text{ g/mole} \end{array}$$

0.293 moles    1.50 moles

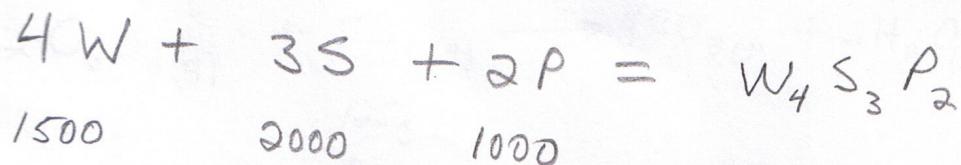
(b)  $\therefore \text{Na is limiting}$

(c) For every 2 moles of Na used, 2 moles NaH is produced

$$0.293 \text{ moles NaH} = \frac{x \text{ g}}{24.01 \text{ g/mole}}$$

x = 7.03 g NaH produced

8.)



$$\frac{4W}{W_4 S_3 P_2} = \frac{X \text{ wrenches needed}}{500 W_4 S_3 P_2}$$

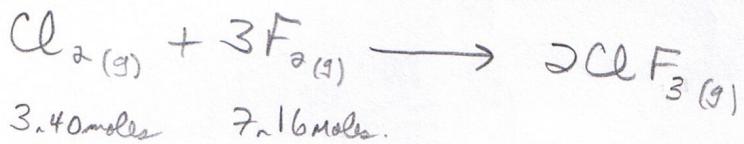
by the same logic 1500 screwdrivers and 1000 pliers are needed and enough of each are available.

$X = 2000$  wrenches needed after  
500 tool sets. Only 1500  
are available ;

No 500 kits cannot be made

9)

(a)



(b) To react all of the  $Cl_2$ , 10.2 moles of  $F_2$  are required. Only 7.16 moles are present therefore  $F_2$  is limiting

(c)

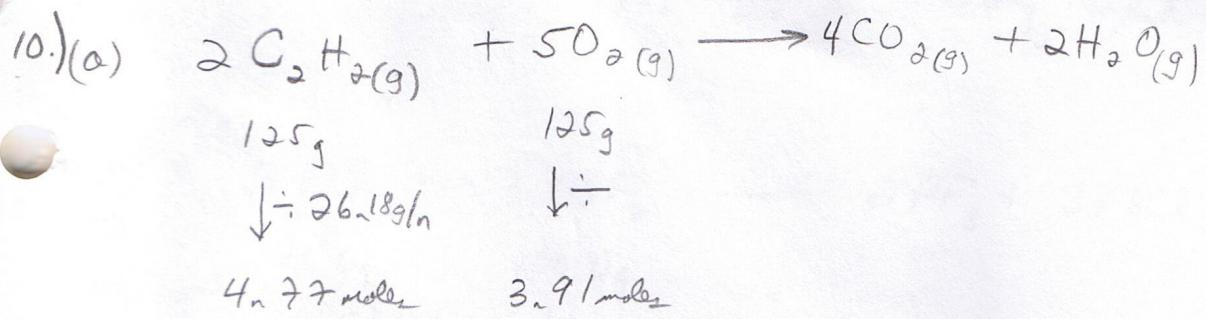
$$7.16 \text{ moles } F_2 \left( \frac{2 \text{ mol } ClF_3}{3 \text{ mol } F_2} \right) = \boxed{4.77 \text{ moles } ClF_3} (92.45 \text{ g/mol } ClF_3)$$

or 441 g

(d)

$$7.16 \text{ moles } F_2 \left( \frac{1 \text{ mol } Cl_2}{3 \text{ mol } F_2} \right) = 2.39 \text{ moles } Cl_2 \text{ used} \therefore \underline{1.01 \text{ moles } Cl_2 \text{ left}}$$

71.6 g  $Cl_2$



(b)  $\frac{2\text{C}_2\text{H}_2}{5\text{O}_2} = \frac{x \text{C}_2\text{H}_2}{3.91\text{mole O}_2}$   $x = 1.56\text{mole C}_2\text{H}_2$  Needed  $\therefore$  O<sub>2</sub> is limiting

(c)  $3.91\text{mole O}_2 \left( \frac{2\text{H}_2\text{O}}{5\text{O}_2} \right) = \boxed{\begin{array}{l} 1.56\text{mole H}_2\text{O} \\ \text{or} \\ 28.2\text{g H}_2\text{O} \end{array}}$