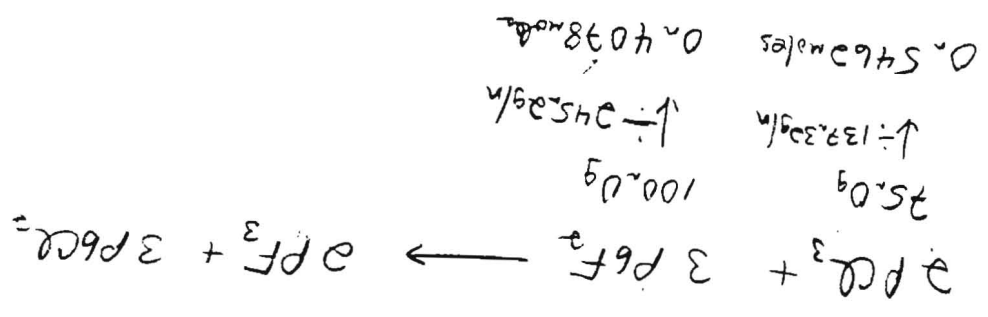


Chapter 11 - Extra Limiting Reagent Problem



$$\frac{2\text{PCl}_3}{3\text{PF}_2} = \frac{\text{X moles PCl}_3 \text{ needed}}{0.4098 \text{ moles PF}_2 \text{ used}}$$

$$X = 0.2719 \text{ moles PCl}_3 \text{ needed}$$

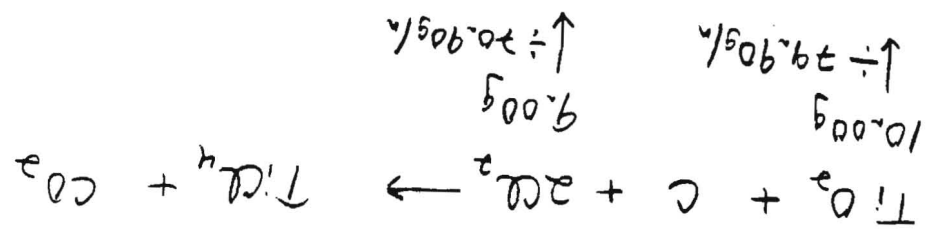
$\therefore \text{PF}_2$  is limiting reagent

$$\frac{2\text{PF}_3}{3\text{PF}_2} = \frac{\text{X moles PF}_3 \text{ produced}}{0.4098 \text{ moles PF}_2 \text{ used}}$$

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

$$\frac{0.2719 \text{ moles}}{\text{X g}} = \frac{87.97\text{g}}{\text{X g}}$$

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



$$\frac{1\text{TiO}_2}{2\text{Cl}_2} = \frac{\text{X TiO}_2}{0.429 \text{ moles}}$$

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

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

a.)

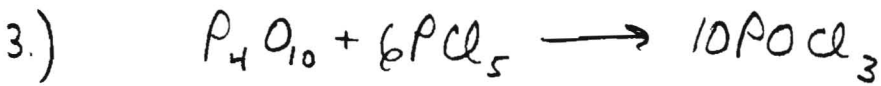
there is more than that amount of  $TiO_2$  present and  $\therefore Cl_2$  is the limiting reagent.

$$\frac{1 TiCl_4}{2 Cl_2} = \frac{x TiCl_4}{0.1269 Cl_2}$$

$$x = 0.06345 \text{ moles } TiCl_4 \text{ Formed}$$

$$0.06345 \text{ moles } TiCl_4 = \frac{x g}{189.7 g/m}$$

$$x = 12.07 g \text{ } TiCl_4 \text{ Formed}$$



$$\begin{array}{ccc} 2.00g & 7.00g & \\ \downarrow \div 283.9 g/m & \downarrow \div 208.2 g/m & \end{array}$$

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

$$\frac{1 P_4O_{10}}{6 PCl_5} = \frac{x P_4O_{10}}{0.03362 PCl_5}$$

$$x = 0.005603 \text{ moles } P_4O_{10} \text{ needed to react with all of } PCl_5$$

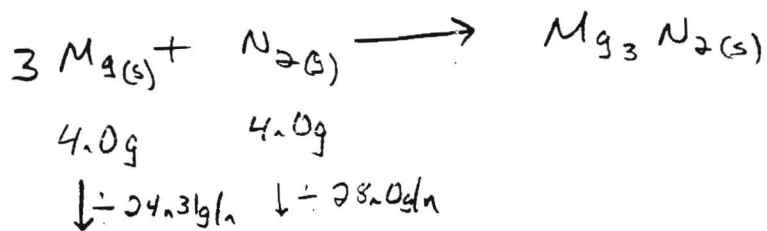
$\therefore PCl_5$  is limiting

$$\frac{10 POCl_3}{6 PCl_5} = \frac{x POCl_3}{0.03362 PCl_5}$$

$$x = 0.05603 \text{ moles } POCl_3 \text{ Produced}$$

$$0.05603 \text{ moles } POCl_3 = \frac{x g}{153.3 g/m}$$

$$x = 8.59 g \text{ } POCl_3 \text{ Produced}$$



$$0.165 \text{ moles} \quad 0.143 \text{ moles}$$

(a.) By inspection, Mg is limiting

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

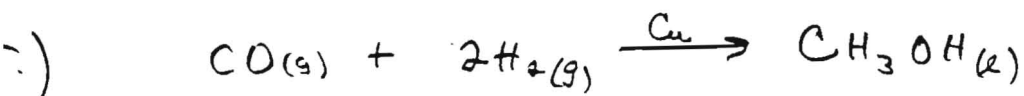
$$0.143 \text{ moles N}_2 \text{ Total} - 0.0550 \text{ moles N}_2 \text{ used} = 0.088 \text{ moles N}_2 \text{ Remaining}$$

$$0.088 \text{ moles N}_2 = \frac{x \text{ g N}_2}{28.0\text{g/mol}} \quad x = 2.5 \text{ g N}_2 \text{ Left over}$$

(c.) The number of moles of  $\text{Mg}_3\text{N}_2$  Formed is the same as the number of moles of  $\text{N}_2$  used  $\therefore 0.0550 \text{ moles Mg}_3\text{N}_2$  Formed

$$0.0550 \text{ moles Mg}_3\text{N}_2 = \frac{x \text{ g}}{101\text{g/mol}}$$

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

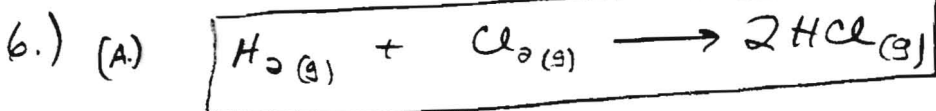


Assume any mass of Reactants

$$\begin{array}{cc} 10\text{g} & 10\text{g} \\ \downarrow \div 28.01\text{g/mol} & \downarrow \div 2.01\text{g/mol} \end{array}$$

$$0.357 \text{ moles CO} \quad 5.0 \text{ moles H}_2$$

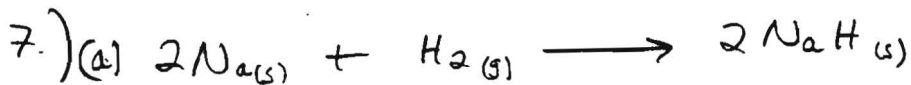
From the balanced equation, there must be two times as many moles of H<sub>2</sub> as CO. In this case there is H<sub>2</sub> in excess



(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



$$\begin{array}{cc} 6.75\text{g} & 3.03\text{g} \\ \downarrow \div 23.00\text{g/mol} & \downarrow \div 2.016\text{g/mol} \end{array}$$

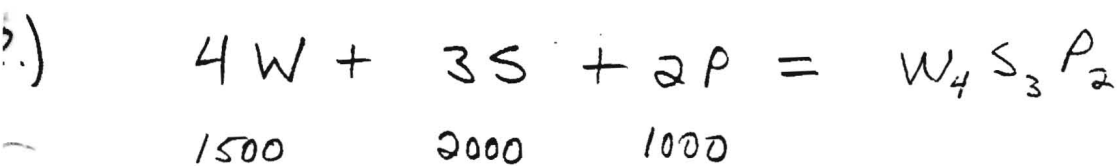
$$0.293 \text{ moles} \quad 1.50 \text{ moles}$$

(b) ∴ Na is limiting

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

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

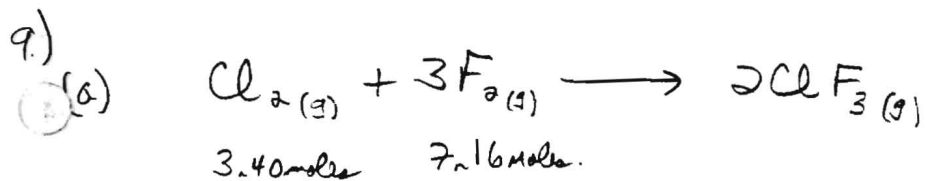
$$\boxed{x = 7.03\text{g NaH produced}}$$



$\frac{4W}{1W_4 S_3 P_2} = \frac{X \text{ wrenches needed}}{500W_4 S_3 P_2}$  by the same logic 1500 screwdrivers and 1000 Pliers are needed and enough of each are available.

$X = 2000$  wrenches needed for 500 tool sets. Only 1500 are available  $\therefore$

No 500 kits can be made

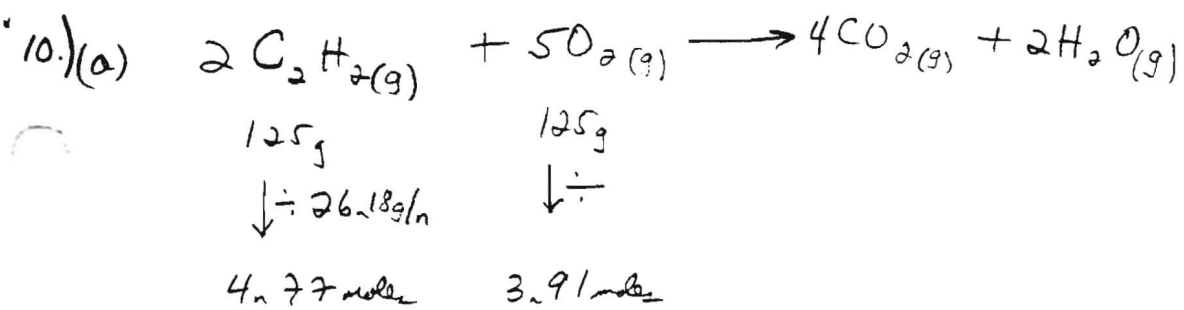


(b) To react all of the  $Cl_2$ , 10.2 moles of  $F_2$  are required. Only 7.16 moles are present therefore  $F_2$  is limiting

(c)  $7.16 \text{ moles } F_2 \left( \frac{2 ClF_3}{3 F_2} \right) = 4.77 \text{ moles } ClF_3$  (92.45 g/mol  $ClF_3$ )  
 $\approx 441 \text{ g}$

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

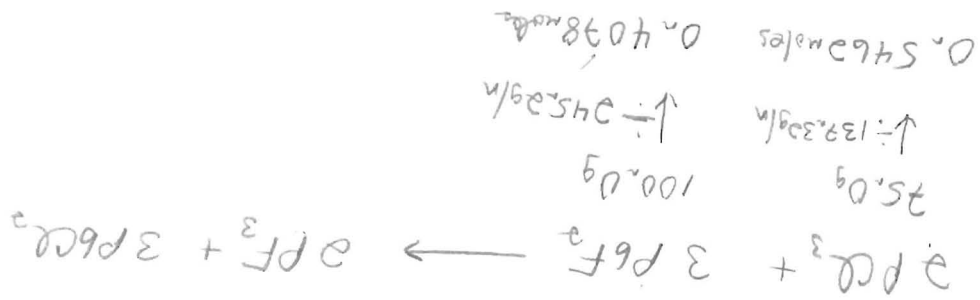
$71.6 \text{ g } Cl_2$



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

(c)  $3.91 \text{ moles O}_2 \left( \frac{2 \text{H}_2\text{O}}{5 \text{O}_2} \right) = \frac{1.56 \text{ moles H}_2\text{O}}{\text{or}} 28.2 \text{ g H}_2\text{O}$

Chapter 11 - Extra Limiting Reagent Problem



$$\frac{2\text{PCl}_2}{3\text{PF}_2} = \frac{X \text{ moles PCl}_2 \text{ needed}}{0.4078 \text{ moles PF}_2 \text{ used}}$$

$$X = 0.2719 \text{ moles PCl}_2 \text{ needed}$$

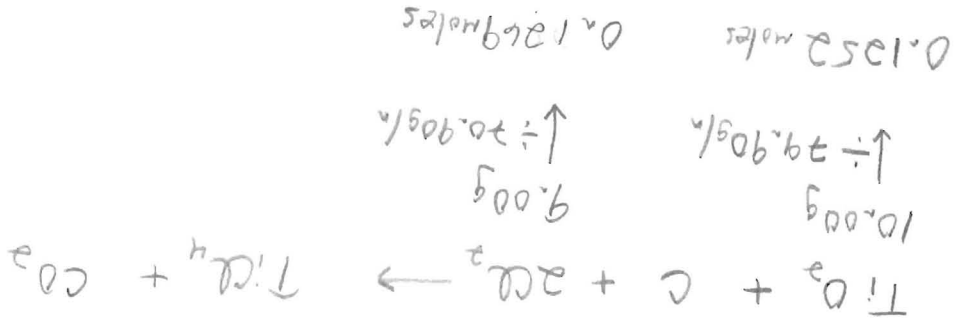
$\therefore \text{PF}_2$  is limiting reagent

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

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

$$0.2719 \text{ moles} = \frac{87.97\text{g}}{X \text{ g}}$$

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



$$\frac{1\text{TiO}_2}{2\text{CO}_2} = \frac{X \text{ TiO}_2}{0.1269 \text{ moles}}$$

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

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

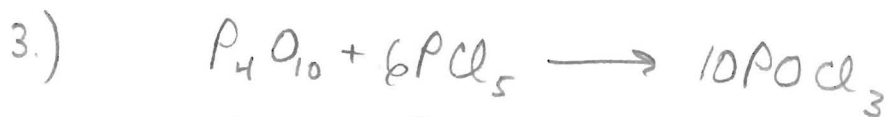
there is more than that amount of  $TiO_2$  present and  $\therefore Cl_2$  is the limiting reagent.

$$\frac{1 TiCl_4}{2 Cl_2} = \frac{x TiCl_4}{0.1269 Cl_2}$$

$$x = 0.06345 \text{ moles } TiCl_4 \text{ Formed}$$

$$0.06345 \text{ moles } TiCl_4 = \frac{x g}{189.7 g/mol}$$

$$x = 12.07 g \text{ } TiCl_4 \text{ Formed}$$



$$2.00 g \quad 7.00 g$$

$$\downarrow \div 283.9 g/mol \quad \downarrow \div 208.2 g/mol$$

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

$$\frac{1 P_4O_{10}}{6 PCl_5} = \frac{x P_4O_{10}}{0.03362 PCl_5}$$

$$x = 0.005603 \text{ moles } P_4O_{10} \text{ needed to react with all of } PCl_5$$

$\therefore PCl_5$  is limiting

$$\frac{10 POCl_3}{6 PCl_5} = \frac{x POCl_3}{0.03362 PCl_5}$$

$$x = 0.05603 \text{ moles } POCl_3 \text{ Produced}$$

$$0.05603 \text{ moles } POCl_3 = \frac{x g}{153.3 g/mol}$$

$$x = 8.59 g \text{ } POCl_3 \text{ Produced}$$





$$4.0\text{g} \quad 4.0\text{g}$$

$$\downarrow \div 24.31\text{g/mol} \quad \downarrow \div 28.02\text{g/mol}$$

$$0.165 \text{ moles} \quad 0.143 \text{ moles}$$

(a.) By inspection, Mg is limiting

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

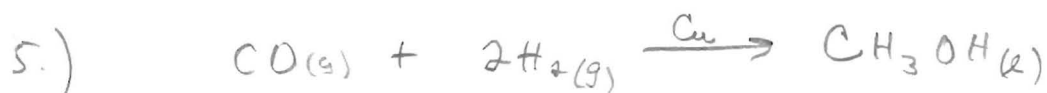
$$0.143 \text{ moles N}_2 \text{ Total} - 0.0550 \text{ moles N}_2 \text{ used} = 0.088 \text{ moles N}_2 \text{ Remaining}$$

$$0.088 \text{ moles N}_2 = \frac{x \text{ g N}_2}{28.02\text{g/mol}} \quad x = 2.5 \text{ g N}_2 \text{ Left over}$$

(c.) The number of moles of  $\text{Mg}_3\text{N}_2$  Formed is the same as the number of moles of  $\text{N}_2$  used  $\therefore$  0.0550 moles  $\text{Mg}_3\text{N}_2$  Formed

$$0.0550 \text{ moles Mg}_3\text{N}_2 = \frac{x \text{ g}}{101\text{g/mol}}$$

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

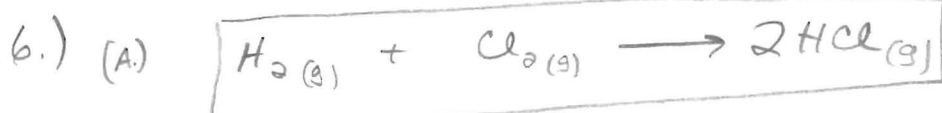


Assume any mass of Reactants

$$\begin{array}{cc} 10\text{g} & 10\text{g} \\ \downarrow \div 28.01\text{g/mol} & \downarrow \div 2.01\text{g/mol} \end{array}$$

$$0.357 \text{ moles CO} \quad 5.0 \text{ moles H}_2$$

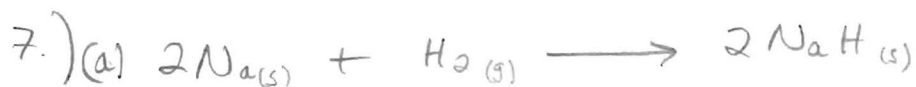
From the balanced equation, there must be two times as many moles of H<sub>2</sub> as CO. In this case there is H<sub>2</sub> in excess



(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



$$\begin{array}{cc} 6.75\text{g} & 3.03\text{g} \\ \downarrow \div 23.00\text{g/mol} & \downarrow \div 2.016\text{g/mol} \end{array}$$

$$0.293 \text{ moles} \quad 1.50 \text{ moles}$$

(b) ∴ Na is limiting

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

∴

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

$$\text{X} = 7.03\text{g NaH produced}$$

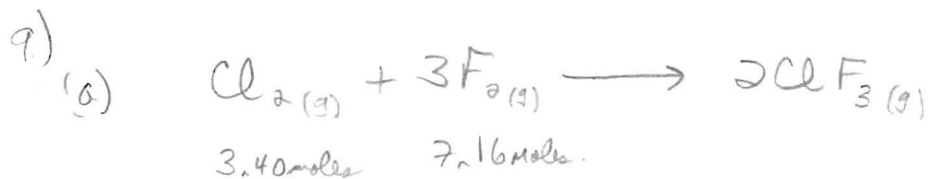


$$\frac{4W}{1W_4 S_3 P_2} = \frac{X \text{ wrenches needed}}{500W_4 S_3 P_2}$$

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

$X = 2000$  wrenches needed for 500 tool sets. Only 1500 are available  $\therefore$

No 500 kits can be made



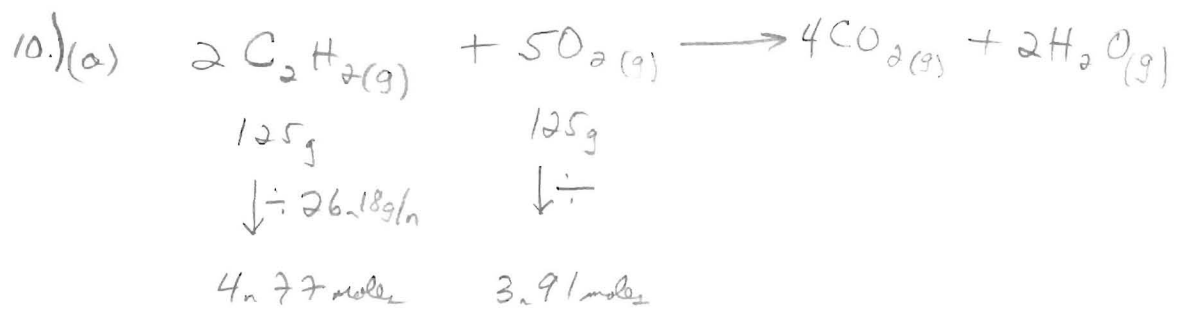
(b) To react all of the  $\text{Cl}_2$ , 10.2 moles of  $\text{F}_2$  are required. Only 7.16 moles are present therefore  $\text{F}_2$  is limiting

$$(c) \quad 7.16 \text{ moles } \text{F}_2 \left( \frac{2 \text{ClF}_3}{3 \text{F}_2} \right) = \boxed{4.77 \text{ moles } \text{ClF}_3} \quad (92.45 \text{ g/mol } \text{ClF}_3)$$

$\approx 441 \text{ g}$

$$(d.) \quad 7.16 \text{ moles } \text{F}_2 \left( \frac{1 \text{Cl}_2}{3 \text{F}_2} \right) = 2.39 \text{ moles } \text{Cl}_2 \text{ used } \therefore \underline{1.01 \text{ moles } \text{Cl}_2 \text{ left}}$$

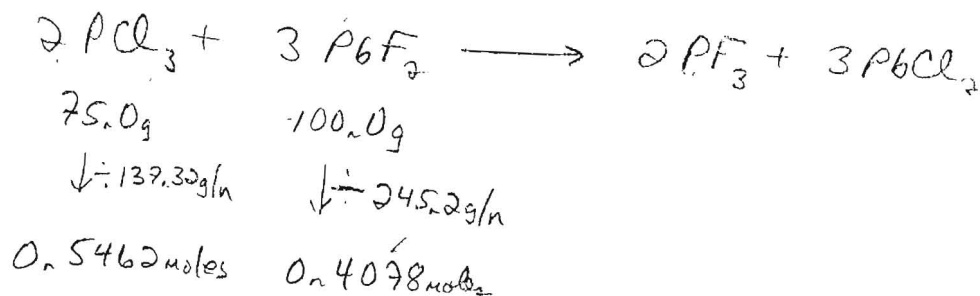
$\boxed{71.6 \text{ g } \text{Cl}_2}$



$$(b) \quad \frac{2 \text{C}_2\text{H}_2}{5 \text{O}_2} = \frac{x \text{C}_2\text{H}_2}{3.91 \text{ moles O}_2} \quad x = 1.56 \text{ moles C}_2\text{H}_2 \text{ Needed } \therefore \text{O}_2 \text{ is limiting}$$

$$(c) \quad 3.91 \text{ moles O}_2 \left( \frac{2 \text{H}_2\text{O}}{5 \text{O}_2} \right) = \frac{1.56 \text{ moles H}_2\text{O}}{\text{or}} 28.2 \text{ g H}_2\text{O}$$

# 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

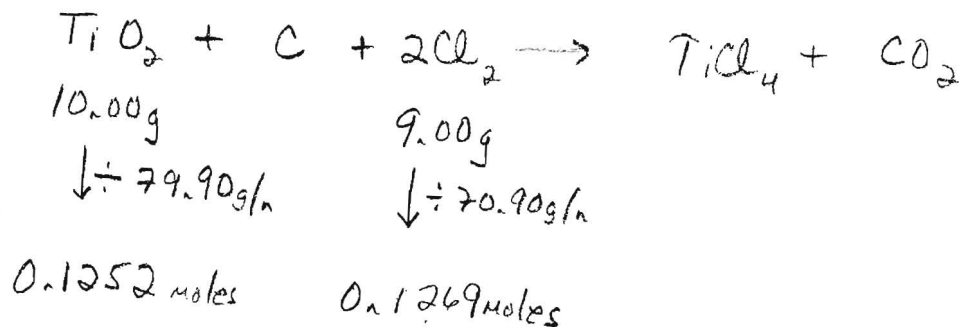
$$\frac{2 \text{ PF}_3}{3 \text{ PbF}_2} = \frac{x \text{ moles PF}_3 \text{ produced}}{0.4078 \text{ moles PbF}_2 \text{ used}}$$

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

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

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

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  $\text{Cl}_2$  →

$$8.) \quad 4W + 3S + 2P = W_4 S_3 P_2$$

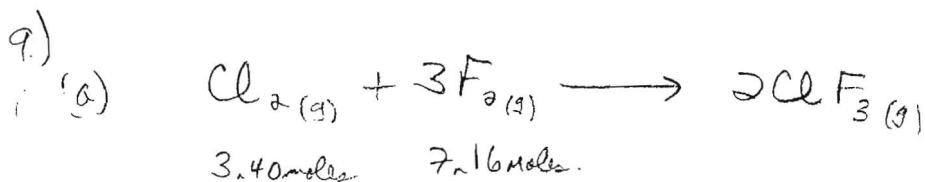
1500                  2000                  1000

$$\frac{4W}{1W_4 S_3 P_2} = \frac{X \text{ wrenches needed}}{500W_4 S_3 P_2}$$

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

$X = 2000$  wrenches needed for 500 tool sets. Only 1500 are available  $\therefore$

No 500 kits can be made



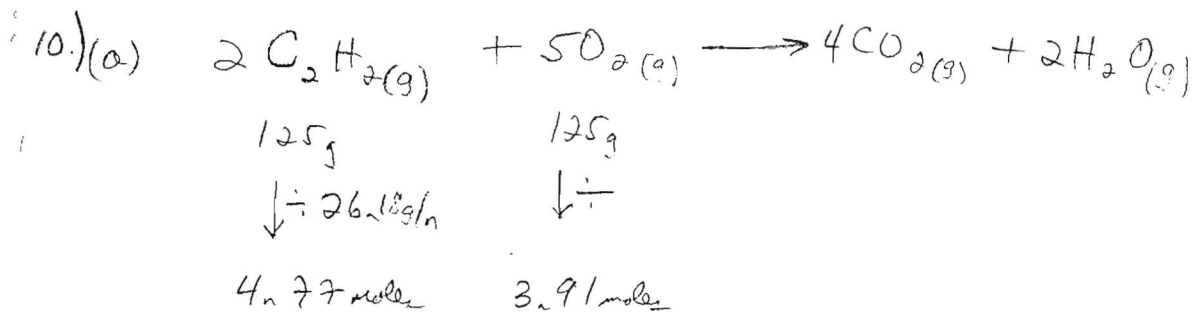
(b) To react all of the  $Cl_2$ , 10.2 moles of  $F_2$  are required. Only 7.16 moles are present therefore  $F_2$  is limiting

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

$\approx 441 \text{ g}$

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

$\boxed{71.6 \text{ g } Cl_2}$



$$(b) \quad \frac{2 \text{C}_2\text{H}_2}{5 \text{O}_2} = \frac{x \text{C}_2\text{H}_2}{3.91 \text{ moles O}_2} \quad x = 1.56 \text{ moles C}_2\text{H}_2 \text{ needed } \therefore \text{O}_2 \text{ is limiting}$$

$$(c) \quad 3.91 \text{ moles O}_2 \left( \frac{2 \text{H}_2\text{O}}{5 \text{O}_2} \right) = \frac{1.56 \text{ moles H}_2\text{O}}{\text{or}} \quad 28.2 \text{ g H}_2\text{O}$$