3.74 $3NiCl_2 + 2Na_3PO_4 \rightarrow Ni_3(PO_4)_2 + 6NaCl$

$0.473\ mole\ Ni_3(PO_4)_2 \cdot \frac{3\ NiCl_2}{1\ Ni_3(PO_4)_2} =$ **1.44 moles $NiCl_2$**

3.76 $2\ Ca_3(PO_4)_{2(s)} + 6\ SiO_{2(s)} + 10\ C_{(s)} \longrightarrow$

$P_{4(g)} + 6\ CaSiO_{3(l)} + 10\ CO_{(g)}$

$5.0g\ P_4 \cdot \left(\frac{1\ mol}{4\times(30.97)\ P_4 g}\right) \cdot \left(\frac{2\ Ca_3(PO_4)_2}{1\ P_4}\right) \cdot \left(\frac{310.18\ g\ Ca_3(PO_4)_2}{1\ mol}\right) =$ **25.g Ca**

3.78 $4\ C_3H_{6(g)} + 6NO_{(g)} \longrightarrow 4\ C_3H_3N_{(g)} + 6\ H_2O_{(g)} + N_{2(g)}$

$651.\ kg\ C_3H_6 \cdot \left(\frac{1000.g}{1kg}\right) \cdot \left(\frac{1\ mol\ C_3H_6}{42.03}\right) \cdot \left(\frac{4\ C_3H_3N}{4\ C_3H_6}\right) \cdot \left(\frac{53.04\ g}{1\ mol\ C_3H_3N}\right) =$ **8.21×10^5 C_3H_3N**

3.80 $Cl_2 + NaOH \rightarrow NaClO + HCl$

$61.1g\ NaOH \cdot \left(\frac{1\ mol\ NaOH}{40.0g\ NaOH}\right) \cdot \left(\frac{1\ mol\ Cl_2}{1\ mol\ NaOH}\right) \cdot \left(\frac{70.90\ g}{1\ mol\ Cl_2}\right) =$ **108 Cl_2**

3.82 $3\ Cu_{(s)} + 8\ HNO_{3(aq)} \rightarrow 3\ Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4\ H_2O_{(l)}$

$5.92g\ Cu(NO_3)_2 \cdot \left(\frac{1\ mol}{187.6g}\right) \cdot \left(\frac{2\ NO}{3\ Cu(NO_3)_2}\right) \cdot \left(\frac{30.0\ g}{1\ mol\ NO}\right) =$ **0.631 g NO**

3.77 $WO_3 + 3H_2 \longrightarrow W + 3H_2O$

$1.81\times10^3 g$ $4.81\ kg\ H_2 \cdot \left(\frac{1\ mol\ H_2}{2.01\ g}\right) \cdot \left(\frac{1\ W}{3\ H_2}\right) \cdot \left(\frac{183.9\ g}{mol\ W}\right) =$ **147g W** ($\times10^3$)

3.79 $CS_2 + 3Cl_{2(g)} \longrightarrow CCl_4 + S_2Cl_2$

$62.7g\ Cl_2 \cdot \left(\frac{1\ mol\ Cl_2}{70.9g\ Cl_2}\right) \cdot \left(\frac{1\ CS_2}{3\ Cl_2}\right) \cdot \left(\frac{76.2\ g}{mol\ CS_2}\right) =$ **22.5g CS_2**

3.81 $2N_2O_5 \xrightarrow{\Delta} 4NO_2 + O_2$

$1.315g\ O_2 \cdot \left(\frac{1\ mol\ O_2}{32.00g}\right) \cdot \left(\frac{4\ NO_2}{1\ O_2}\right) \cdot \left(\frac{46.01\ g}{mol\ NO_2}\right) =$ **7.563 g NO_2**

3.83 $4KO_{2(s)} + 2H_2O_{(l)} \longrightarrow 4KOH_{(s)} + 3O_{2(g)}$

$0.25 \text{ mol } KO_2 \cdot \left(\frac{3\ O_2}{4\ KO_2}\right) =$ **0.19 mol O_2 = LR**

$0.15 \text{ mol } H_2O \cdot \left(\frac{3\ O_2}{2\ H_2O}\right) = 0.23 \text{ mol } O_2$

3.84 $4NH_3 + 5O_2 \xrightarrow{Pt} 4NO + 6H_2O$

$0.120 \text{ mol } NH_3 \cdot \left(\frac{4\ NO}{4\ NH_3}\right) = 0.120 \text{ mol NO}$

$0.140 \text{ mol } O_2 \cdot \left(\frac{4\ NO}{5\ O_2}\right) =$ **0.112 mol NO = LR**

3.86 $CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$

$30.0g\ CS_2 \cdot \left(\frac{\text{mol } CS_2}{76.14g}\right) \cdot \left(\frac{2\ SO_2}{1\ CS_2}\right) \cdot \left(\frac{64.07g\ SO_2}{\text{mol } SO_2}\right) = 50.5g\ SO_2$

$35.0g\ O_2 \cdot \left(\frac{1 \text{ mol } O_2}{32.0g}\right) \cdot \left(\frac{2\ SO_2}{3\ O_2}\right) \cdot \left(\frac{64.07\ SO_2}{\text{mol } SO_2}\right) =$ **46.7g SO_2**

O_2 → LR

$35.0g\ O_2 \cdot \left(\frac{1 \text{ mol } O_2}{32.0g}\right) \cdot \left(\frac{1 \text{ mol } CS_2}{3 \text{ mol } O_2}\right) \cdot \left(\frac{76.14g\ CS_2}{1 \text{ mol } CS_2}\right) = 27.8g\ CS_2$ needed

$30.0g - 27.8g =$ **2.24g CS_2 Left Over**

3.88 $2NH_3 + 3O_2 + 2CH_4 \xrightarrow{Pt} 2HCN + 6H_2O$

$11.5g\ NH_3 \cdot \left(\frac{1 \text{ mol } NH_3}{17.01g}\right) \cdot \left(\frac{2\ HCN}{2\ NH_3}\right) \cdot \left(\frac{27.01g\ HCN}{\text{mol } HCN}\right) = 18.3\ g\ HCN$

$10.0g\ O_2 \cdot \left(\frac{1 \text{ mol } O_2}{32.0g}\right) \cdot \left(\frac{2\ HCN}{3\ O_2}\right) \cdot \left(\frac{27.01g\ HCN}{\text{mol } HCN}\right) =$ **5.63g H** LR

$10.5g\ CH_4 \cdot \left(\frac{1 \text{ mol } CH_4}{16.0g}\right) \cdot \left(\frac{2\ CH_4}{2\ HCN}\right) \cdot \left(\frac{27.01g\ HCN}{\text{mol } HCN}\right) = 17.7g\ H$

3.90 $C_7H_6O_3 + CH_3OH \xrightarrow{\Delta} C_8H_8O_3 + H_2O$

$1.50g \cdot \left(\frac{1\,mol}{138.1g}\right) \cdot \left(\frac{1}{1}\right) \cdot \left(\frac{152.1g}{mol}\right) = 1.65g\ C_8H_8O_3$

$11.20g \cdot \left(\frac{1\,mol}{32.0}\right) \cdot \left(\frac{1}{1}\right) \cdot \left(\frac{152.1g}{mol}\right) = 53.2g\ C_8H_8O_3$

$\frac{1.31g\ C_8H_8O_3}{1.65g\ C_8H_8O_3} \times 100 =$ **79.4% yield**

3.113 $(10.0cm \times 20.0cm \times 15.0cm) \cdot \left(\frac{8.17g\ Alloy}{cm^3}\right) \cdot \left(\frac{54.7g\ Fe}{100g\ Alloy}\right) \cdot \left(\frac{1\,mol\ Fe}{55.85g\ Fe}\right)$

$\cdot \frac{6.02 \times 10^{23}\ atom\ Fe}{mole\ Fe} =$

1.45×10^{26} atoms

3.108 Let x = mass Fe_2O_3 $\quad 100 - x$ = mass FeO

$Fe_2O_3 = \frac{159.7g}{mol} \Rightarrow 70.0\%\ Fe$ $\qquad FeO = \frac{71.85g}{mol} = 77.8\%\ Fe$

$$\frac{(0.700)(x) + (.778)(100-x)}{100} = \frac{72}{100} = \%\ Fe\ in\ Mix$$

$.700x + 77.8 - .778x = 72$

$-0.078x = -5.8$

$x = 74.4g\ Fe_2O_3$ $= 74.4\%\ FeO_3$

$25.6g\ FeO$

$.744 \times 0.5 =$ $\quad 0.372g\ Fe_2O_3$

3.110 Penn V →

$S \rightarrow BaSO_4$ $BaSO_4 =$

$$5.46\,mg \cdot \left(\frac{1\,mol\,BaSO_4}{233.4\,g}\right)\left(\frac{1\,mol\,S}{1\,mol\,SO_4}\right)\left(\frac{32.1\,g}{mol\,S}\right) = 0.751\,mg\,S$$

$$\frac{0.751\,mg\,S}{8.19\,mg\,Sample} = 9.17\%\,S$$

$$\frac{.751\,mg\,S}{8.19\,mg\,Penn} = \frac{32.1\,g/mol}{x\,g/mol} \Rightarrow \boxed{x = 350.\,\frac{g}{mol}}$$

3.112

$$M^{+2} + 2X^- \rightarrow MX_2$$

$$1.92g + (.158\,mol)\,mm = mass\,MX_2$$

86.8% mass = X
13.2% mass = M

$$\left[\frac{1.92g\,M^{+2}}{1.92+(.158)(mm)}\right] = 0.132\%\,M^{+2}$$

$$1.92 = (0.132)\left[1.92 + (0.158)(mm)\right]$$

$$1.92 = 0.253 + 0.0209\,mm$$

$$mm = 79.8\,g/mol = Br$$

$$\frac{(2\times 79.9)}{M + (2\times 79.9)} = .868\%\,Br$$

$$159.8 = .868\,M + (159.8)(.868)$$

$$159.6 = .868M + 139$$

$$m = 24.3\,g/m$$

$$\boxed{MgBr_2}$$