Volume Stoich. Hmwk:

(10) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

a) given: 31.8L NH_3 need: ? L N_2 Type: Vol → Vol

$$31.8\,L\,NH_3 \times \frac{1\,mol\,NH_3}{22.4\,L\,NH_3} \times \frac{1\,mol\,N_2}{2\,mol\,NH_3} \times \frac{22.4\,L\,N_2}{1\,mol\,N_2} = \boxed{15.9\,L\,N_2}$$

b) given: 5602.7L N_2 need: ? L H_2 Type: Vol → Vol

$$5602.7\,L\,N_2 \times \frac{1\,mol\,N_2}{22.4\,L\,N_2} \times \frac{3\,mol\,H_2}{1\,mol\,N_2} \times \frac{22.4\,L\,H_2}{1\,mol\,H_2} = \boxed{1688\,L\,H_2}$$

(11) $\_\_CH_4(g) + \underline{2}\,O_2(g) \rightarrow \underline{2}\,H_2O(g) + \_\_CO_2(g)$ (1) (2) (3)

a) given: 10.0L O_2 (2) need: ? L CH_4 (3) Type: Vol → Vol

$$10.0\,L\,O_2 \times \frac{1\,mol\,O_2}{22.4\,L\,O_2} \times \frac{1\,mol\,CH_4}{2\,mol\,O_2} \times \frac{22.4\,L\,CH_4}{1\,mol\,CH_4} = \boxed{5.00\,L\,CH_4}$$

b) given: 70.5L CH_4 need: ? L CO_2 Type: Vol → Vol

$$70.5\,L\,CH_4 \times \frac{1\,mol\,CH_4}{22.4\,L\,CH_4} \times \frac{1\,mol\,CO_2}{1\,mol\,CH_4} \times \frac{22.4\,L\,CO_2}{1\,mol\,CO_2} = \boxed{70.5\,L\,CO_2}$$

Volume Stoich. Homwk:

(12) $2K + 2H_2O \rightarrow 2KOH + H_2(g)$

a) given: 20.0g K need: ? L H_2 Type: mass → vol

$$20.0\text{g K} \times \frac{1\text{mol K}}{39.10\text{g K}} \times \frac{1\text{ mol } H_2}{2\text{ mol K}} \times \frac{22.4\text{L } H_2}{1\text{ mol } H_2} = \boxed{5.73\text{L } H_2}$$

b) given: 23.0L H_2 need: ? g H_2O Type: vol → mass

$$23.0\text{L } H_2 \times \frac{1\text{mol } H_2}{22.4\text{L } H_2} \times \frac{2\text{ mol } H_2O}{1\text{ mol } H_2} \times \frac{18.02\text{g } H_2O}{1\text{mol}} = \boxed{37.0\text{g } H_2O}$$

(13) $Zn + 2HCl(aq) \rightarrow ZnCl_2 + H_2(g)$

a) given: 60.70L H_2 need: ? g Zn Type: vol → mass

$$60.70\text{L } H_2 \times \frac{1\text{mol } H_2}{22.4\text{L } H_2} \times \frac{1\text{ mol Zn}}{1\text{ mol } H_2} \times \frac{65.39\text{g Zn}}{1\text{ mol Zn}} = \boxed{177.2\text{g Zn}}$$

b) given: 47.8g HCl need: ? L H_2 Type: mass → vol

$$47.8\text{g HCl} \times \frac{1\text{mol HCl}}{36.46\text{g HCl}} \times \underbrace{\frac{1\text{ mol } H_2}{2\text{ mol HCl}}}_{\text{molar ratio}} \times \frac{22.4\text{L } H_2}{1\text{mol } H_2} = \boxed{14.7\text{ L } H_2}$$

Volume Stoich. Homwk:

(14) $2C + O_2(g) \rightarrow 2CO(g)$

a) given: 34.2L CO need: ?g C Type: vol → mass

$$34.2\,L\,CO \times \frac{1\,mol\,CO}{22.4\,L\,CO} \times \frac{2\,mol\,C}{2\,mol\,CO} \times \frac{12.01\,g\,C}{1\,mol\,C} = \boxed{18.3\,g\,C}$$

b) given: 21.9g C need: ?L $O_2(g)$ Type: mass → vol

$$21.9\,g\,C \times \frac{1\,mol\,C}{12.01\,g\,C} \times \frac{1\,mol\,O_2}{2\,mol\,C} \times \frac{22.4\,L\,O_2}{1\,mol\,O_2} = \boxed{20.4\,L\,O_2}$$

(15) $2NaF + Cl_2(g) \longrightarrow 2NaCl + F_2(g)$

a) given: 88.0L Cl_2 need: ?g NaCl Type: vol → mass

$$88.0\,L\,Cl_2 \times \frac{1\,mol\,Cl_2}{22.4\,L\,Cl_2} \times \frac{2\,mol\,NaCl}{1\,mol\,Cl_2} \times \frac{58.45\,g\,NaCl}{1\,mol\,NaCl} = \boxed{459\,g\,NaCl}$$

b) given: 97.8g NaF need: ?L F_2 Type: mass → vol

$$97.8\,g\,NaF \times \frac{1\,mol\,NaF}{42.00\,g\,NaF} \times \underbrace{\frac{1\,mol\,F_2}{2\,mol\,NaF}}_{\text{molar ratio}} \times \frac{22.4\,L\,F_2}{1\,mol\,F_2} = \boxed{26.1\,L\,F_2}$$

16. $4HCl(aq) + O_2(g) \rightarrow 2H_2O + 2Cl_2(g)$

given #1 = 750g HCl } needed = ? g Cl_2
given #2 = 320g O_2 }

theo. yield

LF Limiting Factor

$750g\ HCl \times \frac{1\ mol\ HCl}{36.46g\ HCl} \times \frac{2\ mol\ Cl_2}{4\ mol\ HCl} \times \frac{70.90g\ Cl_2}{1\ mol\ Cl_2} = 730g\ / 729.22\ Cl_2$ TY

$320g\ O_2 \times \frac{1\ mol\ O_2}{32.00g\ O_2} \times \frac{2\ mol\ Cl_2}{1\ mol\ O_2} \times \frac{70.90g\ Cl_2}{1\ mol\ Cl_2} = 1400g\ Cl_2 / 1420g\ Cl_2$

17. $NaCl + H_2O \rightarrow NaOH + HCl(aq)$ (H(OH))

given #1 = 645g NaCl } needed = ? g NaOH
given #2 = 290g H_2O }

smaller

LF $645g\ NaCl \times \frac{1\ mol\ NaCl}{58.45g\ NaCl} \times \frac{1\ mol\ NaOH}{1\ mol\ NaCl} \times \frac{40.01g\ NaOH}{1\ mol\ NaOH} =$ Theo Yield 441g NaOH

P.T. P.T.

$290g\ H_2O \times \frac{1\ mol\ H_2O}{18.02g\ H_2O} \times \frac{1\ mol\ NaOH}{1\ mol\ H_2O} \times \frac{40.01g\ NaOH}{1\ mol\ NaOH} = 644g\ NaOH$

18. $2Na + Cl_2(g) \rightarrow 2NaCl$

given #1 = 50.0g Na } needed: ? g NaCl
given #2 = 30.0L Cl_2 }

Theo yield

LF $50.0g\ Na \times \frac{1\ mol\ Na}{23.00g\ Na} \times \frac{2\ mol\ NaCl}{2\ mol\ Na} \times \frac{58.45g\ NaCl}{1\ mol\ NaCl} =$ 127g NaCl

$30.0L\ Cl_2 \times \frac{1\ mol\ Cl_2}{22.4L\ Cl_2} \times \frac{2\ mol\ NaCl}{1\ mol\ Cl_2} \times \frac{58.45g\ NaCl}{1\ mol\ NaCl} = 157\ g\ NaCl$

19. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

given #1 63.4g Cu
given #2 213g $AgNO_3$
} needed = ? g Ag

$$63.4\,g\,Cu \times \frac{1\,mol\,Cu}{63.55\,g\,Cu} \times \frac{2\,mol\,Ag}{1\,mol\,Cu} \times \frac{107.9\,g\,Ag}{1\,mol\,Ag} = 215\,g\,Ag$$

limiting factor

$$213\,g\,AgNO_3 \times \frac{1\,mol\,AgNO_3}{169.91\,g\,AgNO_3} \times \frac{2\,mol\,Ag}{2\,mol\,AgNO_3} \times \frac{107.9\,g\,Ag}{1\,mol\,Ag} = \boxed{135\,g\,Ag}$$ Theo yield

actual yield → 104.9g
T.y. → 135g

$$\frac{104.9\,g}{135\,g} \times 100 = \boxed{77.7\%\ yield}$$

20. $2K_3PO_4 + 3Ni(ClO_3)_2 \rightarrow Ni_3(PO_4)_2 + 6KClO_3$

given #1 ~ 1500g K_3PO_4
given #2 = 1250g $Ni(ClO_3)_2$
} needed = ? g $Ni_3(PO_4)_2$

$$1500\,g\,K_3PO_4 \times \frac{1\,mol\,K_3PO_4}{212.27\,g\,K_3PO_4} \times \frac{1\,mol\,Ni_3(PO_4)_2}{2\,mol\,K_3PO_4} \times \frac{381.01\,g\,Ni_3(PO_4)_2}{1\,mol\,Ni_3(PO_4)_2} =$$

$$= \frac{1203}{1300}\,g\,Ni_3(PO_4)_2$$

limiting factor

$$1250\,g\,Ni(ClO_3)_2 \times \frac{1\,mol\,Ni(ClO_3)_2}{225.59\,g\,Ni(ClO_3)_2} \times \frac{1\,mol\,Ni_3(PO_4)_2}{3\,mol\,Ni(ClO_3)_2} \times \frac{381.01\,g\,Ni_3(PO_4)_2}{1\,mol\,Ni_3(PO_4)_2}$$

$$= \boxed{676\,g\,Ni_3(PO_4)_2\ theo\ yield}$$

$$\frac{658\,g}{676\,g} \times 100 = 97.3\%\ yield$$

$$\frac{actual}{theo} \times 100$$

$2H + 1C + 2M \longrightarrow H_2CM_2$

7 H

$7 \text{ mol } H \times \frac{1 \text{ mol } H_2CM_2}{2 \text{ mol } H} = 3.5 \ H_2CM_2$