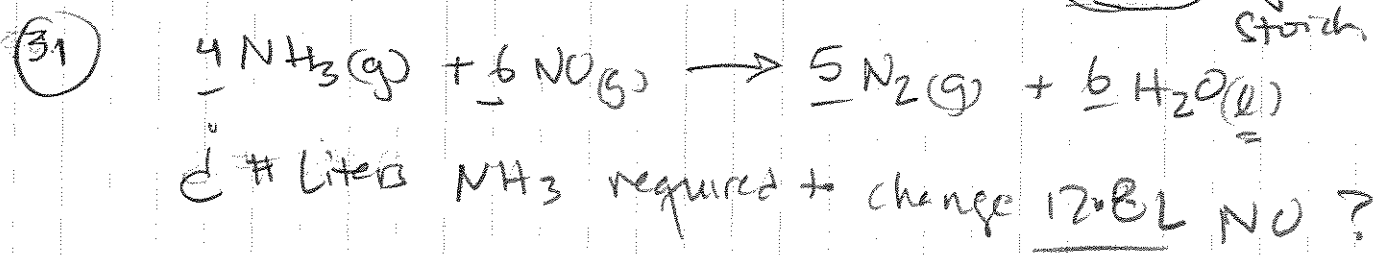
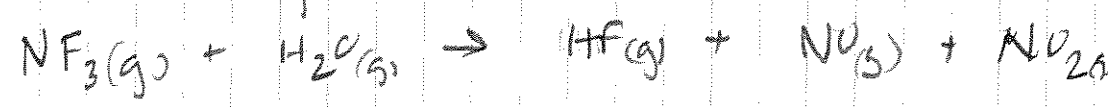


35.4 gas stoich

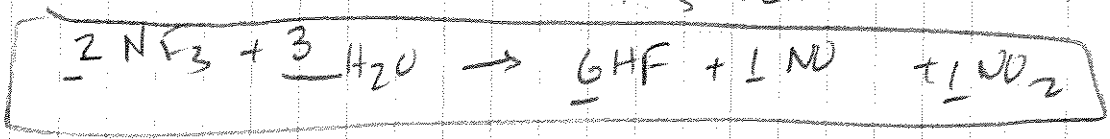


$$\frac{12.8 \text{ L NO}}{1} \times \frac{4 \text{ L NH}_3}{6 \text{ L NO}} = \underline{8.53 \text{ L NH}_3} \quad (100\% \text{ yield})$$

32 (a) balanced chem eq.



(i) all H in HF comes from H_2O
 (1 NF_3 : 3 HF ratio) \rightarrow 1 $\text{NF}_3 \rightarrow$ 3 HF doesn't work
 2 $\text{NF}_3 \rightarrow$ 6 HF \leftarrow so try



(b) C Vol $\text{NO} \rightarrow$ from 5.22 L NF_3 + 5.22 L steam

(i) LR's

$$\text{NF}_3: \frac{5.22 \text{ L NF}_3}{1} \times \frac{1 \text{ L NO}}{2 \text{ L NF}_3} = 2.61 \text{ L NO}$$

$$\text{H}_2\text{O}: \frac{5.22 \text{ L H}_2\text{O}}{1} \times \frac{1 \text{ L NO}}{3 \text{ L H}_2\text{O}} = \underline{1.74 \text{ L NO}}$$

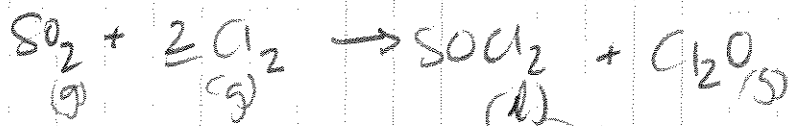
LR

NB My method differs from Sol'n workbook:

$$\text{LR mol NF}_3: 5.22 \text{ L} \frac{P}{RT} \times \frac{1 \text{ mol NO}}{2 \text{ mol NF}_3} = 2.61 \text{ L} \left(\frac{P}{RT} \right) (\text{NO})$$

$$\text{LR mol H}_2\text{O}: 5.22 \text{ L} \frac{P}{RT} \times \frac{1 \text{ mol NO}}{3 \text{ mol H}_2\text{O}} = 1.74 \left(\frac{P}{RT} \right) (\text{NO})$$

$$\text{LR } (V_{\text{NO}} = 1.74 \left(\frac{P}{RT} \right) = 1.74 \text{ L})$$



(l) note - liquid

How many liters of Cl_2O can be produced from

(a) 5.85 L SO_2 & 9.00 L Cl_2

(using law of combining volumes)

(100% yield)

$$\boxed{\text{SO}_2} \quad \frac{5.85 \text{ L SO}_2}{1 \text{ L SO}_2} \times \frac{1 \text{ L Cl}_2\text{O}}{2 \text{ L Cl}_2} \rightarrow 5.85 \text{ L Cl}_2\text{O}$$

$$\boxed{\text{Cl}_2} \quad \frac{9.00 \text{ L Cl}_2}{2 \text{ L Cl}_2} \times \frac{1 \text{ L Cl}_2\text{O}}{1 \text{ L SO}_2} = \boxed{4.50 \text{ L Cl}_2\text{O}}$$

L.R.

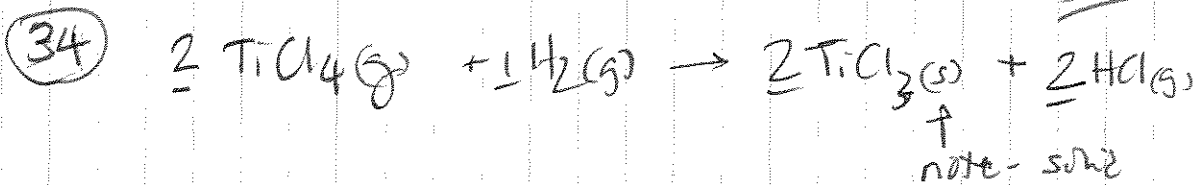
(b) Liters of XS reactant remain?

amt. possibly made by $\text{SO}_2 = 5.85 \text{ L Cl}_2\text{O}$
 " actually " " " " = $4.50 \text{ L Cl}_2\text{O}$

$1.35 \text{ L Cl}_2\text{O}$ not made

$$1.35 \text{ L Cl}_2\text{O} \rightarrow \boxed{1.35 \text{ L SO}_2} \text{ (1:1 ratio)}$$

remain unused XS reactant



(a) How many litres HCl from 3.72 L TiCl_4 & 4.50 L H_2 (100% yield)

TiCl_4 3.72 L $\text{TiCl}_4 \times \frac{2 \text{ L HCl}}{2 \text{ L TiCl}_4} = 3.72 \text{ L HCl}$

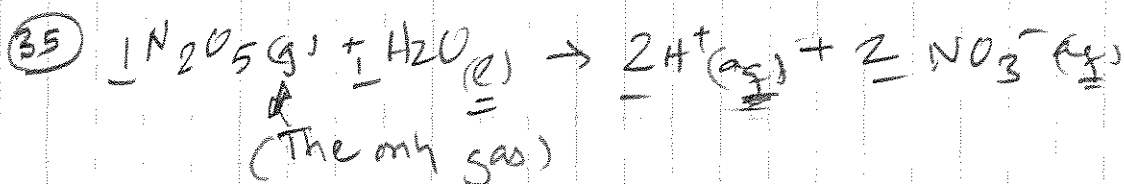
H_2 4.50 L $\text{H}_2 \times \frac{2 \text{ L HCl}}{1 \text{ L H}_2} = 9.00 \text{ L HCl}$

LR

(b) L XS reactant (H_2): ?

$$\begin{array}{r} 9.00 \text{ L HCl} \\ - 3.72 \text{ L HCl} \\ \hline 5.28 \text{ L HCl} \end{array}$$

ratio: $2 \text{ HCl} : 1 \text{ H}_2 \downarrow \div 2 = 2.64 \text{ L H}_2$



(a) moles H^+ from 1.50 L N_2O_5 @ 25°C & 1 atm

(i) moles $\text{N}_2\text{O}_5 \rightarrow PV = nRT \Rightarrow n = \frac{PV}{RT} = \frac{(1)(1.50)}{(0.08206)(298)}$

$n = 6.13 \times 10^{-2} \text{ mol N}_2\text{O}_5$

(ii) $6.13 \times 10^{-2} \text{ mol N}_2\text{O}_5 \times \frac{2 \text{ mol H}^+}{1 \text{ mol N}_2\text{O}_5} = 0.123 \text{ mol H}^+$

(cont)

35b) cont

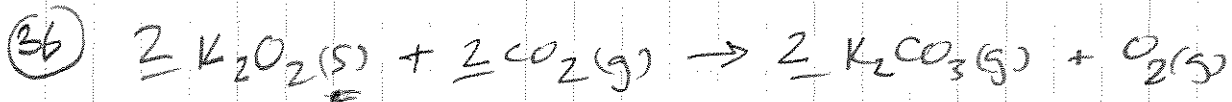
b) after rxn, vol = 437 mL, Molarity HNO₃ obtained?

(1) $Molarity = \frac{mol}{L}$

(mol H⁺ = mol NO₃⁻ = mole HNO₃)

$= \frac{0.123 \text{ mol HNO}_3}{0.437 \text{ L}} = \boxed{0.281 \text{ M HNO}_3}$

(n.b. vol results for original vol H₂O not used in rxn)



(a) $\frac{3.0 \text{ L air}}{1 \text{ min}}$ & air is 3.4% (v/v) CO₂
grams K₂O₂ / person for 5 days?

T = 25°C = 298K

P = $\frac{728 \text{ mmHg}}{760 \text{ mmHg}} = 0.958 \text{ atm}$

(1) Person exhales $\frac{3.0 \text{ L}}{\text{min}} \times 3.4\% \text{ CO}_2 = \frac{0.102 \text{ L CO}_2}{\text{min}}$

(2) for 5 days - L CO₂ exhaled

$\frac{0.102}{\text{min}} \rightarrow \frac{0.102 \text{ L CO}_2}{1 \text{ min}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{\text{day}} \times 5 \text{ days}$

= 734.4 L CO₂

Can't use law multiple volumes
 s/c not @ STP, vol affects # moles
 (cont)

36 (cont) (b) 734.4 L CO_2 (needed for 5 atm)

$$PV = nRT \Rightarrow n = \frac{PV}{RT} = \frac{(0.958)(734.4)}{(0.08206)(298)} = 28.8 \text{ mol } \text{CO}_2$$



$$\frac{28.8 \text{ mol } \text{CO}_2}{1} = 28.8 \text{ mol } \text{K}_2\text{O}_2 \times \frac{110.196 \text{ g}}{1 \text{ mol}} = 3.17 \times 10^3 \text{ g } \text{K}_2\text{O}_2$$

$$\begin{array}{r} 25 \text{ ft} \\ (3.02) \\ \hline 3.2 \times 10^3 \text{ g} \end{array}$$

37



vol of 6.00 M HCl \rightarrow HCN to fill room 12 x 11 x 9 ft

$$P = 0.987 \text{ atm}$$

$$T = 72^\circ \text{F} = 22^\circ \text{C} = 295 \text{ K}$$

(i) vol in liters

$$(1) \quad 12 \times 11 \times 9 \text{ ft} = 1.188 \times 10^3 \text{ ft}^3$$

$$1.188 \times 10^3 \text{ ft}^3 \times \frac{(12 \text{ in})^3}{(1 \text{ ft})^3} \times \frac{(2.54 \text{ cm})^3}{(1 \text{ in})^3} \times \frac{1 \text{ mL}}{1 \text{ cm}^3} \times \frac{1 \text{ L}}{10^3 \text{ mL}} = 3 \times 10^4 \text{ L}$$

$$\begin{array}{l} \downarrow \quad \quad \quad \uparrow \\ (1.728 \times 10^3 \text{ in}^3) \quad (1.639 \times 10^4 \text{ cm}^3) \end{array}$$

(ii) amt HCN(g) in room

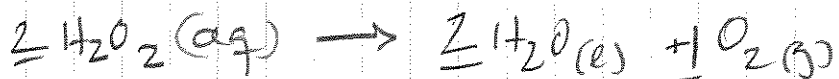
$$PV = nRT \Rightarrow n = \frac{PV}{RT} = \frac{(0.987)(3 \times 10^4)}{(0.08206)(295 \text{ K})} = 1 \times 10^3 \frac{\text{mol}}{\text{HCN}}$$

(iii) vol 6.00 M HCl \rightarrow 1.37 mol HCN

$$\frac{1 \times 10^3 \text{ mol}}{1} \times \frac{1 \text{ mol HCl}}{1 \text{ mol HCN}} \times \frac{1 \text{ L HCl}}{6.00 \text{ mol HCl}} = 2 \times 10^2 \text{ L}$$

38

5.4



25.00 mL of a 30.0% (m/m) of $\text{H}_2\text{O}_2 \rightarrow$? $\text{O}_2(\text{g})$

$P = 1 \text{ atm}$

$T = 298 \text{ K}$

$d_{\text{H}_2\text{O}_2} = 1.05 \text{ g/mL}$

(i) mol H_2O_2 used

$$25.00 \text{ mL} \times \frac{1.05 \text{ g}}{1 \text{ mL}} \times \frac{1 \text{ mol H}_2\text{O}_2}{34.02 \text{ g H}_2\text{O}_2} = 0.7716 \text{ mol}$$

$\times 30\% = 0.2315$

(ii) mol $\text{H}_2\text{O}_2 \rightarrow$ mol $\text{O}_2 = 0.2315 \text{ mol H}_2\text{O}_2$

$$\frac{1 \text{ mol O}_2}{2 \text{ mol H}_2\text{O}_2} = 0.1157 \text{ mol O}_2$$

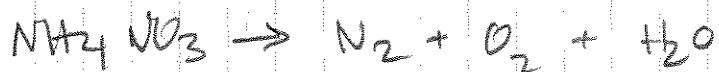
(iii) mol $\text{O}_2 \rightarrow$ vol O_2

$$V = \frac{nRT}{P} = \frac{(0.1157)(0.08206)(298)}{1}$$

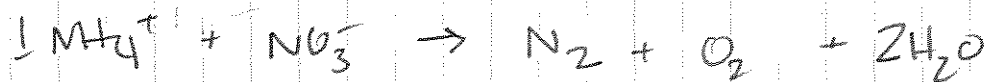
$V = 2.83 \text{ L O}_2$

(3 sf from 30.0%)

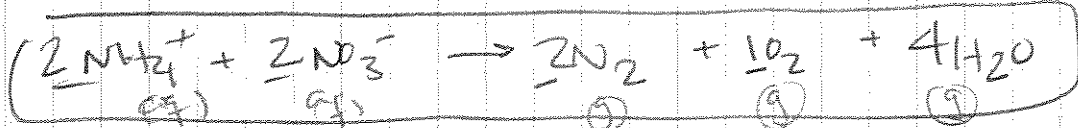
39 (a) bal. equation (net ionic)



• H in H₂O comes only from NH₄⁺
∴ ratio $1 \text{ NH}_4^+ \rightarrow 2 \text{ H}_2\text{O}$



{ check N: 1+2=2 → 2
H: 4 → 4
O: 3 → 4 } per 2NH₄NO₃



2.00 kg NH₄NO₃ / V = 50.0 L steel / T = 74°C = 1,018 K

P = ?

$$\begin{aligned} & \text{1) moles} \rightarrow \text{molar} \\ & = \frac{2.00 \text{ kg} \times 10^3}{1 \text{ kg}} \times \frac{1 \text{ mol}}{80.043 \text{ g}} \times \frac{7 \text{ mol gas}}{2 \text{ mol NH}_4\text{NO}_3} = 87.4 \text{ mol} \end{aligned}$$

(TOTAL GAS (law of multiple volumes)
2+1+4 = 7

$$P = \frac{(87.4)(0.08206)(1018)}{50.0 \text{ L } R/\text{given}} = 146 \text{ atm}$$

40

(35,4)



@ bal. chem.



all H_2O from $C_9H_{18}O_6$ = ratio = 18:2 \rightarrow 9:1



(Note: nine carbons \rightarrow coefficient is even)

b

$P = ?$

$V = 2.00 L / 5.00g C_9H_{18}O_6 / T = 828 K$

(100% combustion)

$P = \frac{nRT}{V}$

$n = \frac{5.00g}{222.24g} \times \frac{1mol}{1} \times \frac{36mol\ gas}{2mol}$

$C_9H_{18}O_6$

gases

$n = 0.405 mol$

$P = (0.405)(0.08206)(828) / 2$

$P = 13.8 atm$

(3sf)
(2.00L)