STOICHIOMETRY OF GASES: SOLUTIONS

(other methods may be possible)

1) a) $4NH_{3(g)} + 3O_{2(g)} \rightarrow 2N_{2(g)} + 6H_2O_{(g)}$

b)

4 mole	3 mole
16 mole	x

$x = 12$ moles O_2 $\rightarrow$ $n = \frac{m}{M}$

$12 = \frac{m}{32}$

$12(32) = m$

$384\ g = m$

---

2) $2N_2H_{4(\ell)} + N_2O_{4(\ell)} \rightarrow 3N_{2(g)} + 4H_2O_{(g)}$

2 mole	3 mole
2.72 moles	x

$x = 4.08$ moles N_2 $\rightarrow$ $n = \frac{m}{M}$

$4.08 = \frac{m}{28}$

$4.08(28) = m$

$114.2\ g = m$

3) a) $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$

1 mole — 3 mole

1.5 L — x

$x = 4.5\,L$ CO_2 gas produced

b) $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$

1 mole — 5 mole

1.5 L — y

$y = 7.5\,L$ of O_2 are required.

---

4) $2NaN_{3(g)} \rightarrow 2Na_{(g)} + 3N_{2(g)}$

2 mole — 3 mole

$n = \frac{m}{M}$

$2 = \frac{m}{65}$

$m = 130g$ — $m = 84g$

117g — x

$x = 75.6g\ N_2$

$T = 20.2 + 273$
$= 293.2K$

$P = 101.2\,kPa$

$M_{N_2} = 28g/mol$

a) $PV = \frac{m}{M}RT$

$V = \frac{mRT}{MP}$

$V = \frac{(75.6)(8.31)(293.2)}{(28)(101.2)}$

$V = 65L$

b) $n = \frac{m}{M}$ $n = \frac{75.6}{28}$

$n = 2.7$ moles

$(2.7)\cdot(6.02 \times 10^{24})$
$= 1.62 \times 10^{24}$ molecules

5) a) $2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

1 mole — 2 mole

x — 12 L

x = 6 L of O_2 is used

6) a) $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$

1 mole — 4 mole

$n = \frac{m}{M}$

$1 = \frac{m}{44}$

$m = 44g$

$n = \frac{m}{M}$

$4 = \frac{m}{18}$

$m = 72g$

35g — x

x = 57.3 g H_2O produced

$V_{H_2O} = ?$

$T = 298K$

$P = 101.3kPa$

$M_{H_2O} = 18g/mol$

$PV = \frac{mRT}{M}$

$V = \frac{mRT}{MP}$

$V = \frac{(57.3)(8.31)(298)}{(18)(101.3)}$

$V = 77.8L$ H_2O

6) b) $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$

1 mole → $n = \frac{m}{M}$ → $1 = \frac{m}{44}$ → 44 g

5 mole → $n = \frac{m}{M}$ → $5 = \frac{m}{32}$ → 160 g

44 g : 160 g

35 g : y

$y = 127.3$ g O_2 used

$V_{O_2} = ?$

$T = 298$ K

$P = 101.2$ kPa

$M_{O_2} = 32$ g/mole

$PV = \frac{mRT}{M}$

$V = \frac{mRT}{MP}$

$V = \frac{(127.3)(8.31)(298)}{(32)(101.2)}$

$V = 97.3$ L O_2

7) a) $P_4S_{3\,(s)} + \underline{8\,O_{2\,(g)}} \rightarrow P_4O_{10\,(g)} + \underline{3\,SO_{2\,(g)}}$

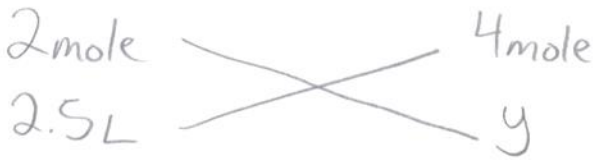
b)

$x = 1.98\,L$ SO_2 is produced

8) a) $\underline{2\,C_2H_5OH_{(g)}} + \underline{6\,O_{2\,(g)}} \rightarrow 4\,CO_{2\,(g)} + 6\,H_2O_{(l)}$

$x = 7.5\,L$ oxygen needed

b) $\underline{2\,C_2H_5OH_{(g)}} + 6\,O_{2\,(g)} \rightarrow \underline{4\,CO_{2\,(g)}} + 6\,H_2O_{(g)}$



$y = 5\,L$ CO_2 produced

P.123

64)

a) $2CH_3OH(\ell) + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O_{(g)}$

b)

3 mole — 2 mole

10 L — x

$x = 6.67\ L$ of CO_2

c) STP:

$T = 273\ K$

$P = 101.3\ kPa$

$V = 10\ L$

$n = ???$

$PV = nRT$

$n = \frac{PV}{RT}$

$n = \frac{101.3(10)}{8.31(273)}$

$n = 0.45$ moles of O_2

$2CH_3OH(\ell) + 3O_{2(g)} \rightarrow 2CO_{2(g)} + 4H_2O$

2 moles — 3 moles

x — 0.45 moles

$x = 0.3$ moles

$n = \frac{m}{M}$ $\quad 0.3 = \frac{m}{32}$ $\quad m = 9.6\ g$

67) $2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + H_2O_{(g)} + CO_{2(g)}$

2 mole → $n = \frac{m}{M}$ → $2 = \frac{m}{84}$ → $168g = m$ → $3g$

1 mole → $n = \frac{m}{M}$ → $1 = \frac{m}{44}$ → $44g = m$ → x

$x = 0.79g$ of CO_2

$T = 195°C \rightarrow 468K$

$P = 100\ kPa$

$m_{CO_2} = 0.79g$

$M_{CO_2} = 44g/mole$

$PV = nRT$

$PV = \frac{mRT}{M}$

$V = \frac{mRT}{MP}$

$V = \frac{(0.79)(8.31)(468)}{(44)(100)}$

$V = 0.69\ L$ of CO_2 gas produced.