Particles, Mass, Volume, Molarity & Energy Problems

1) $2NH_{4(g)} + 5\ O_{2(g)} \rightarrow 6H_2O_{(g)} + 4\ NO_{(g)}$

a) $112\text{L}\ NH_4\left(\frac{1\text{ mol}}{22.4\text{L}}\right)\left(\frac{6\text{ mol}\ H_2O}{2\text{ mol}\ NH_4}\right)\left(\frac{22.4\text{L}}{1\text{ mol}}\right) = 336\text{L}$

or $112\text{L}\ NH_4\left(\frac{6\text{ L}\ H_2O}{2\text{ L}\ NH_4}\right) = 336\text{ L}\ H_2O$

since they are all gases.

b) $8.96\text{L}\ NH_4\left(\frac{5\text{ L}\ O_2}{2\text{ L}\ NH_4}\right) = 22.4\text{L}\ O_2$

c) $134\text{L}\ H_2O\left(\frac{2\text{ L}\ NH_4}{6\text{ L}\ H_2O}\right) = 44.7\text{ L}\ NH_4$

d) $1.20\times10^{24}\text{ mlcl NO}\left(\frac{5\ O_2}{4\text{ mlcl NO}}\right) = 1.50\times10^{24}\text{ mlcl}\ O_2$

e) $22.4\text{L}\ O_2\left(\frac{4\text{ L NO}}{5\text{ L}\ O_2}\right)\left(\frac{1\text{ mol NO}}{22.4\text{L}}\right)\left(\frac{30\text{ g}}{1\text{ mol}}\right) = 240.0\text{g NO}$

f) $34.1\text{g}\ NH_4\left(\frac{1\text{ mol}\ NH_4}{18.0\text{g}}\right)\left(\frac{6\text{ mol}\ H_2O}{2\text{ mol}\ NH_4}\right)\left(\frac{6.02\times10^{23}\text{ mlcl}}{1\text{ mol}}\right)$

$= 3.42\times10^{24}\text{ mlcl}\ H_2O$

g) $6.02\times10^{24}\text{ mlcl}\ NH_4\left(\frac{\text{mol}}{6.02\times10^{23}\text{ mlcl}}\right)\left(\frac{4\text{ mol NO}}{4\text{ mol}}\right)\left(\frac{22.4\text{L}}{1\text{ mol}}\right) = 448\text{L}$

$360.\text{g}\ O_2\left(\frac{\text{mol}}{32.0\text{g}}\right)\left(\frac{4\text{ mol NO}}{5\text{ mol}\ O_2}\right)\left(\frac{22.4\text{L}}{1\text{ mol}}\right) = 202\text{ L}$

1st is more.

2) $C_3H_8(g) + 5\ O_2(g) \rightarrow 3CO_2 + 4H_2O_{(g)} + 2234\ kJ$

a) $5.60\ L\ C_3H_8\left(\frac{5\ L\ O_2}{1\ L\ C_3H_8}\right)\left(\frac{1\ mol}{22.4\ L}\right) = 1.25\ mol\ O_2$

b) $0.800\ mol\ C_3H_8\left(\frac{5\ mol\ O_2}{1\ mol\ C_3H_8}\right)\left(\frac{6.02\times10^{23}\ mlcl}{1\ mol}\right) = 2.41\times10^{24}\ mlcl$

c) $6.00\ L\ C_3H_8\left(\frac{3\ L\ CO_2}{1\ L\ C_3H_8}\right) = 18.0\ L\ CO_2$

d) $3.60\times10^{22}\ mlcl\ H_2O\left(\frac{5\ mlcl\ O_2}{4\ mlcl\ H_2O}\right) = 4.50\times10^{22}\ mlcl\ O_2$

e) $1.17\times10^{3}\ kJ\left(\frac{1\ mol\ C_3H_8}{2234\ kJ}\right) = 0.524\ mol\ C_3H_8$

f) $280.0\ L\ O_2\left(\frac{2234\ kJ}{5\ L\ O_2}\right) = 1.251\times10^{5}\ kJ$

g) $4.92\times10^{3}\ kJ\left(\frac{1\ mol\ C_3H_8}{2234\ kJ}\right)\left(\frac{44.0\ g}{1\ mol\ C_3H_8}\right) = 96.9\ g\ C_3H_8$

h) $89.6\ L\left(\frac{1\ mol}{22.4\ L}\right)\left(\frac{3\ mol\ CO_2}{1\ mol\ C_3H_8}\right)\left(\frac{6.02\times10^{23}\ mlcl}{1\ mol\ CO_2}\right) = \cancel{1.62\times10^{24}\ mlcl}$ $7.22\times10^{24}\ mlcl$

3) $2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$

$50.0\ L\left(\frac{4.6\ mol\ C_8H_{18}}{1\ L}\right)\left(\frac{16\ mol\ CO_2}{2\ mol\ C_8H_{18}}\right)\left(\frac{44.0\ g}{1\ mol\ CO_2}\right) = 1.16\times10^{5}\ g$

$= 116\ kg$

4) $Ca_3(PO_4)_2 + 3SiO_2 + 5C \rightarrow 3CaSiO + 5CO + P_2$

a) $75 \text{ atoms C}\left(\frac{1 \text{ mol C}}{1 \text{ atom C}}\right)\left(\frac{1 \text{ mol P}}{5 \text{ mol C}}\right)\left(\frac{2 \text{ atom P}}{1 \text{ mol P}}\right) = 30. \text{ atoms P}$

b) $186 \text{ g P}\left(\frac{1 \text{ mol}}{62.0 \text{ g}}\right)\left(\frac{5 \text{ mol C}}{1 \text{ mol P}}\right) = 15.0 \text{ mol C}$

c) $22.4 \text{ L CO}\left(\frac{1 \text{ mol CO}}{22.4 \text{ L}}\right)\left(\frac{1 \text{ mol } Ca_3(PO_4)_2}{5 \text{ mol CO}}\right)\left(\frac{310.3 \text{ g}}{1 \text{ mol}}\right)$

$= 621 \text{ g}$

d) $3.00 \times 10^{25} \text{ atoms C}\left(\frac{1 \text{ mol C}}{1 \text{ atom C}}\right)\left(\frac{1.0 \text{ mol C}}{6.02 \times 10^{23} \text{ mol C}}\right)\left(\frac{3 \text{ mol CaSiO}}{5 \text{ mol C}}\right)$

$\left(\frac{116 \text{ g}}{1 \text{ mol CaSiO}}\right) = 3470 \text{ g CaSiO}$

e) $7.20 \times 10^{20} \text{ atoms C}\left(\frac{1 \text{ mol C}}{1 \text{ atom C}}\right)\left(\frac{5 \text{ mol CO}}{5 \text{ mol C}}\right) = 7.20 \times 10^{20} \text{ mol CO}$

5) $C_{25}H_{52} + 38\ O_{2(g)} \rightarrow 25\ CO_{2(g)} + 26\ H_2O + 336 \text{ kJ}$

a) $1.25 \text{ L } O_2\left(\frac{25 \text{ L } CO_2}{38 \text{ L } O_2}\right) = 0.822 \text{ L } CO_2$

b) $1.00 \text{ g } C_{25}H_{52}\left(\frac{1 \text{ mol } C_{25}H_{52}}{352.0 \text{ g}}\right)\left(\frac{38 \text{ mol } O_2}{1 \text{ mol } C_{25}H_{52}}\right)\left(\frac{22.4 \text{ L } O_2}{1 \text{ mol } O_2}\right)$

$= 2.42 \text{ L } O_2$

5a) $1.25\,L\ O_2\left(\frac{25\,L\ CO_2}{38\,L\ O_2}\right) = 0.822\,L\ CO_2$

b) $1.00\,g\ C_{25}H_{52}\left(\frac{1\,mol\ C_{25}H_{52}}{352.0\,g}\right)\left(\frac{38\,L\ O_2}{1\,mol\ C_{25}H_{52}}\right)\left(\frac{1\,mol\ O_2}{22.4\,L\ O_2}\right)$

$= 4.82\times10^{-3}\ mol\ O_2$

c) $5.82\,mol\ C_{25}H_{52}\left(\frac{336\,kJ}{1\,mol\ C_{25}H_{52}}\right) = 1956$

$= 1960\,kJ$

d) $67.2\,kJ\left(\frac{26\,mol\ H_2O}{336\,kJ}\right)\left(\frac{6.02\times10^{23}\ mld}{1\,mol\ H_2O}\right) = 3.13\times10^{24}\ mld\ H_2O$

e) $15.0\,g\ C_{25}H_{52}\left(\frac{1\,mol\ C_{25}H_{52}}{352.0\,g}\right)\left(\frac{22.4\,L\ C_{25}H_{52}}{1\,mol}\right) = 0.955\,L\ C_{25}H_{52}$

$.955\,L\ C_{25}H_{52}\left(\frac{25\,L\ CO_2}{1\,L}\right) = 23.9\,L\ CO_2$

$.955\,L\ C_{25}H_{52}\left(\frac{26\,L\ H_2O}{1\,L}\right) = 24.8\,L\ H_2O$

Total $= 48.7\,L$

f) $1.00\,kJ\left(\frac{1\,mol\ C_{25}H_{52}}{336\,kJ}\right)\left(\frac{352.0\,g}{1\,mol}\right) = 1.05\,g\ C_{25}H_{52}$

6.

a) $mol = M \times L$

$= .5M(.05L) = 0.0250 mol\ HCl$

$.025\ mol\ HCl \left(\frac{2\ mol\ Fe}{6\ mol\ HCl}\right)\left(\frac{55.8\ g}{1\ mol\ Fe}\right) = 0.465\ g\ Fe$

b) $mol = 6M(.01L) = 0.06\ mol\ HCl$

$.0600\ mol\ HCl \left(\frac{3\ mol\ H_2}{6\ mol\ HCl}\right)\left(\frac{22.4L\ H_2}{1\ mol\ H_2}\right) = 0.672L\ H_2$

c) $11.2g\ Fe \left(\frac{1\ mol\ Fe}{55.8g\ Fe}\right)\left(\frac{6\ mol\ HCl}{2\ mol\ Fe}\right) = 0.602\ mol\ HCl$

$M = \frac{mol}{L} = \frac{.602\ mol}{.020L} = 30.1\ M\ HCl$

d) $1.20 \times 10^{25}\ mlcl\ H_2 \left(\frac{6\ mlcl\ HCl}{3\ mlcl\ H_2}\right)\left(\frac{1\ mol\ HCl}{6.02 \times 10^{23}\ mlcl}\right) = 39.9\ mol\ HCl$

$L = \frac{mol}{M} = \frac{39.9\ mol}{1.00M} = 39.9\ L\ HCl$

e) $mol = .120M(.025L) = 0.00300\ mol\ HCl$

$.003\ mol\ HCl \left(\frac{2\ mol\ FeCl_3}{6\ mol\ HCl}\right)\left(\frac{162.3g}{1\ mol\ FeCl_3}\right) = 0.162g\ FeCl_3$

f) $16.2g\ FeCl_3 \left(\frac{1\ mol\ FeCl_3}{162.3g}\right)\left(\frac{3\ mol\ H_2}{2\ mol\ FeCl_3}\right)\left(\frac{22.4L\ H_2}{1\ mol\ H_2}\right)$

$= 3.35\ L\ H_2$