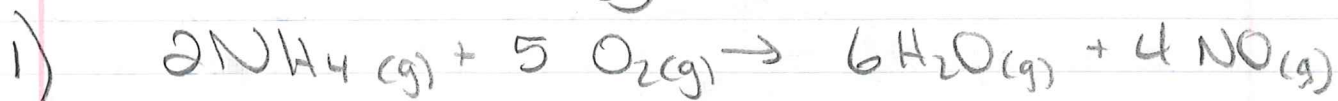


## Particles, Mass, Volume, Molarity = Energy Problems



a)  $112\text{L NH}_4 \left( \frac{1\text{mol}}{22.4\text{L}} \right) \left( \frac{6\text{mol H}_2\text{O}}{2\text{mol NH}_4} \right) \left( \frac{22.4\text{L}}{1\text{mol}} \right) = 336\text{L}$

or  $112\text{L NH}_4 \left( \frac{6\text{L H}_2\text{O}}{2\text{L NH}_4} \right) = 336\text{L H}_2\text{O}$

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)  $134\text{L H}_2\text{O} \left( \frac{2\text{L NH}_4}{6\text{L H}_2\text{O}} \right) = 44.7\text{L NH}_4$

d)  $1.20 \times 10^{24}\text{ mlcl NO} \left( \frac{5\text{ O}_2}{4\text{ mlcl NO}} \right) = 1.50 \times 10^{24}\text{ mlcl O}_2$

e)  $224\text{L O}_2 \left( \frac{4\text{L NO}}{5\text{L O}_2} \right) \left( \frac{1\text{mol NO}}{22.4\text{L}} \right) \left( \frac{30\text{g}}{1\text{mol}} \right) = 240.0\text{g NO}$

f)  $34.1\text{g NH}_4 \left( \frac{1\text{mol NH}_4}{18.0\text{g}} \right) \left( \frac{6\text{mol H}_2\text{O}}{2\text{mol NH}_4} \right) \left( \frac{6.02 \times 10^{23}\text{ mlcl}}{1\text{mol}} \right)$   
 $= 3.42 \times 10^{24}\text{ mlcl H}_2\text{O}$

g)  $6.02 \times 10^{24}\text{ mlcl NH}_4 \left( \frac{\text{mol}}{6.02 \times 10^{23}\text{ mlcl}} \right) \left( \frac{22.4\text{L}}{1\text{mol}} \right) = 448\text{L}$   
 $360.\text{g O}_2 \left( \frac{\text{mol}}{32.0\text{g}} \right) \left( \frac{22.4\text{L}}{5\text{mol O}_2} \right) = 202\text{L}$

1st is more.



$$a) \quad 5.60 \text{ L C}_3\text{H}_8 \left( \frac{5 \text{ L O}_2}{1 \text{ L C}_3\text{H}_8} \right) \left( \frac{1 \text{ mol}}{22.4 \text{ L}} \right) = 1.25 \text{ mol O}_2$$

$$b) \quad 0.800 \text{ mol C}_3\text{H}_8 \left( \frac{5 \text{ mol O}_2}{1 \text{ mol C}_3\text{H}_8} \right) \left( \frac{6.02 \times 10^{23} \text{ mcl}}{1 \text{ mol}} \right) = 2.41 \times 10^{24} \text{ mcl}$$

$$c) \quad 6.00 \text{ L C}_3\text{H}_8 \left( \frac{3 \text{ L CO}_2}{1 \text{ L C}_3\text{H}_8} \right) = 18.0 \text{ L CO}_2$$

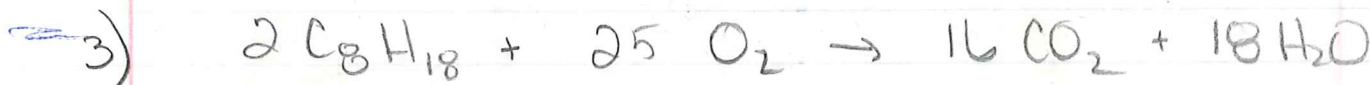
$$d) \quad 3.60 \times 10^{22} \text{ mcl H}_2\text{O} \left( \frac{5 \text{ mcl O}_2}{4 \text{ mcl H}_2\text{O}} \right) = 4.50 \times 10^{22} \text{ mcl O}_2$$

$$e) \quad 1.17 \times 10^3 \text{ kJ} \left( \frac{1 \text{ mol C}_3\text{H}_8}{2234 \text{ kJ}} \right) = 0.524 \text{ mol C}_3\text{H}_8$$

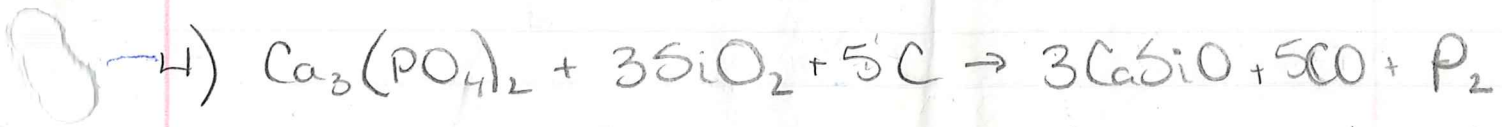
$$f) \quad 280.0 \text{ L O}_2 \left( \frac{2234 \text{ kJ}}{5 \text{ L O}_2} \right) = 1.251 \times 10^5 \text{ kJ}$$

$$g) \quad 4.92 \times 10^3 \text{ kJ} \left( \frac{1 \text{ mol C}_3\text{H}_8}{2234 \text{ kJ}} \right) \left( \frac{44.0 \text{ g}}{1 \text{ mol C}_3\text{H}_8} \right) = 96.9 \text{ g C}_3\text{H}_8$$

$$h) \quad 89.6 \text{ L} \left( \frac{1 \text{ mol}}{22.4 \text{ L}} \right) \left( \frac{3 \text{ mol CO}_2}{1 \text{ mol C}_3\text{H}_8} \right) \left( \frac{6.02 \times 10^{23} \text{ mcl}}{1 \text{ mol CO}_2} \right) = \frac{1.62 \times 10^{26} \text{ mcl}}{7.22 \times 10^{24} \text{ mcl}}$$



$$50.0 \text{ L} \left( \frac{6.6 \text{ mol C}_8\text{H}_{18}}{1 \text{ L}} \right) \left( \frac{16 \text{ mol CO}_2}{2 \text{ mol C}_8\text{H}_{18}} \right) \left( \frac{44.0 \text{ g}}{1 \text{ mol CO}_2} \right) = 1.16 \times 10^5 \text{ g} = 116 \text{ kg}$$



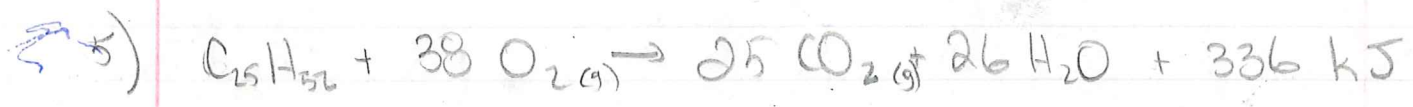
a)  $75 \text{ atoms C} \left( \frac{1 \text{ mol C}}{1 \text{ atom C}} \right) \left( \frac{1 \text{ mol P}}{5 \text{ mol C}} \right) \left( \frac{2 \text{ atom P}}{1 \text{ mol P}} \right) = 30 \text{ atoms P}$

b)  $186 \text{ g P} \left( \frac{1 \text{ mol}}{32.0 \text{ g}} \right) \left( \frac{5 \text{ mol C}}{1 \text{ mol P}} \right) = 15.0 \text{ mol C}$

c)  $224 \text{ L CO} \left( \frac{1 \text{ mol CO}}{22.4 \text{ L}} \right) \left( \frac{1 \text{ mol Ca}_3(\text{PO}_4)_2}{5 \text{ mol CO}} \right) \left( \frac{310.3 \text{ g}}{1 \text{ mol}} \right) = 621 \text{ g}$

d)  $3.00 \times 10^{25} \text{ atoms C} \left( \frac{1 \text{ mol C}}{1 \text{ atom C}} \right) \left( \frac{15.0 \text{ mol C}}{6.02 \times 10^{23} \text{ mol}^{-1}} \right) \left( \frac{3 \text{ mol CaSiO}}{5 \text{ mol C}} \right) \left( \frac{116.2 \text{ g}}{1 \text{ mol CaSiO}} \right) = 2520 \text{ g CaSiO}$

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



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)  $1.00 \text{ g C}_{25}\text{H}_{52} \left( \frac{1 \text{ mol C}_{25}\text{H}_{52}}{352.0 \text{ g}} \right) \left( \frac{38 \text{ mol O}_2}{1 \text{ mol C}_{25}\text{H}_{52}} \right) \left( \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} \right) = 2.42 \text{ L O}_2$

$$5a) 1.25 \text{ L } \text{O}_2 \left( \frac{25 \text{ L CO}_2}{38 \text{ L O}_2} \right) = 0.822 \text{ L CO}_2$$

$$b) 1.00 \text{ g C}_{25}\text{H}_{52} \left( \frac{1 \text{ mol C}_{25}\text{H}_{52}}{352.0 \text{ g}} \right) \left( \frac{38 \text{ L O}_2}{1 \text{ mol C}_{25}\text{H}_{52}} \right) \left( \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \right) = 4.82 \times 10^{-3} \text{ mol O}_2$$

$$c) 5.82 \text{ mol C}_{25}\text{H}_{52} \left( \frac{336 \text{ kJ}}{1 \text{ mol C}_{25}\text{H}_{52}} \right) = 1956 = 1960 \text{ kJ}$$

$$d) 67.2 \text{ kJ} \left( \frac{26 \text{ mol H}_2\text{O}}{336 \text{ kJ}} \right) \left( \frac{6.02 \times 10^{23} \text{ mL}}{1 \text{ mol H}_2\text{O}} \right) = 3.13 \times 10^{24} \text{ mL H}_2\text{O}$$

$$e) 15.0 \text{ g C}_{25}\text{H}_{52} \left( \frac{1 \text{ mol C}_{25}\text{H}_{52}}{352.0 \text{ g}} \right) \left( \frac{22.4 \text{ L C}_{25}\text{H}_{52}}{1 \text{ mol}} \right) = 0.955 \text{ L C}_{25}\text{H}_{52}$$

$$0.955 \text{ L C}_{25}\text{H}_{52} \left( \frac{25 \text{ L CO}_2}{1 \text{ L}} \right) = 23.9 \text{ L CO}_2$$

$$0.955 \text{ L C}_{25}\text{H}_{52} \left( \frac{26 \text{ L H}_2\text{O}}{1 \text{ L}} \right) = 24.8 \text{ L H}_2\text{O}$$

$$\text{Total} = 48.7 \text{ L}$$

$$f) 1.00 \text{ kJ} \left( \frac{1 \text{ mol C}_{25}\text{H}_{52}}{336 \text{ kJ}} \right) \left( \frac{352.0 \text{ g}}{1 \text{ mol}} \right) = 1.05 \text{ g C}_{25}\text{H}_{52}$$

6.

$$a) \text{ mol} = M \times L \\ = .5M(.05L) = 0.0250 \text{ mol HCl}$$

$$0.025 \text{ mol HCl} \left( \frac{2 \text{ mol Fe}}{6 \text{ mol HCl}} \right) \left( \frac{55.8 \text{ g}}{1 \text{ mol Fe}} \right) = 0.465 \text{ g Fe}$$

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

$$0.0600 \text{ mol HCl} \left( \frac{3 \text{ mol H}_2}{6 \text{ mol HCl}} \right) \left( \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} \right) = 0.672 \text{ L H}_2$$

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

$$M = \frac{\text{mol}}{L} = \frac{0.602 \text{ mol}}{0.020 \text{ L}} = 30.1 \text{ M HCl}$$

$$d) 1.20 \times 10^{25} \text{ mol H}_2 \left( \frac{6 \text{ mol HCl}}{3 \text{ mol H}_2} \right) \left( \frac{1 \text{ mol HCl}}{6.02 \times 10^{23} \text{ mol}} \right) = 39.9 \text{ mol HCl}$$

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

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

$$0.003 \text{ mol HCl} \left( \frac{2 \text{ mol FeCl}_3}{6 \text{ mol HCl}} \right) \left( \frac{162.3 \text{ g}}{1 \text{ mol FeCl}_3} \right) = 0.162 \text{ g FeCl}_3$$

$$f) 16.2 \text{ g FeCl}_3 \left( \frac{1 \text{ mol FeCl}_3}{162.3 \text{ g}} \right) \left( \frac{3 \text{ mol H}_2}{2 \text{ mol FeCl}_3} \right) \left( \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} \right)$$

$$= 3.35 \text{ L H}_2$$