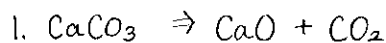
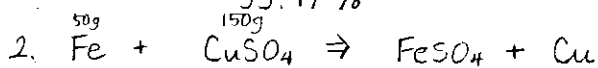


Sheet #7



b) $225 \text{ g CaCO}_3 \times \frac{1 \text{ mol CaCO}_3}{100.086 \text{ g CaCO}_3} \times \frac{1 \text{ mol CO}_2}{1 \text{ mol CaCO}_3} \times \frac{22.414 \text{ L CO}_2}{1 \text{ mol CO}_2} = 50.388 \text{ L CO}_2$

c) $\% \text{ yield} = \frac{\text{theoretical yield}}{\text{actual yield}} \times 100\%$
 $= \frac{50.388 \text{ L}}{28.2 \text{ L}} \times 100\%$
 $= 55.97\%$



consider Fe:

$50 \text{ g Fe} \times \frac{1 \text{ mol Fe}}{55.845 \text{ g Fe}} = 0.8953 \text{ mol Fe (available)}$

$0.8953 \text{ mol Fe} \times \frac{1 \text{ mol CuSO}_4}{1 \text{ mol Fe}} = 0.8953 \text{ mol CuSO}_4 \text{ (required)}$

consider CuSO_4 :

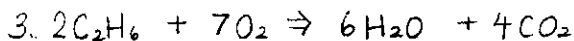
$150 \text{ g CuSO}_4 \times \frac{1 \text{ mol CuSO}_4}{159.608 \text{ g CuSO}_4} = 0.9398 \text{ mol CuSO}_4 \text{ (available)}$

$0.9398 \text{ mol CuSO}_4 \times \frac{1 \text{ mol Fe}}{1 \text{ mol CuSO}_4} = 0.9398 \text{ mol Fe (required)}$

\therefore Fe is the limiting reagent.

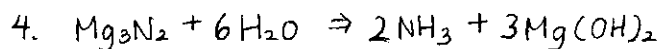
a) $0.8953 \text{ mol Fe} \times \frac{1 \text{ mol Cu}}{1 \text{ mol Fe}} \times \frac{63.546 \text{ g Cu}}{1 \text{ mol Cu}} = 56.893 \text{ g Cu}$

c) $\% \text{ yield} = \frac{43 \text{ g Cu}}{56.893 \text{ g Cu}} \times 100\%$
 $= 75.58\%$



$40 \text{ g C}_2\text{H}_6 \times \frac{1 \text{ mol C}_2\text{H}_6}{30.070 \text{ g C}_2\text{H}_6} \times \frac{6 \text{ mol H}_2\text{O}}{2 \text{ mol C}_2\text{H}_6} \times \frac{18.015 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 71.892 \text{ g H}_2\text{O}$

$\% \text{ yield} = \frac{60 \text{ g H}_2\text{O}}{71.892 \text{ g H}_2\text{O}} \times 100\%$
 $= 83.46\%$



consider Mg_3N_2 :

$50.0 \text{ g Mg}_3\text{N}_2 \times \frac{1 \text{ mol Mg}_3\text{N}_2}{100.929 \text{ g Mg}_3\text{N}_2} = 0.4954 \text{ mol Mg}_3\text{N}_2 \text{ (available)}$

$0.4954 \text{ mol Mg}_3\text{N}_2 \times \frac{6 \text{ mol H}_2\text{O}}{1 \text{ mol Mg}_3\text{N}_2} = 2.9724 \text{ mol H}_2\text{O (required)}$

consider H_2O :

$30.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.015 \text{ g H}_2\text{O}} = 1.6653 \text{ mol H}_2\text{O (available)}$

$1.6653 \text{ mol H}_2\text{O} \times \frac{1 \text{ mol Mg}_3\text{N}_2}{6 \text{ mol H}_2\text{O}} = 0.2776 \text{ mol Mg}_3\text{N}_2 \text{ (required)}$

\therefore H_2O is the limiting reagent.

$1.6653 \text{ mol H}_2\text{O} \times \frac{3 \text{ mol Mg(OH)}_2}{6 \text{ mol H}_2\text{O}} \times \frac{58.319 \text{ g Mg(OH)}_2}{1 \text{ mol Mg(OH)}_2} = 48.559 \text{ g Mg(OH)}_2$

$\% \text{ yield} = \frac{40 \text{ g Mg(OH)}_2}{48.559 \text{ g Mg(OH)}_2} \times 100\%$
 $= 82.37\%$

(continued on next page)

$$P = 98 \text{ kPa}$$

$$V = ? \text{ L}$$

$$n = 1.6653 \text{ mol H}_2\text{O} \times \frac{2 \text{ mol NH}_3}{6 \text{ mol H}_2\text{O}} = 0.5551 \text{ mol NH}_3$$

$$R = 8.314 \frac{\text{kPa}\cdot\text{L}}{\text{mol}\cdot\text{K}}$$

$$T = 25^\circ\text{C} + 273.15 = 298.15 \text{ K}$$

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

$$= \frac{0.5551 \text{ mol} \times 8.314 \frac{\text{kPa}\cdot\text{L}}{\text{mol}\cdot\text{K}} \times 298.15 \text{ K}}{98 \text{ kPa}}$$

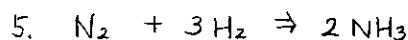
$$= 14.04 \text{ L}$$

(of NH_3)

if % yield was the same,

$$14.04 \text{ L NH}_3 \times 82.37\%$$

$$= 11.563 \text{ L NH}_3$$



consider N_2 :

$$10 \text{ L N}_2 \times \frac{1 \text{ mol N}_2}{22.414 \text{ L N}_2} = 0.4461 \text{ mol N}_2 \text{ (available)}$$

$$0.4461 \text{ mol N}_2 \times \frac{3 \text{ mol H}_2}{1 \text{ mol N}_2} = 1.3383 \text{ mol H}_2 \text{ (required)}$$

consider H_2 :

$$25 \text{ L H}_2 \times \frac{1 \text{ mol H}_2}{22.414 \text{ L H}_2} = 1.1154 \text{ mol H}_2 \text{ (available)}$$

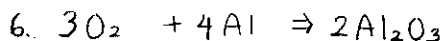
$$1.1154 \text{ mol H}_2 \times \frac{1 \text{ mol N}_2}{3 \text{ mol H}_2} = 0.3718 \text{ mol N}_2 \text{ (required)}$$

$\therefore \text{H}_2$ is the limiting reagent.

$$1.1154 \text{ mol H}_2 \times \frac{2 \text{ mol NH}_3}{3 \text{ mol H}_2} \times \frac{22.414 \text{ L NH}_3}{1 \text{ mol NH}_3} = 16.667 \text{ L NH}_3$$

$$\% \text{ yield} = \frac{15 \text{ L NH}_3}{16.667 \text{ L NH}_3} \times 100\%$$

$$= 89.998\%$$



consider O_2 :

$$5 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.414 \text{ L O}_2} = 0.2231 \text{ mol O}_2 \text{ (available)}$$

$$0.2231 \text{ mol O}_2 \times \frac{4 \text{ mol Al}}{3 \text{ mol O}_2} = 0.2975 \text{ mol Al} \text{ (required)}$$

consider Al

$$2 \text{ g Al} \times \frac{1 \text{ mol Al}}{26.982 \text{ g Al}} = 0.0741 \text{ mol Al} \text{ (available)}$$

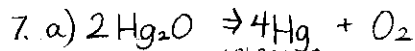
$$0.0741 \text{ mol Al} \times \frac{3 \text{ mol O}_2}{4 \text{ mol Al}} = 0.0556 \text{ mol O}_2 \text{ (required)}$$

$\therefore \text{Al}$ is the limiting reagent

$$0.0741 \text{ mol Al} \times \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} \times \frac{101.961 \text{ g Al}_2\text{O}_3}{1 \text{ mol Al}_2\text{O}_3} = 3.778 \text{ g Al}_2\text{O}_3$$

$$\% \text{ yield} = \frac{2.95 \text{ g Al}_2\text{O}_3}{3.778 \text{ g Al}_2\text{O}_3} \times 100\%$$

$$= 78.08\%$$



$$P = 1 \text{ atm.} \times \frac{101.325 \text{ kPa}}{1 \text{ atm.}} = 101.325 \text{ kPa}$$

$$V = ? \text{ L}$$

$$n = 500 \text{ g Hg}_2\text{O} \times \frac{1 \text{ mol Hg}_2\text{O}}{417.179 \text{ g Hg}_2\text{O}} \times \frac{1 \text{ mol O}_2}{2 \text{ mol Hg}_2\text{O}} = 0.5993 \text{ mol O}_2$$

$$R = 8.314 \frac{\text{kPa} \cdot \text{L}}{\text{mol} \cdot \text{K}}$$

$$T = 185^\circ\text{C} + 273.15 = 458.15 \text{ K}$$

$$V = \frac{0.5993 \text{ mol O}_2 \times 8.314 \frac{\text{kPa} \cdot \text{L}}{\text{mol} \cdot \text{K}} \times 458.15 \text{ K}}{101.325 \text{ kPa}}$$

$$= 22.529 \text{ L O}_2$$

$$\% \text{ yield} = \frac{6.95 \text{ L O}_2}{22.529 \text{ L O}_2} \times 100\%$$

$$= 30.849 \%$$

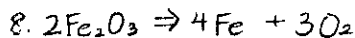
$$\text{b) } 500 \text{ g Hg}_2\text{O} \times \frac{1 \text{ mol Hg}_2\text{O}}{417.179 \text{ g Hg}_2\text{O}} \times \frac{4 \text{ mol Hg}}{2 \text{ mol Hg}_2\text{O}} \times \frac{200.59 \text{ g Hg}}{1 \text{ mol Hg}} = 480.825 \text{ g Hg}$$

c) if % yield was the same,

$$480.825 \text{ g Hg} \times 30.849 \%$$

$$= 148.3297 \text{ g Hg}$$

d) The mass in b) would be closer to the experimental observations because gas is harder to recover than liquids or solids in a reaction.



$$12200 \text{ t iron ore} \times \frac{56.1 \text{ t Fe}_2\text{O}_3}{100 \text{ t iron ore}} \times \frac{85.5 \text{ t Fe}_2\text{O}_3}{100 \text{ t Fe}_2\text{O}_3} \times \frac{1000000 \text{ g Fe}_2\text{O}_3}{1 \text{ t Fe}_2\text{O}_3} \times \frac{1 \text{ mol Fe}_2\text{O}_3}{159.687 \text{ g Fe}_2\text{O}_3} \times \frac{4 \text{ mol Fe}}{2 \text{ mol Fe}_2\text{O}_3} \times \frac{55.845 \text{ g Fe}}{1 \text{ mol Fe}} \times \frac{1 \text{ t Fe}}{1000000 \text{ g Fe}} = 4092.923 \text{ t Fe}$$