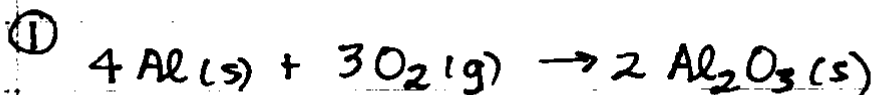
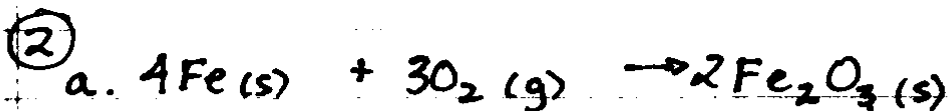


"Problem Set" 3.5 - Stoichiometry



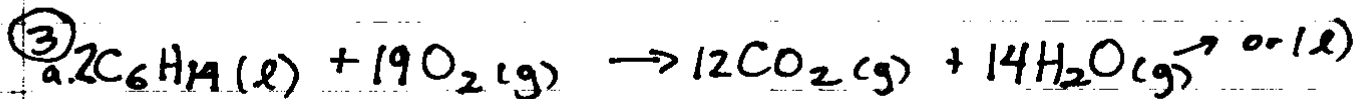
$6.0 \text{ mol Al} \left( \frac{3 \text{ mol O}_2}{4 \text{ mol Al}} \right) = 4.5 \text{ mol O}_2 \text{ needed}$

$6.0 \text{ mol Al} \left( \frac{2 \text{ mol Al}_2\text{O}_3}{4 \text{ mol Al}} \right) \left( \frac{101.9612 \text{ g}}{1 \text{ mol Al}_2\text{O}_3} \right) = 3.1 \times 10^2 \text{ g Al}_2\text{O}_3$



b.  $2.68 \text{ g Fe} \left( \frac{1 \text{ mol Fe}}{55.847 \text{ g}} \right) \left( \frac{2 \text{ mol Fe}_2\text{O}_3}{4 \text{ mol Fe}} \right) \left( \frac{159.6922 \text{ g}}{1 \text{ mol Fe}_2\text{O}_3} \right) = 3.83 \text{ g Fe}_2\text{O}_3$

c.  $2.68 \text{ g Fe} \left( \frac{1 \text{ mol Fe}}{55.847 \text{ g}} \right) \left( \frac{3 \text{ mol O}_2}{4 \text{ mol Fe}} \right) \left( \frac{31.9988 \text{ g}}{1 \text{ mol O}_2} \right) = 1.15 \text{ g O}_2$



b. Find the limiting reactant:

max. mass  $\text{CO}_2$  from  $\text{C}_6\text{H}_{14} = 215 \text{ g} \left( \frac{1 \text{ mol C}_6\text{H}_{14}}{86.178 \text{ g}} \right) \left( \frac{12 \text{ mol CO}_2}{2 \text{ mol C}_6\text{H}_{14}} \right) \left( \frac{44.010 \text{ g}}{1 \text{ mol CO}_2} \right) = 658.8 \text{ g CO}_2$

max. mass  $\text{CO}_2$  from  $\text{O}_2 = 215 \text{ g} \left( \frac{1 \text{ mol O}_2}{31.9988 \text{ g}} \right) \left( \frac{12 \text{ mol CO}_2}{19 \text{ mol O}_2} \right) \left( \frac{44.010 \text{ g}}{1 \text{ mol CO}_2} \right) = 186.8 \text{ g CO}_2$

$\text{O}_2$  is limiting. 187 g of  $\text{CO}_2$  can be formed.

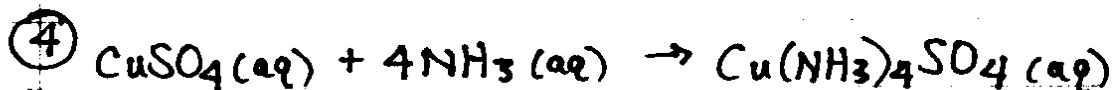
max. mass  $\text{H}_2\text{O} = 215 \text{ g O}_2 \left( \frac{1 \text{ mol O}_2}{31.9988 \text{ g}} \right) \left( \frac{14 \text{ mol H}_2\text{O}}{19 \text{ mol O}_2} \right) \left( \frac{18.015 \text{ g}}{1 \text{ mol H}_2\text{O}} \right) = 89.2 \text{ g H}_2\text{O}$

③ cont.

c)  $C_6H_{14}$  is in excess. Amount left over = Initial mass - Mass used

$$\text{mass } C_6H_{14} \text{ used} = 215 \text{ g } O_2 \left( \frac{1 \text{ mol } O_2}{31.9988 \text{ g}} \right) \left( \frac{2 \text{ mol } C_6H_{14}}{19 \text{ mol } O_2} \right) \left( \frac{86.178 \text{ g}}{1 \text{ mol } C_6H_{14}} \right) = 60.95 \text{ g}$$

$$215 \text{ g initially} - 60.95 \text{ g used} = \boxed{154 \text{ g } C_6H_{14} \text{ left over}}$$

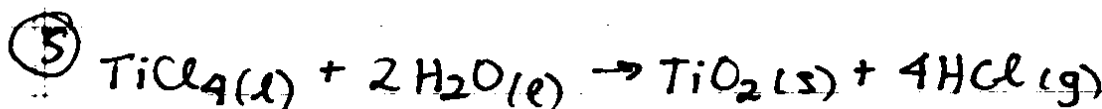


a) Note: You are told that  $CuSO_4$  is the limiting reactant.

$$10.0 \text{ g } CuSO_4 \left( \frac{1 \text{ mol } CuSO_4}{159.6096 \text{ g}} \right) \left( \frac{1 \text{ mol } Cu(NH_3)_4SO_4}{1 \text{ mol } CuSO_4} \right) \left( \frac{227.734 \text{ g}}{1 \text{ mol}} \right)$$

$$= \boxed{14.3 \text{ g } Cu(NH_3)_4SO_4}$$

$$b) \% \text{ Yield} = \frac{12.6 \text{ g actually made}}{14.3 \text{ g theoretically}} \times 100\% = \boxed{88.1\%}$$



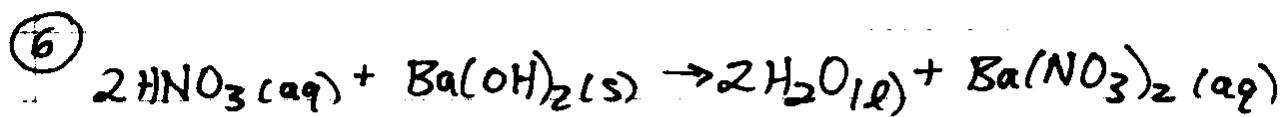
a) titanium (IV) chloride; water; titanium (IV) oxide; hydrogen chloride or hydrochloric acid

$$b) 14.0 \text{ mL } TiCl_4 \left( \frac{1.73 \text{ g}}{1 \text{ mL } TiCl_4} \right) \left( \frac{1 \text{ mol } TiCl_4}{189.692 \text{ g}} \right) \left( \frac{2 \text{ mol } H_2O}{1 \text{ mol } TiCl_4} \right) \left( \frac{18.015 \text{ g}}{1 \text{ mol } H_2O} \right)$$

From 1st 2 steps in (b) =  $\boxed{4.60 \text{ g } H_2O}$

$$c) 0.12768 \text{ mol } TiCl_4 \left( \frac{1 \text{ mol } TiO_2}{1 \text{ mol } TiCl_4} \right) \left( \frac{79.8788 \text{ g}}{1 \text{ mol } TiO_2} \right) = \boxed{10.2 \text{ g } TiO_2}$$

$$0.12768 \text{ mol } TiCl_4 \left( \frac{4 \text{ mol } HCl}{1 \text{ mol } TiCl_4} \right) \left( \frac{36.461 \text{ g}}{1 \text{ mol } HCl} \right) = \boxed{18.6 \text{ g } HCl}$$



1. Find moles of  $\text{HNO}_3$  required; then, use concentration to find volume of  $\text{HNO}_3$ .

$$\text{moles}_{\text{HNO}_3} = 2.50 \text{ g Ba}(\text{OH})_2 \left( \frac{1 \text{ mol Ba}(\text{OH})_2}{171.3448 \text{ g}} \right) \left( \frac{2 \text{ mol HNO}_3}{1 \text{ mol Ba}(\text{OH})_2} \right) = 0.02918 \text{ mol HNO}_3$$

$$\text{Molarity} = \frac{\text{moles HNO}_3}{V \text{ in liters}}$$

$$V = \frac{\text{moles}}{\text{molarity}} = \frac{0.02918 \text{ mol}}{0.109 \text{ mol/L}} = 0.268 \text{ L}$$

$$0.268 \text{ L} \left( \frac{1000 \text{ mL}}{1 \text{ L}} \right) = \boxed{268 \text{ mL of HNO}_3}$$