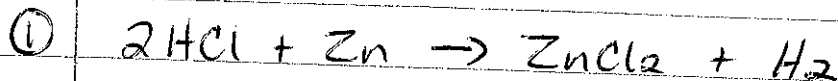


# Limiting Reagent Problems

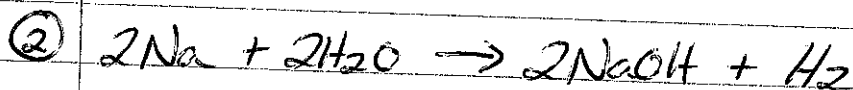


$$50\text{g HCl} \times \frac{1\text{mol}}{36.5\text{g}} = \boxed{1.37\text{ mol HCl}} \quad \text{Have} \quad \times \frac{1\text{mol Zn}}{2\text{mol HCl}} = \boxed{0.685\text{ mol Zn}} \quad \text{Need}$$

$$50\text{g Zn} \times \frac{1\text{mol}}{65.4\text{g}} = \boxed{0.76\text{ mol Zn}} \quad \therefore \text{Zn} = \text{excess, HCl is L.R.}$$

$$1.37\text{ mol HCl} \times \frac{1\text{mol ZnCl}_2}{2\text{mol HCl}} = 0.685\text{ mol ZnCl}_2 \times \frac{136.4\text{g}}{1\text{mol}} = \boxed{93.43\text{g ZnCl}_2}$$

$$\times \frac{1\text{mol H}_2}{2\text{mol HCl}} = 0.685\text{ mol H}_2 \times \frac{22.4\text{L}}{1\text{mol}} = \boxed{15.34\text{ L H}_2}$$



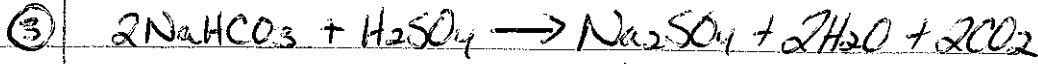
$$35\text{g Na} \times \frac{1\text{mol}}{23\text{g}} = \boxed{1.52\text{ mol Na}} \quad \text{Have} \quad \times \frac{2\text{mol H}_2\text{O}}{2\text{mol Na}} = \boxed{1.52\text{ mol H}_2\text{O}} \quad \text{Need}$$

$$35\text{g H}_2\text{O} \times \frac{1\text{mol}}{18.02\text{g}} = \boxed{1.9\text{ mol H}_2\text{O}} \quad \therefore \text{H}_2\text{O} = \text{excess, Na} = \text{L.R.}$$

$$1.52\text{ mol Na} \times \frac{2\text{mol NaOH}}{2\text{mol Na}} = 1.52\text{ mol NaOH} \times \frac{40.01\text{g}}{1\text{mol}} = \boxed{60.8\text{g NaOH}}$$

$$\times \frac{1\text{mol H}_2}{2\text{mol Na}} = 0.76\text{ mol H}_2 \times \frac{22.4\text{L}}{1\text{mol}} = \boxed{17.02\text{ L H}_2}$$

②



HAVE

$$40\text{g NaHCO}_3 \times \frac{1\text{mol}}{84.01\text{g}} = 0.48\text{mol NaHCO}_3$$

$$6\text{g H}_2\text{SO}_4 \times \frac{1\text{mol}}{98.12\text{g}} = 0.06\text{mol H}_2\text{SO}_4$$

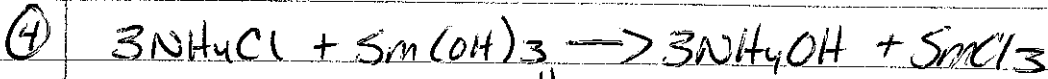
NEED

$$0.48\text{mol NaHCO}_3 \times \frac{1\text{mol H}_2\text{SO}_4}{2\text{mol NaHCO}_3} = 0.24\text{mol H}_2\text{SO}_4$$

$\therefore \text{H}_2\text{SO}_4$  is L.R.

$$0.06\text{mol H}_2\text{SO}_4 \times \frac{2\text{mol CO}_2}{1\text{mol H}_2\text{SO}_4} = 0.12\text{mol CO}_2 \times \frac{22.4\text{L}}{1\text{mol}} = 2.69\text{L CO}_2$$

$$\times \frac{2\text{mol H}_2\text{O}}{1\text{mol H}_2\text{SO}_4} = 0.12\text{mol H}_2\text{O} \times \frac{18.02\text{g}}{1\text{mol}} = 2.16\text{g H}_2\text{O}$$



HAVE

$$100\text{g NH}_4\text{Cl} \times \frac{1\text{mol}}{53.5\text{g}} = 1.87\text{mol NH}_4\text{Cl}$$

$$50\text{g Sm}(\text{OH})_3 \times \frac{1\text{mol}}{201.43\text{g}} = 0.25\text{mol Sm}(\text{OH})_3$$

NEED

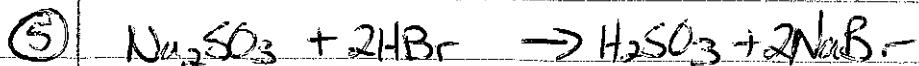
$$1.87\text{mol NH}_4\text{Cl} \times \frac{1\text{mol Sm}(\text{OH})_3}{3\text{mol NH}_4\text{Cl}} = 0.623\text{mol Sm}(\text{OH})_3$$

$\therefore \text{Sm}(\text{OH})_3$  = L.R.

$$0.25\text{mol Sm}(\text{OH})_3 \times \frac{3\text{mol NH}_4\text{OH}}{1\text{mol Sm}(\text{OH})_3} = 0.75\text{mol NH}_4\text{OH} \times \frac{35.05\text{g}}{1\text{mol}} = 26.29\text{g}$$

$$\times \frac{1\text{mol SmCl}_3}{1\text{mol Sm}(\text{OH})_3} = 0.25\text{mol SmCl}_3 \times \frac{256.6\text{g}}{1\text{mol}} = 64.15\text{g}$$

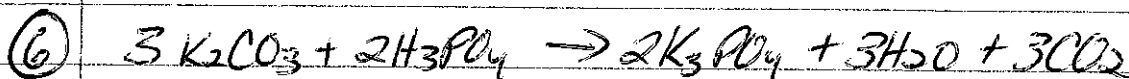
3



$75.0\text{g Na}_2\text{SO}_3 \times \frac{1\text{mol}}{126.1\text{g}}$	Have 0.6 mol Na <sub>2</sub> SO <sub>3</sub>	x	$\frac{2\text{mol HBr}}{1\text{mol Na}_2\text{SO}_3}$	Need 1.2 mol HBr
$80.0\text{g HBr} \times \frac{1\text{mol}}{80.9\text{g}}$	0.99 mol HBr			∴ HBr = L.R.

$$0.99 \text{ mol HBr} \times \frac{1 \text{ mol H}_2\text{SO}_3}{2 \text{ mol HBr}} = 0.5 \text{ mol H}_2\text{SO}_3 \times \frac{82.12 \text{ g}}{1 \text{ mol}} = \boxed{41.06 \text{ g H}_2\text{SO}_3}$$

$$\times \frac{2 \text{ mol NaBr}}{2 \text{ mol HBr}} = 0.99 \text{ mol NaBr} \times \frac{102.9 \text{ g}}{1 \text{ mol}} = \boxed{101.7 \text{ g NaBr}}$$



$35\text{g K}_2\text{CO}_3 \times \frac{1\text{mol}}{138.2\text{g}}$	Have 0.25 mol K <sub>2</sub> CO <sub>3</sub>	x	$\frac{2\text{mol H}_3\text{PO}_4}{3\text{mol K}_2\text{CO}_3}$	Need 0.17 mol H <sub>3</sub> PO <sub>4</sub>
$11.5\text{g H}_3\text{PO}_4 \times \frac{1\text{mol}}{98.03\text{g}}$	0.12 mol H <sub>3</sub> PO <sub>4</sub>			∴ H <sub>3</sub> PO <sub>4</sub> = L.R.

$$0.12 \text{ mol H}_3\text{PO}_4 \times \frac{3 \text{ mol CO}_2}{2 \text{ mol H}_3\text{PO}_4} = 0.18 \text{ mol CO}_2 \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{4.03 \text{ L CO}_2}$$

$$\times \frac{3 \text{ mol H}_2\text{O}}{2 \text{ mol H}_3\text{PO}_4} = 0.18 \text{ mol H}_2\text{O} \times \frac{18.02 \text{ g}}{1 \text{ mol}} = \boxed{3.24 \text{ g H}_2\text{O}}$$

(4)



$$45\text{g FeS} \times \frac{1\text{mol}}{87.09\text{g}} = 0.51\text{mol FeS} \quad \text{Have}$$

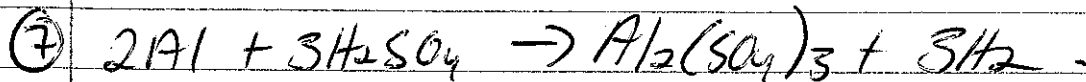
$$30\text{g HCl} \times \frac{1\text{mol}}{36.51\text{g}} = 0.82\text{mol HCl}$$

$$0.51\text{mol FeS} \times \frac{2\text{mol HCl}}{1\text{mol FeS}} = 1.02\text{mol HCl} \quad \text{Need}$$

$\therefore \text{HCl}$  is L.R.

$$0.82\text{mol HCl} \times \frac{1\text{mol FeCl}_2}{2\text{mol HCl}} = 0.41\text{mol FeCl}_2 \times \frac{126.8\text{g}}{1\text{mol}} = 51.99\text{g}$$

$$\times \frac{1\text{mol H}_2\text{S}}{2\text{mol HCl}} = 0.41\text{mol FeCl}_2 \times \frac{34.12\text{g}}{1\text{mol}} = 13.99\text{g}$$



$$5.0\text{g Al} \times \frac{1\text{mol}}{27\text{g}} = 0.185\text{mol Al} \quad \text{Have}$$

$$4.0\text{g H}_2\text{SO}_4 \times \frac{1\text{mol}}{98.12\text{g}} = 0.04\text{mol H}_2\text{SO}_4$$

$$0.185\text{mol Al} \times \frac{3\text{mol H}_2\text{SO}_4}{2\text{mol Al}} = 0.2775\text{mol H}_2\text{SO}_4 \quad \text{Need}$$

$\therefore \text{H}_2\text{SO}_4$  is L.R.

$$0.04\text{mol H}_2\text{SO}_4 \times \frac{1\text{mol Al}_2(\text{SO}_4)_3}{3\text{mol H}_2\text{SO}_4} = 0.013\text{mol Al}_2(\text{SO}_4)_3 \times \frac{342.3\text{g}}{1\text{mol}} = 4.45\text{g}$$

$$\times \frac{3\text{mol H}_2}{3\text{mol H}_2\text{SO}_4} = 0.04\text{mol H}_2 \times \frac{22.4\text{L}}{1\text{mol}} = 0.9\text{L}$$