Lezione 5

$$Fe_2(SO_4)_3 = ? \qquad 53.4\,g \quad Fe(OA)_3 \quad e \quad 0.186\,L \quad H_2SO_4 \quad d = 1.80\,g/mL \quad 98\% \, \frac{m}{m}$$

$$2\,Fe(OA)_3 + 3\,H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 6\,H_2O \qquad r$$

$$mol\ Fe(OA)_3 = \frac{53.4\,g}{106.9\,g/mol} = 0.500\,mol\ Fe(OA)_3$$

$$mol\ H_2SO_4 = \left(186\,mL \cdot 1.80\,g/mL\right) \cdot 0.98 = 328.1\,g \quad H_2SO_4$$

$$mol\ H_2SO_4 = \frac{328.1\,g}{98.0\,g/mol} = 3.348\,mol\ H_2SO_4$$

LIMITANTE è $Fe(OA)_3$

$$2:3 = 0.500\,mol : x_{H_2SO_4}$$

$$0.500 \cdot 3/2 = \underline{0.750\,mol} \qquad V$$
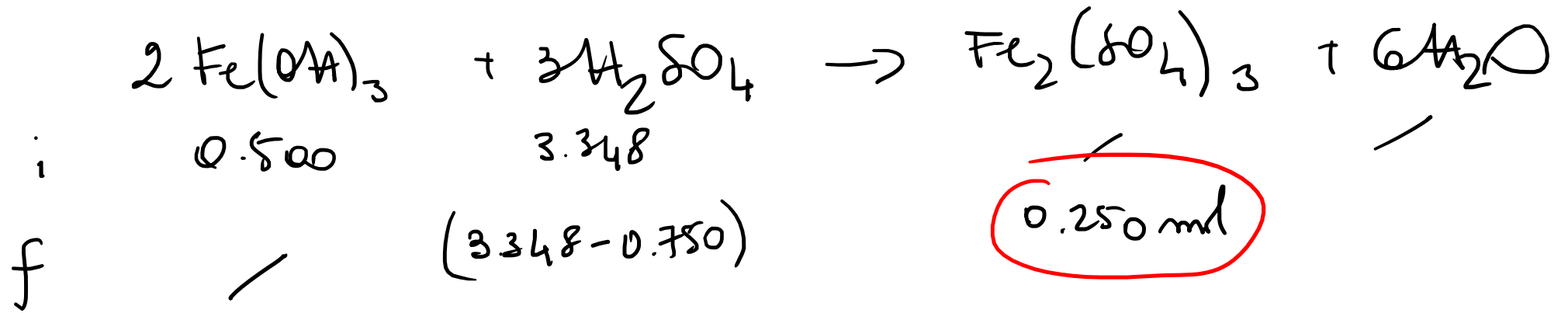
$$3:2 = 3.348\,mol : x_{Fe(OA)_3}$$

ECCESSO è H_2SO_4

①

$$2\ Fe(OH)_3 \quad + \quad 3H_2SO_4 \quad \rightarrow \quad Fe_2(SO_4)_3 \quad + \quad 6H_2O$$

i: $\quad\quad 0.500 \quad\quad\quad\quad 3.348$

f: $\quad\quad\quad\quad\quad\quad (3.348 - 0.750) \quad\quad\quad \boxed{0.250\ mol}$

$$2:1 = 0.500\ mol : X_{Fe_2(SO_4)_3} \quad\Rightarrow\quad mol\ Fe_2(SO_4)_3 = 0.250\ mol$$

$$m_{Fe_2(SO_4)_3} = 0.250\ mol \cdot 399.9\ g/mol = \boxed{100\ g\ Fe_2(SO_4)_3}$$

②

EX2

$$5.40g \quad \xrightarrow[\Delta]{O_2} \quad 1.80g \; H_2O \; + \; V = 1010 mL \qquad P = 5540.4 \; mmHg$$

$$C_1H_1O \qquad\qquad\qquad\qquad CO_2 \qquad\qquad T = 23°C + 273\;N = 296 K$$

Formule minima = ?
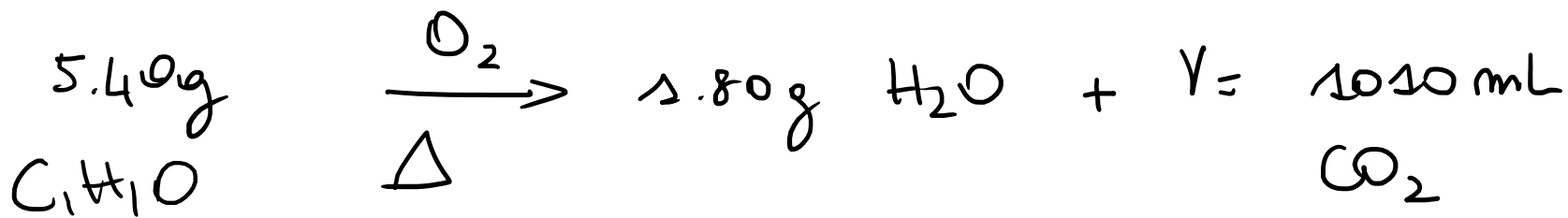
$$pV = nRT$$

$$R = 0.0821 \; \frac{atm L}{mol \; K}$$

$$n = \frac{pV}{Rt} = \frac{7.29 \; atm \cdot 1.010 L}{0.0821 \frac{atm L}{mol K} \cdot 296 K}$$

$$1 atm = 760 \; mmHg$$

$$P = \frac{5540.4 \; mmHg}{760 \; mmHg} = 7.29 atm$$

$$\boxed{\begin{array}{l} n = 0.303 \; mol \; CO_2 = mol \; C \\[2mm] m_C = 0.303 \; mol \; C \cdot 12.0 g/mol = 3.63 \; g \; C \end{array}}$$

$$mol \; H = 2 \cdot mol \; H_2O = \frac{1.80 g}{18.0 \, g/mol} = 0.100 \, mol \cdot 2 = \boxed{0.200 \; mol \; H}$$

$$\downarrow \cdot 1.0 \, g/mol$$

$$\boxed{0.202 \; g \; H}$$

③

$m_C = 3.63 \text{ g}$

$m_H = 0.202 \text{ g}$

$\text{mol O} = \dfrac{1.57 \text{ g}}{16.0 \text{ g/mol}} = $ ⭕ 0.098 mol O

$5.40 \text{ g} - 3.63 \text{ g} - 0.202 \text{ g} = 1.57 \text{ g of O}$

$\underset{C}{\uparrow} \qquad \underset{H}{\uparrow} \qquad \underset{O}{\uparrow}$

$\text{mol H} = 0.200 \text{ mol}$

$\text{mol C} = 0.303 \text{ mol}$

$O = 1$

$C \sim 3$

$H \sim 2$

$C_3 H_2 O$

Formula minima.

④

EX3

B_2H_6

$$3\,NaBH_4 + 4\,BF_3 \longrightarrow 2\,B_2H_6 + 3\,NaBF_4$$

Rese = 75%.
B_2H_6

$NaBH_4 = ?$

$25\,g\ B_2H_6$

$$\text{mol di } B_2H_6 = \frac{25.0\,g}{27.6\,g/mol} = 0.906\,mol \text{ EFFETTIVE}$$

$$Rese = \frac{eff}{Teor.} \cdot 100$$

$$\text{mol Teoriche} = \frac{0.906\,mol}{0.75} = 1.21\,mol \text{ TEORICHE}$$

$$2 : 3 = 1.21\,mol : X_{mol}\ NaBH_4 \qquad \Rightarrow \text{mol } NaBH_4 = \left(1.21 \cdot 3/2\right) mol$$
$$= 1.81\,mol$$

$$\boxed{m\ NaBH_4} = 1.81\,mol \cdot 37.8\,g/mol = \boxed{68.4\,g}$$

⑤

EX4

$g = ?$ H_2SO_4 5% m/m m_1
$g = ?$ H_2SO_4 30% m/m m_2 $\Bigg\}$ $\longrightarrow$ $10g$ soluzione 20% m/m H_2SO_4

$$\begin{cases} 10g = m_1 + m_2 \\ \\ m_1 \cdot 0.05 + m_2 \cdot 0.30 = 10g \cdot 0.20 \end{cases}$$

$m_1 = 10 - m_2$

$(10 - m_2) \cdot 0.05 + m_2 \cdot 0.30 = 10g \cdot 0.20$

$\boxed{m_2 = 6g}$ $\boxed{m_1 = 4g}$

⑥

EX5

$$Sm-Pb + HNO_3 \longrightarrow \left[\begin{array}{c} \sim Pb \sim \\ Sm \end{array}\right] + H_2SO_4 \longrightarrow PbSO_4 \quad 5.13\,g$$
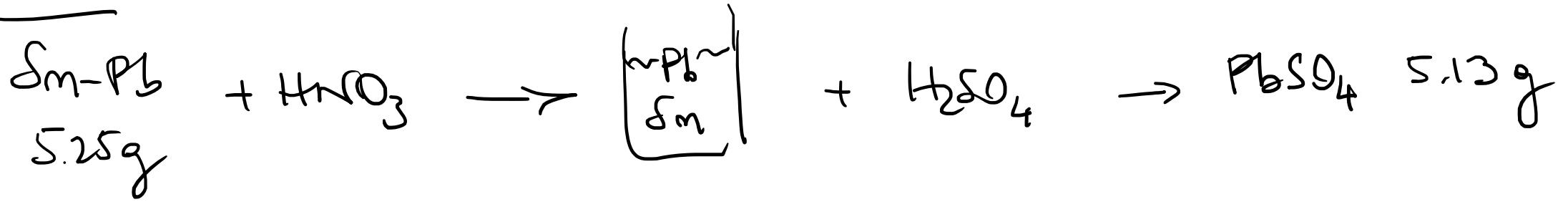
5.25 g

Calcolare la composizione % sulla lega.

$$n\,PbSO_4 = \frac{5.13\,g}{303\,g/mol} = 0.0169\,mol\ PbSO_4 = mol\ Pb \cdot 207\,g/mol = 3.50\,g\ Pb$$

$$\%\ Pb = \frac{3.50\,g}{5.25\,g} \cdot 100 = 66.7\,\%$$

$$\%\ Sm = 33.3\,\%$$

Composizione della lega

Ex6

10g

$$Al, Mg, Cu \xrightarrow{NaOH} Al_{soluzione} + soluto\ 2.41g\ (Mg, Cu) \xrightarrow{HCl} Mg_{soluzione} + soluto\ 0.78\ g\ (Cu)$$

Composizione?

$$Al\ Mg\ Cu \qquad Mg, Cu$$

i) $10g - 2.41g = 7.59g\ Al$

ii) $2.41\ g - 0.78\ g = 1.63g\ Mg$

$Mg\ Cu \qquad\qquad Cu$

$\%\ Al = \dfrac{7.59g}{10g} \cdot 100 = 75.9\%$

$\%\ Mg = \dfrac{1.63g}{10.0\ g} \cdot 100 = 16.3\%$

$\%\ Cu = \dfrac{0.78}{10.0} \cdot 100 = 7.8\%$

EX7

$$1.5 \text{ g } Na_2CO_3 + K_2CO_3 \longrightarrow 1.217 \text{ g } CaCO_3$$

$$\underset{x}{} \quad \underset{y}{} \quad \underset{CaCl_2}{}$$
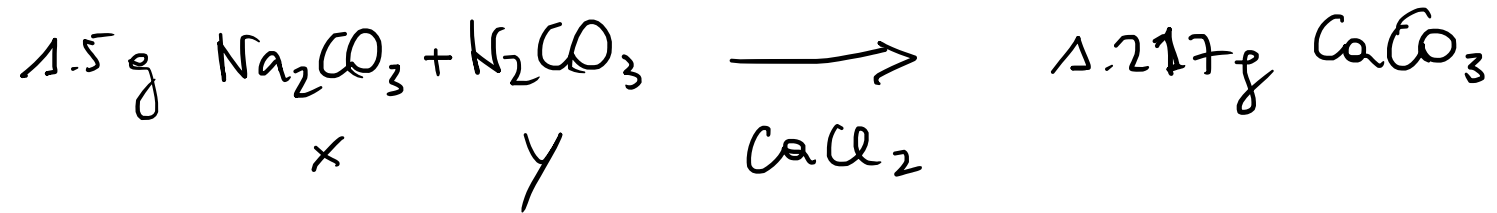
Composizione
della miscela

$$\begin{cases} x + y = 1.5 \text{ g} \\[2em] \dfrac{x}{106 \text{ g/mol}} + \dfrac{y}{138.2 \text{ g/mol}} = \dfrac{1.217 \text{ g}}{100 \text{ g/mol}} \end{cases}$$
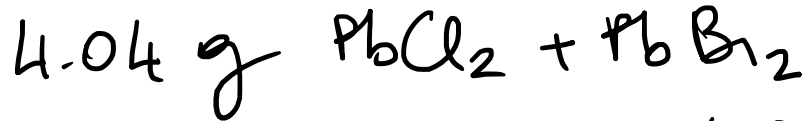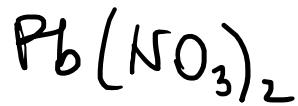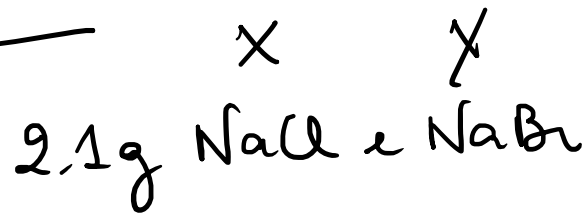
$MM_{Na_2CO_3} = 106 \text{ g/mol}$

$MM_{K_2CO_3} = 138.2 \text{ g/mol}$

$MM_{CaCO_3} = 100 \text{ g/mol}$

$$\boxed{x = 0.6 \text{ g} \qquad y = 0.9 \text{ g}}$$

9

EX 8

$$x \qquad y$$

$2.1 g$ NaCl e NaBr $\longrightarrow$ $4.04 g$ $PbCl_2 + PbBr_2$

$Pb(NO_3)_2$

Composizione miscela iniziale.

$2 NaCl + Pb(NO_3)_2 \rightarrow PbCl_2 + 2 NaNO_3$

$2 NaBr + Pb(NO_3)_2 \rightarrow PbBr_2 + 2 NaNO_3$

$$\boxed{x + y = 2.1 g}$$

$$m_{PbCl_2} + m_{PbBr_2} = 4.04 g$$

$$\Rightarrow \quad \underbrace{\frac{x}{58.5 \, g/mol \cdot 2} \cdot 278.1 \, g/mol}_{m \, PbCl_2} + \underbrace{\frac{y}{102.9 \, g/mol \cdot 2} \cdot 367 \, g/mol}_{m \, PbBr_2} = 4.04 g \Longrightarrow$$

$$x = 0.5 g$$
$$y = 1.6 g$$

(10)

EX 9

$0.640 g \ SO_3$

$SO_3 + 2NaOH \longrightarrow Na_2SO_4 + H_2O$

$NaOH \ 30\% \ \dfrac{m}{m}$

$: 0.008 \qquad 1.6 \cdot 10^{-2}$

$d = 1.2 \ g/mL$

$f \qquad \diagup \qquad \diagup$

$V = ?$

$mol \ SO_3 = \dfrac{0.640 g}{80.0 \ g/mol} = 0.008 \ mol$

$1 : 2 = 0.008 : mol \ NaOH$

$mol \ NaOH \ pure = 1.6 \cdot 10^{-2} mol \cdot 40.0 \ g/mol = 0.640 g \ NaOH \ pure$

$m \ NaOH = \dfrac{0.640 \ g}{0.30} = 2.132 g \ sol \ NaOH \ 30\%$

$V = \dfrac{2.132 g}{1.2 \ g/mL} = 1.777 mL$

M

EX 10

g HNO_3 20 % m/m   NCl + HNO_3 → KNO_3 + HCl   Resa 92.8 %
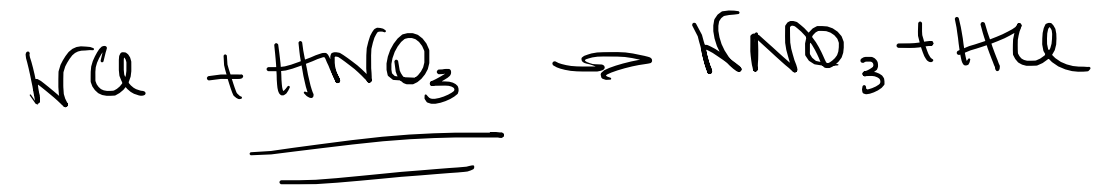
45 g KNO₃

$$mol\ HNO_3 = \frac{45.0\ g}{101\ g/mol} = 0.446\ mol\ effettive$$

$Resa = \frac{eff}{teor}$

$$mol\ TEORICHE = \frac{0.446\ mol}{0.928} = 0.480\ mol\ TEORICHE\ KNO_3 = 0.480\ mol\ HNO_3\ PURO$$

$$m\ HNO_3\ PURO = 0.480\ mol \cdot 63.0\ g/mol = 30.2\ g\ HNO_3\ PURO$$

$$m\ HNO_3\ al\ 20\% = \frac{30.2\ g}{0.20} = 151\ g\ HNO_3\ 20\%$$

(12)