

1

$w_T(C_5H_{12}) = \%44$ $P_{C_5}^{\circ} = 1291,98 \text{ mbar}$
 $w_T(C_6H_{14}) = \%56$ $P_{C_6}^{\circ} = 430,57 \text{ mbar}$
 $T = 320 \text{ K}$

a) $P_{C_5} = Y_{C_5} \cdot P$ $Y_{C_5} = \frac{P_{C_5}}{P} = \frac{P_{C_5}^{\circ} \cdot X_{C_5}}{P}$
 $Y_{C_5} + Y_{C_6} = 1 \rightarrow \frac{P_{C_5}^{\circ} X_{C_5}}{P} + \frac{P_{C_6}^{\circ} X_{C_6}}{P} = 1$
 $P = P_{C_5}^{\circ} \cdot X_{C_5} + P_{C_6}^{\circ} \cdot X_{C_6}$

$100 \text{ g} \left| \begin{array}{l} 44 \text{ g } C_5H_{12} \rightarrow n = \frac{g}{PM} = 0,61 \text{ mol} \\ 56 \text{ g } C_6H_{14} \rightarrow n = 0,65 \text{ mol} \end{array} \right. \quad X_{C_5} = \frac{0,61}{0,65+0,61} = 0,48$
 $X_{C_6} = 0,52$

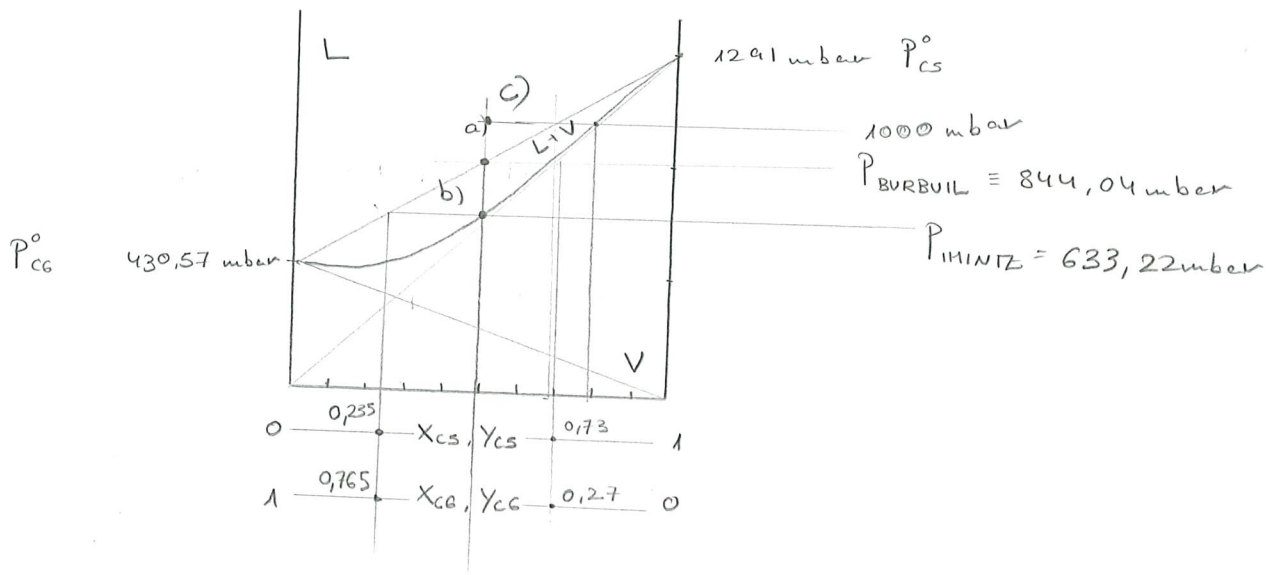
$P_{BURBUIL} = 1291,98 \cdot 0,48 + 430,57 \cdot 0,52 = 844,04 \text{ mbar} = P_{BURBUIL}$

$Y_{C_5} = \frac{1291,98 \cdot 0,48}{844,04} = 0,73$
 $Y_{C_6} = 0,27$

b) $P_{C_5} = X_{C_5} \cdot P_{C_5}^{\circ}$ $X_{C_5} = \frac{P_{C_5}}{P_{C_5}^{\circ}} = \frac{Y_{C_5} \cdot P}{P_{C_5}^{\circ}}$
 $X_{C_5} + X_{C_6} = 1 \rightarrow \frac{Y_{C_5} \cdot P}{P_{C_5}^{\circ}} + \frac{Y_{C_6} \cdot P}{P_{C_6}^{\circ}} = 1$ $X_{C_5} = 0,235$
 $X_{C_6} = 0,765$

$P_{INIURTE} = \frac{1}{\frac{0,48}{1291,98} + \frac{0,52}{430,57}} = 633,22 \text{ mbar} = P_{INIURTE}$

c)



1000 mbar → FASE UNIDUA

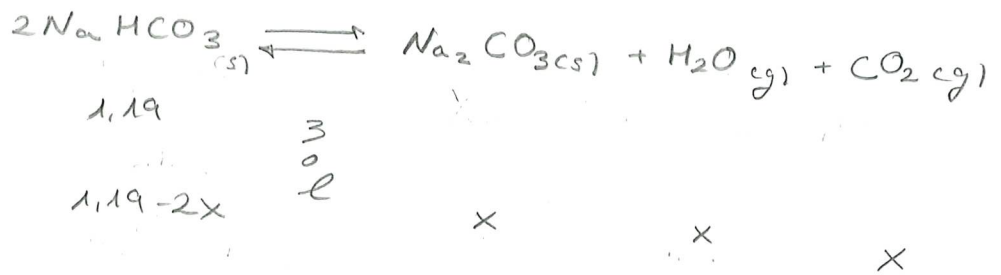
2

$T = 398K$

$K_p = 3,25$

100g $NaHCO_3$

$V = 2L$



a)

$$n(NaHCO_3) = \frac{g}{PM} = \frac{100}{23+1+12+3 \cdot 16} = 1,19 \text{ mol}$$

$$P_{H_2O} = \frac{nRT}{V} = \frac{x \cdot 0,082 \cdot 398}{2} \quad P_{CO_2} = \frac{x \cdot 0,082 \cdot 398}{2}$$

$$K_p = P_{H_2O} \cdot P_{CO_2} = \left(\frac{x \cdot 0,082 \cdot 398}{2} \right)^2 = 3,25 \quad x = 0,11 \text{ mol}$$

$$P_{TOT} = P_{H_2O} + P_{CO_2} = \frac{(0,11 \cdot 0,082 \cdot 398) \cdot 2}{2} = 0,11 \cdot 0,082 \cdot 398 = 3,59 \text{ atm}$$

$$P_{TOT} = 3,59 \text{ atm}$$

b)

$$w\%(\text{NaHCO}_3) = \frac{(1,19 - 2 \cdot 0,11) \cdot (23 + 1 + 12 + 3 \cdot 16)}{11 + 0,11 \cdot (23 \cdot 2 + 12 + 3 \cdot 16)} = 87,5\%$$

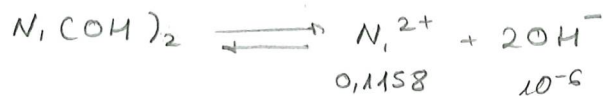
$$w\%(\text{Na}_2\text{CO}_3) = \frac{11,66}{93,14} = 0,125 \cdot 100 = 12,5\%$$

$w\%(\text{NaHCO}_3) = 87,5\%$ $w\%(\text{Na}_2\text{CO}_3) = 12,5\%$
--

3

15g NiCl_2 $I = 1,8 \text{ A}$ $\eta = 90\% = 0,9$ $t = 3600 \text{ s}$ $\text{pH} = 8$ $[\text{H}^+] = 10^{-8}$ $V = 1 \text{ L}$

a)

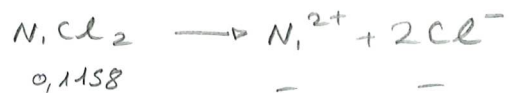


$$0,1158 \quad 10^{-6}$$

$$0,1158 - x \quad 10^{-6} - 2x$$

$$[\text{OH}^-] = \frac{10^{-14}}{10^{-8}} = 10^{-6}$$

$$[\text{NiCl}_2] = \left(\frac{g}{\text{PM}}\right) / 1 \text{ L} = \frac{15}{129,5} = 0,1158$$



$$0,1158 \quad - \quad -$$

$$- \quad 0,1158 \quad 0,2316$$

$$K_{ps} = 5,48 \cdot 10^{-16} = (10^{-6} - 2x)^2 \cdot (0,1158 - x)$$

$$x = 4,656 \cdot 10^{-7}$$

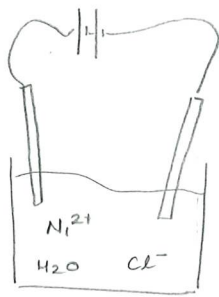
$$[\text{Ni}^{2+}] = 0,11579 \text{ mol/l}$$

$$[\text{OH}^-] = \sqrt{\frac{K_{ps}}{[\text{Ni}^{2+}]}} = 6,879 \cdot 10^{-8}$$

$$[\text{H}^+] = \frac{10^{-14}}{6,879 \cdot 10^{-8}} = 1,454 \cdot 10^{-7}$$

$\text{pH} = 6,837$

b)



$$\text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}_{(s)} \quad E_{\text{red}} = -0,257 - \frac{0,0257}{2} \ln \frac{1}{|\text{Ni}^{2+}|} = -0,285 \text{ V}$$

$$E_{\text{red}} = -0,285 \text{ V} \quad 0,11579$$

$$2\text{H}_2\text{O} + 2e^- \rightarrow \text{H}_2(\text{cg}) + 2\text{OH}^- \quad E_{\text{red}} = -0,83 - \frac{0,0257}{2} \ln \frac{6,879 \cdot 10^{-8} \cdot 1 \text{ atm}}{|\text{H}^+|^2 \cdot P_{\text{H}_2}} = -0,406$$

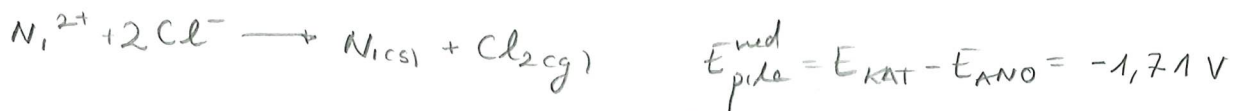
$$E_{\text{red}} = -0,846 \text{ V} \quad E_{\text{red}} = -0,406 - 0,44 = -0,846 \text{ V}$$

$$\text{O}_2 + 4\text{H}^+ + 4e^- \rightarrow 2\text{H}_2\text{O} \quad E_{\text{red}} = 1,23 - \frac{0,0257}{4} \ln \frac{1}{|\text{H}^+|^4 \cdot P_{\text{O}_2}} = 1,128 \text{ V}$$

$$E_{\text{red}} = 1,838 \text{ V} \quad E_{\text{red}} = 1,128 + 0,71 = 1,838 \text{ V} \quad 1,454 \cdot 10^{-7}$$

$$\text{Cl}_2 + 2e^- \rightarrow 2\text{Cl}^- \quad E_{\text{red}} = 1,35 - \frac{0,0257}{2} \ln \frac{10^{-2316}}{P_{\text{Cl}_2}} = 1,397 \text{ V}$$

$$E_{\text{red}} = 1,4275 \text{ V} \quad E_{\text{red}} = 1,397 + 0,03 = 1,4275 \text{ V} \quad \text{atm}$$



$$E_{\text{red}} = -1,71 \text{ V}$$

$$c) \quad I = 1,8 \text{ A} \quad \eta = 0,9 \quad t = 3600 \text{ s} \quad V = 1 \text{ L}$$

ERREAZIONATUTAKO molek

$$N_i^{2+} : \quad 3600 \text{ s} \cdot 1,8 \text{ A} \cdot \frac{1}{96500 \text{ C/mole}^-} \cdot \frac{1}{2 \text{ mole}^-} = 0,03357 \text{ mol}$$

$$Cl^- : \quad 3600 \text{ s} \cdot 1,8 \text{ A} \cdot \frac{1}{96500 \text{ C/mole}^-} \cdot \frac{1}{2 \text{ mole}^-} = 0,06715 \text{ mol}$$

$$|N_i^{2+}| = 0,11579 - \frac{0,03357}{1} = \boxed{8,22 \cdot 10^{-2} \text{ M} = |N_i^{2+}|}$$

$$|Cl^-| = 0,2316 - 0,06715 = \boxed{0,16445 \text{ M} = |Cl^-|}$$

1

$$V = 45 \text{ m}^3 = 45000 \text{ dm}^3 = 45000 \text{ L}$$

$$\text{ETANOL} = 3900 \text{ kg} = 3,9 \cdot 10^6 \text{ g} \quad d = 800 \text{ g/L}$$

$$T = 373 \text{ K}$$

$$P_{\text{max}} = 2,2 \text{ atm}$$

$$a) \quad \ln P_e^{\circ} = 12,2917 - \frac{3803,98}{100 + 231,5} \Rightarrow \boxed{P_e^{\circ} = 2,26 \text{ atm}}$$

$$3,9 \cdot 10^6 \text{ g} \longrightarrow L = 4875 \quad V_g = 45000 - 4875 = 40125 \text{ L}$$

$$800 \text{ g} \longrightarrow 1 \text{ L}$$

$$PV = nRT \quad n = \frac{PV}{RT} = \frac{2,26 \cdot 40125}{0,082 \cdot 373} = 2964,84 \text{ mol}$$

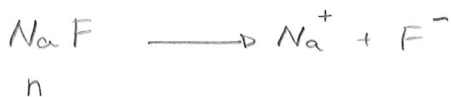
$$g = n \cdot PM = 2964,84 \cdot (2 \cdot 12 + 6 + 16) = 136.382,5 \text{ g}$$

$$\boxed{\text{Wateral} = 4036,38 \text{ kg}}$$

b)

$$\alpha = 0,9$$

$$P_d = P_d^{\circ} \cdot x_d \rightarrow \Delta P = P_d^{\circ} \cdot x_s \cdot i$$



$$\Delta P = 2,26 - 2,2 = 0,06 \text{ atm}$$

$$n(1-\alpha) \quad n\alpha \quad n\alpha$$

$$P_d^{\circ} = 2,26 \text{ atm}$$

$$i = \frac{k(1-\alpha + \alpha + \alpha)}{1} =$$

$$i = 1,9$$

$$= 1 + \alpha = i$$

$$x_s = \frac{\Delta P}{P_d^{\circ} i} = \frac{0,06}{2,26 \cdot 1,9} = 0,01397$$

$$x_s = \frac{n_s}{n_s + n_d}$$

$$n_d = \frac{g}{PM} = \frac{3,9 \cdot 10^6}{(2 \cdot 12 + 6 + 16)} = 84782,6$$

$$\boxed{w_L(\text{NaF}) = 50,45 \text{ kg}}$$

$$0,01397 = \frac{n_s}{n_s + 84782,6}$$

$$n_s = 1201,2 \text{ mol kg} = n \cdot PM \cdot 10^{-3} = 50,45 \text{ kg}$$

c)

$$P_{\text{tot}} = 2,2 = P_e^{\circ} \cdot x_e + P_p^{\circ} \cdot x_p = P_e^{\circ} x_e + P_p^{\circ} (1 - x_e)$$

$$P_e^{\circ} = 2,26 \text{ atm}$$

$$P_p^{\circ} = 1,12 \text{ atm}$$

$$x_e = \frac{n_e}{n_e + n_p}$$

$$n_e = 84782,6 \text{ mol}$$

$$2,2 = 2,26 \cdot x_e + 1,12 \cdot (1 - x_e)$$

$$x_e = 0,947$$

$$0,947 = \frac{84782,6}{84782,6 + n_p}$$

$$n_p = 4744,96 \text{ mol}$$

$$m_p = n_p \cdot M_p \cdot 10^{-3} = 284,7 \text{ kg propanal}$$

$$W_{\text{propanal}} = 284,7 \text{ kg}$$

2

$$a) w_c(\text{Na}_2\text{CO}_3) = 12,5 \quad 0,25 \text{ L} \quad d = 1013 \text{ g/L}$$

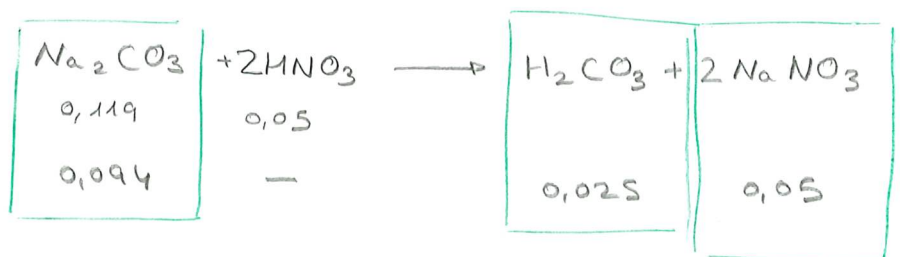
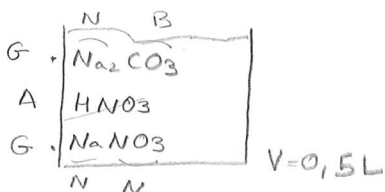
$$|\text{HNO}_3| = 0,1 \text{ M} \quad |\text{NaNO}_3| = 0,1 \text{ M} \quad 0,25 \text{ L}$$

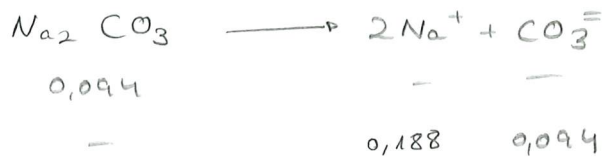
$$V_{\text{tot}} = 0,5 \text{ L}$$

$$0,25 \text{ L} \xrightarrow{d} 253,25 \text{ g} \xrightarrow{\%} 6,33 \text{ g STO} \quad n = 0,0597 \text{ mol}$$

$$\text{BERRIA: } |\text{Na}_2\text{CO}_3| = 0,119 \text{ M} \quad |\text{HNO}_3| = 0,05 \text{ M} \quad |\text{NaNO}_3| = 0,05 \text{ M}$$

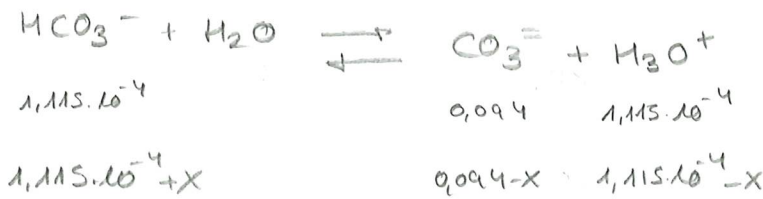
$$n_{\text{HNO}_3} = 0,1 \cdot 0,25 = 0,025 \text{ mol} = n_{\text{NaNO}_3}$$





$$K_a = 5 \cdot 10^{-7} = \frac{x(10^{-7} + x)}{0,025 - x}$$

$$x = 1,115 \cdot 10^{-4}$$



$$Q = 0,094 > K_{a2}$$

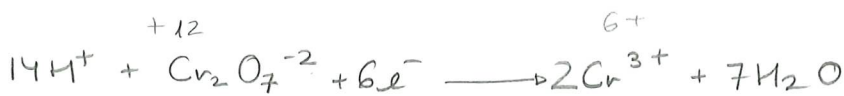
$$K_{a2} = 5 \cdot 10^{-11} = \frac{(1,115 \cdot 10^{-4} - x) \cdot (0,094 - x)}{(1,115 \cdot 10^{-4} + x)}$$

$$x = 1,11499 \cdot 10^{-4}$$

$$\boxed{[\text{CO}_3^{2-}] = 0,0938 \text{ M}}$$

3

$$V = 1 \text{ L} \quad \text{pH} = 3 \quad |\text{H}^+| = 10^{-3} \text{ M} \quad |\text{Cl}^-| = 1 \text{ M}$$



$$E_{\text{red}} = 1,333 - \frac{0,0257}{6} \ln \frac{|\text{Cr}^{3+}|^2}{|\text{H}^+|^{14} \cdot |\text{Cr}_2\text{O}_7^{2-}|} = 1,303 \text{ V LAT}$$



$$E_{\text{red}} = 0,771 - \frac{0,0257}{1} \ln \frac{|\text{Fe}^{2+}|}{|\text{Fe}^{3+}|} = 0,771 \text{ V ANO}$$

KAT / ERRE



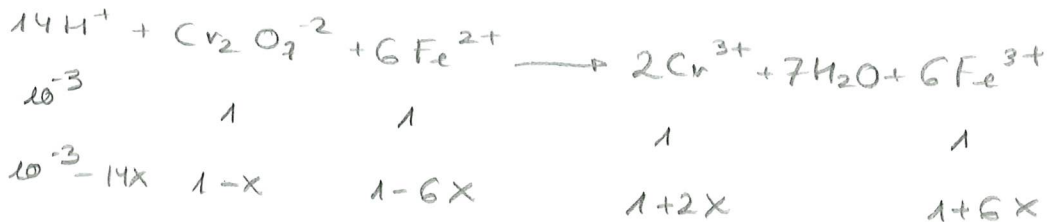
ANO / OXI



$$E_{\text{pile}}^{\text{med}} = E_{\text{kat}} - E_{\text{ano}} = 1,303 - 0,771 = 0,532 \text{ V}$$

$$E_{\text{pile}}^{\text{med}} = 0,532 \text{ V}$$

b)



$$Q = 1000$$

$$K = 9,57 \cdot 10^{56} \quad \left\{ \begin{array}{l} Q < K \\ \text{OREKAN} \end{array} \right.$$

$$\text{OREKAN} \rightarrow E_{\text{pile}}^{\text{med}} = 0 \quad 0 = E_{\text{pile}}^{\circ} - \frac{0,0257}{6} \ln K$$

$$E_{\text{pile}}^{\circ} = 1,333 - 0,771 = 0,562 \quad K = 9,57 \cdot 10^{56}$$

$$K = 9,57 \cdot 10^{56} = \frac{(1+6x)^6 \cdot (1+2x)^2}{(10^{-3}-14x)^{14} \cdot (1-x) \cdot (1-6x)^6}$$

$$9,57 \cdot 10^{56} = \frac{1}{(10^{-3}-14x)^{14}} \rightarrow (10^{-3}-14x)^{14} = \frac{1}{9,57 \cdot 10^{56}}$$

$$x = \frac{\sqrt[14]{9,57 \cdot 10^{-56}} - 10^{-3}}{-14} = 6,303 \cdot 10^{-5}$$

$$|\text{H}^+| = 10^{-3} - 14 \cdot 6,303 \cdot 10^{-5} = 1,1758 \cdot 10^{-4}$$

$$\text{pH} = 3,929$$

$$c) \quad I = 0,1 \text{ A} \quad V = 1 \text{ L}$$

$$| \text{Fe}^{3+} |_1 = 1 \text{ M}$$

$$| \text{Fe}^{3+} |_2 = 0,0002 \text{ M}$$

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 $| \text{Fe}^{3+} | = 0,0002 \text{ M}$

$$n = M \cdot V = 0,0002 \text{ mol}$$

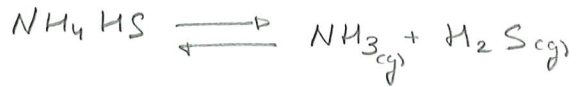
$$T: \quad 0,0002 \text{ mol} \cdot \frac{1 \text{ mole}^-}{1 \text{ mol Fe}^{3+}} \cdot 96500 \frac{\text{C}}{\text{mole}^-} \cdot \frac{1}{0,1 \text{ A}} = 193 \text{ s}$$

$$\boxed{T = 3,21 \text{ min}}$$

3) 2017 - 2018 PARTIZIALA

a)

$V = 2,5 \text{ L}$ $T = 298 \text{ K}$

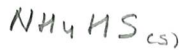


$n_{\text{N}_2} = 0,2 \text{ mol}$

$\frac{P}{n}$ $0,48872$ $-$

$n_{\text{NH}_3} = 0,05 \text{ mol}$

$0,48872 + x$ x



$K_p = 0,108$

$K_p = P_{\text{NH}_3} \cdot P_{\text{H}_2\text{S}} = (0,48872 + x) \cdot x = 0,108$

$P_{\text{NH}_3} = \frac{0,05 \cdot 0,082 \cdot 298}{2,5} = 0,48872$

$x = 0,1652$

ORERA:

$P_{\text{H}_2\text{S}} = 0,1652 \text{ atm} \rightarrow n_{\text{H}_2\text{S}} = \frac{PV}{RT} = \frac{0,1652 \cdot 2,5}{0,082 \cdot 298} = 0,0169 \text{ mol}$

$P_{\text{NH}_3} = 0,48872 + 0,1652 = 0,654 \text{ atm} \rightarrow n_{\text{NH}_3} = \frac{0,654 \cdot 2,5}{0,082 \cdot 298} = 0,0669 \text{ mol}$

$\rightarrow n_{\text{N}_2} = 0,2 \text{ mol}$

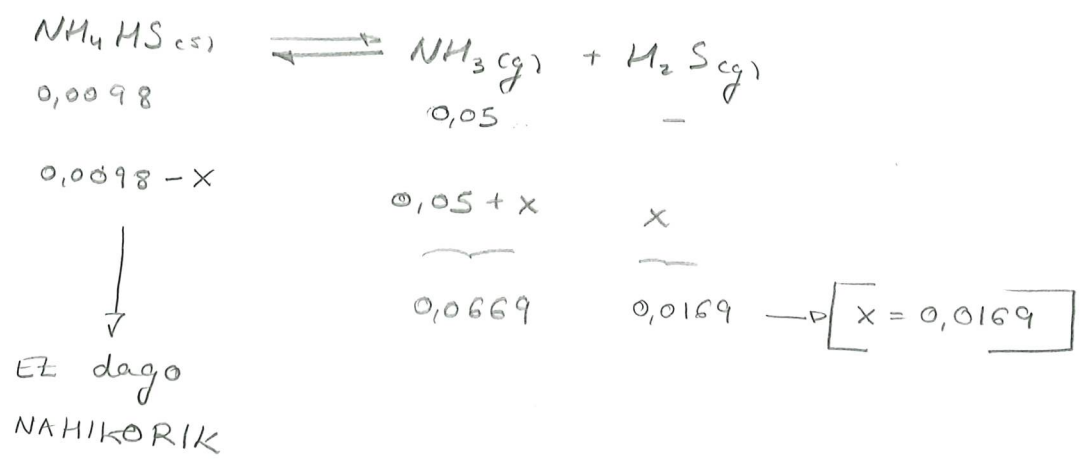
$Y_{\text{N}_2} = \frac{0,2}{0,0169 + 0,2 + 0,0669} = 0,705 = Y_{\text{N}_2}$

$Y_{\text{H}_2\text{S}} = \frac{0,0169}{0,0169 + 0,2 + 0,0669} = 0,059 = Y_{\text{H}_2\text{S}}$

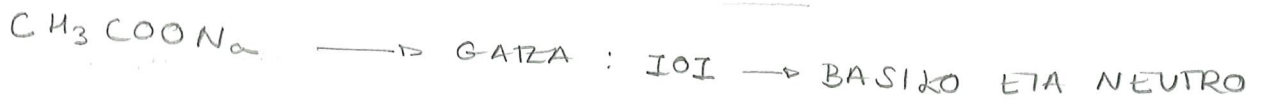
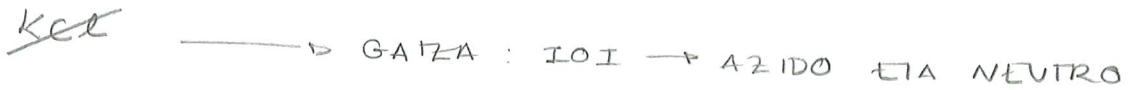
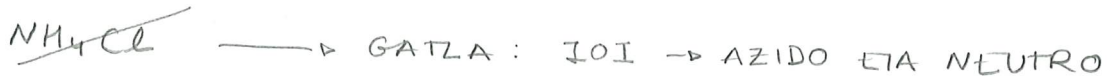
$Y_{\text{NH}_3} = \frac{0,0669}{0,0169 + 0,2 + 0,0669} = 0,236 = Y_{\text{NH}_3}$

b)

$$n = \frac{g}{PM} = \frac{0,50g}{(14+4+1+32)} = 0,0098 \text{ mol}$$



a)



CH₃COONa izango da egokiena, ioi basiko bat duen gatz eta elementu bakarra delako

b)

$[H_2SO_4] = 0,04 \text{ mol/l}$



$$K_a(H_2SO_4) = \frac{[H_3O^+][HSO_4^-]}{[H_2SO_4]} = \frac{[H_3O^+][SO_4^{2-}]}{[HSO_4^-]}$$

$$1,26 \cdot 10^{-2} = \frac{x^2}{0,04 - x}$$

$$\begin{array}{ccc}
 HSO_4^- + H_2O & \rightleftharpoons & SO_4^{2-} + H_3O^+ \\
 0,04 & & 0,04 \\
 0,04 - x & & x \quad x + 0,04
 \end{array}$$

$x = 0,017$

$pH = -\log([H_3O^+]) = -\log(0,017 + 0,04) = 1,25$

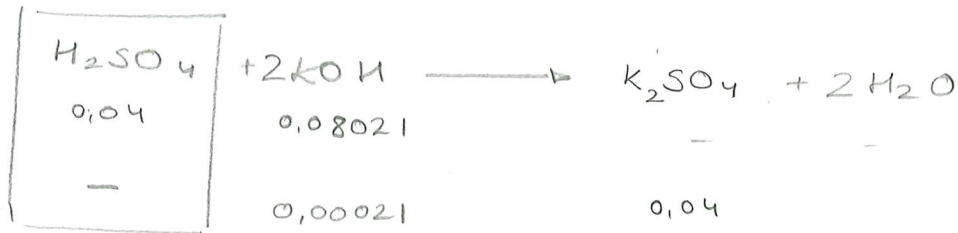
$pH = 1,25$

c) $V = 60 \text{ L}$

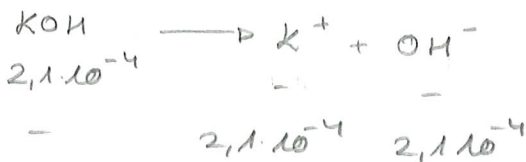
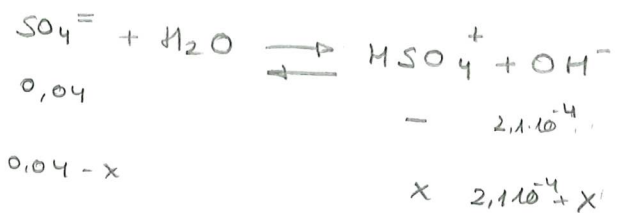
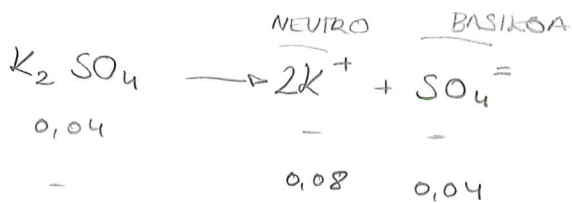
$|\text{H}_2\text{SO}_4| = 0,04 \text{ mol/l}$

$270 \text{ g KOH} \rightarrow n = \frac{g}{PM} = 4,813 \text{ mol}$

$|\text{KOH}| = \frac{4,813}{60} = 0,08021$



↳ NEUTRALIZAZIEN
DA



$$K_b = \frac{10^{-14}}{1,26 \cdot 10^{-2}} = 7,94 \cdot 10^{-13}$$

$$= \frac{|\text{OH}^-| \cdot |\text{HSO}_4^-|}{|\text{SO}_4^{2-}|} = \frac{x \cdot (2,1 \cdot 10^{-4} + x)}{0,04 - x}$$

$$= 7,94 \cdot 10^{-13} \quad x = 1,51 \cdot 10^{-10}$$

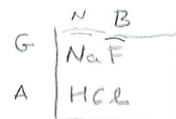
$$|\text{OH}^-| = 2,1 \cdot 10^{-4} + 1,51 \cdot 10^{-10}$$

$$= 2,1 \cdot 10^{-4}$$

$$|\text{H}^+| = \frac{10^{-14}}{2,1 \cdot 10^{-4}} = 4,76 \cdot 10^{-11}$$

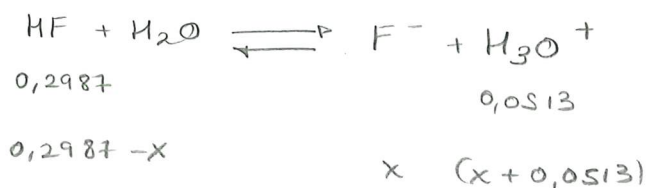
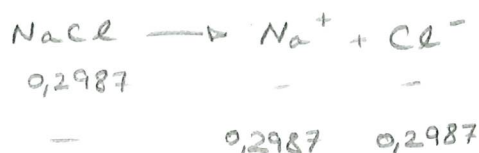
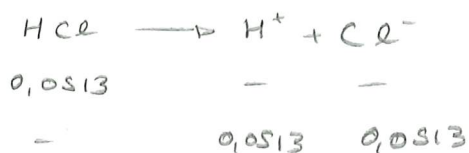
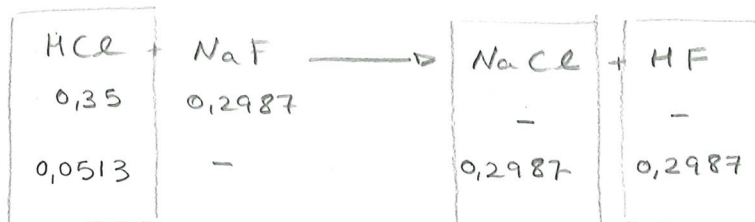
$\text{pH} = 10,3$

$|HCl| = 0,35 \text{ mol/l}$ $0,275 \text{ L}$



$3,45 \text{ g NaF} \rightarrow n = \frac{g}{PM} = \frac{3,45}{42} = 0,0821 \text{ mol}$ $|NaF| = 0,2987 \text{ M}$

a)

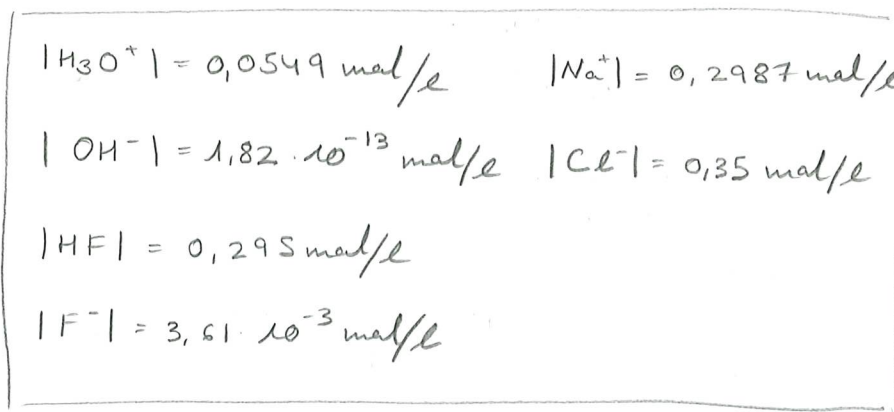


$K_a = 6,71 \cdot 10^{-4} = \frac{|H_3O^+| |F^-|}{|HF|} = \frac{x \cdot (x + 0,0513)}{0,2987 - x} = 6,71 \cdot 10^{-4}$

$|H_3O^+| = 3,61 \cdot 10^{-3} + 0,0513 = 0,0549$

$x = 3,61 \cdot 10^{-3}$

$pH = 1,26$



b)



$$K_{ps}(\text{CaCO}_3) = 5,5 \cdot 10^{-6}$$

$$K_{ps}(\text{CaF}_2) = 4 \cdot 10^{-11}$$



$$K_{ps} = [\text{Ca}^{2+}] \cdot [\text{OH}^-]^2$$

$$\frac{5,5 \cdot 10^{-6}}{(1,82 \cdot 10^{-6})^2} = [\text{Ca}^{2+}] = 1,66 \cdot 10^{-6}$$

$$K_{ps} = [\text{Ca}^{2+}] \cdot [\text{F}^-]^2$$

$$\frac{4 \cdot 10^{-11}}{(3,61 \cdot 10^{-3})^2} = [\text{Ca}^{2+}] = 3,07 \cdot 10^{-6}$$

1. HAU SPEZIALIZEN



$$[\text{Ca}^{2+}] = 3,07 \cdot 10^{-6} \text{ M}$$

c)

1) pH ↑

$[\text{OH}^-]$ ↑

$[\text{Ca}^{2+}]$ ↓

gutxiago

disolbatuko da.

2) pH ↓

$[\text{OH}^-]$ ↓

$[\text{Ca}^{2+}]$ ↑

gehiago disolbatuko

da.

1. KASUAN

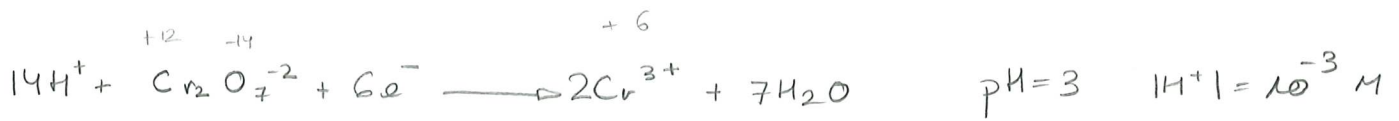


azkarrago mitsiko da saturaziona

2. KASUAN



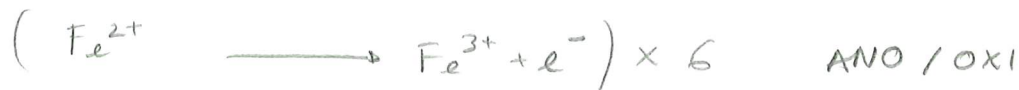
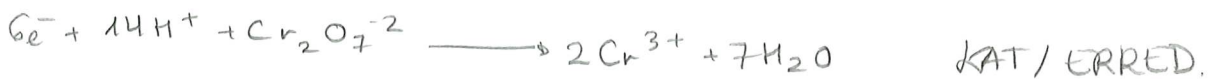
mantxoago mitsiko litzake.



$$E_{pila}^{med} = 1,333 - \frac{0,0257}{6} \ln \frac{|Cr^{3+}|^2}{|H^+|^{14} \cdot |Cr_2O_7^{2-}|} = 0,916 V \quad KAT$$



$$E_{pila}^{med} = 0,771 - \frac{0,0257}{1} \ln \frac{|Fe^{2+}|}{|Fe^{3+}|} = 0,771 V \quad ANO$$



$$E_{pila}^{med} = E_{KAT}^{med} - E_{ANO}^{med} = 0,916 - 0,771 = \boxed{0,145 V = E_{pila}^{med}}$$

b) AGORTUTA: $E_{pila}^{med} = 0$

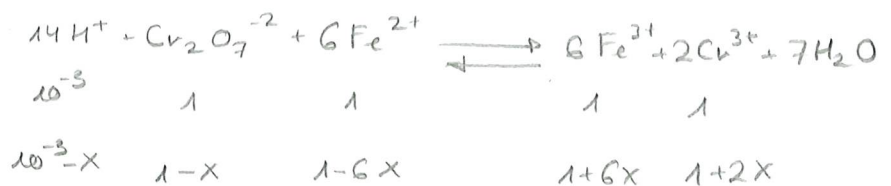
$$0 = E_{pila}^0 - \frac{0,0257}{6} \ln K \quad E_{pila}^0 = E_{KAT}^0 - E_{ANO}^0 = 0,562$$

$$K = 9,57 \cdot 10^{56}$$

$$Q = 10^{42}$$

$$Q < K$$

\implies



$$9,57 \cdot 10^{56} = \frac{(1+6x)^6 \cdot (1+2x)^2}{(10^{-3}-x)^{14} \cdot (1-x) \cdot (1-6x)^6} = \frac{1}{(10^{-3}-x)^{14} \cdot 1}$$

$$\boxed{pH = 3,93}$$

$$x = \sqrt[14]{9,57 \cdot 10^{56}} + 10^{-3} = 0,0008824 \quad pH = -\log(10^{-3} - 8,824 \cdot 10^{-4}) = 3,9317$$

c)

$$I = 0,1 \text{ A} \quad V = 1 \text{ L}$$

$$|Fe^{3+}|_{eq} = 1,0002 \text{ M}$$

$$|Fe^{3+}|_H = 1 \text{ M}$$

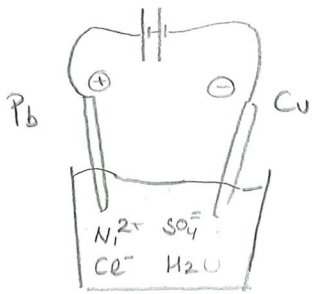
} → ERREAKZIONATUTAKOA:
 $2 \cdot 10^{-4} \text{ mol/l}$

$$n_{Fe^{3+}} = 2 \cdot 10^{-4} \text{ mol}$$

$$\tau: 2 \cdot 10^{-4} \text{ mol} \cdot \frac{1 \text{ mol } e^-}{1 \text{ mol } Fe^{3+}} \cdot 96500 \text{ C/mol } e^- \cdot \frac{1}{0,1 \text{ A}} = 193 \text{ s}$$

$$\tau = 193 \text{ s} = \boxed{3,21 \text{ min} = \tau}$$

47



Cu 13g

V = 1L

T = 25°C

Pb 16g

t = 10 min = 600s I = 12A

[NiSO₄] = 1,3M

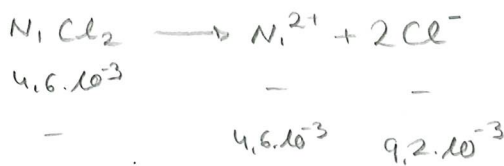
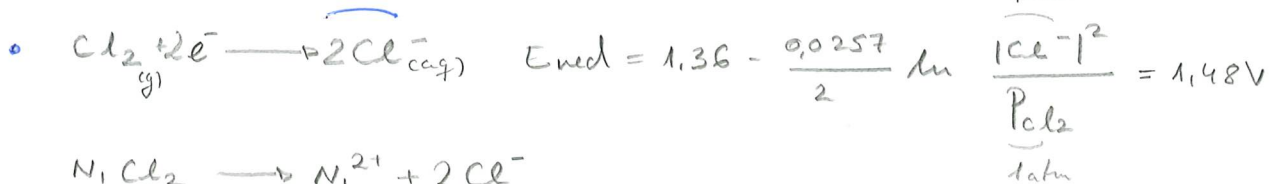
pH = 5 [H⁺] = 10⁻⁵M

[NiCl₂] = 4,6 · 10⁻³M

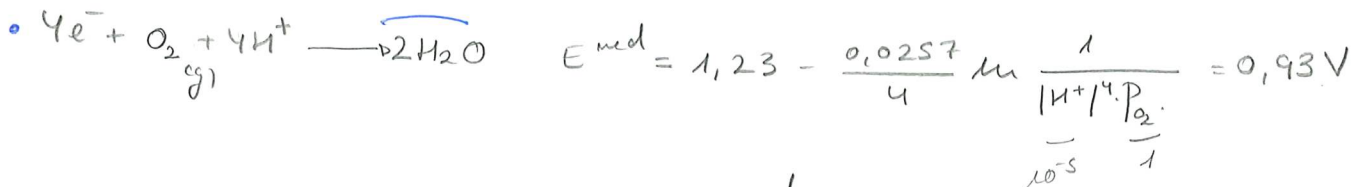
P_g = 1 atm

9,2 · 10⁻³

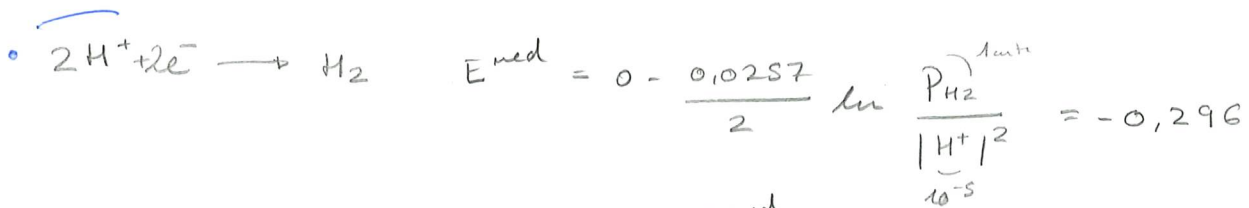
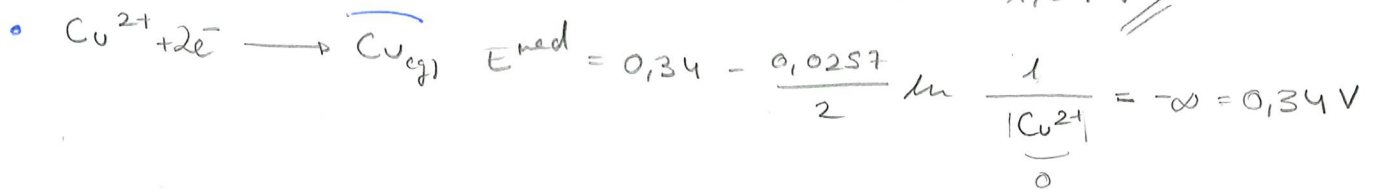
a)



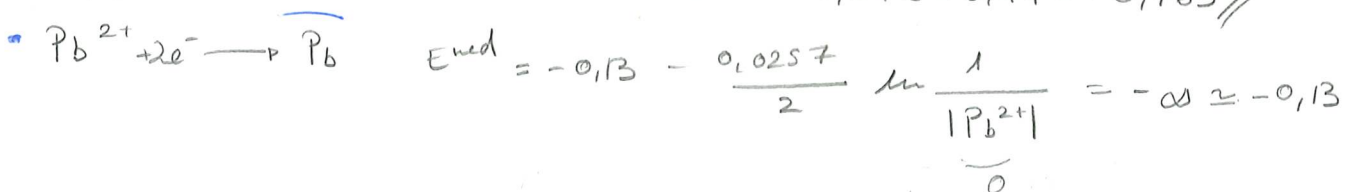
$$E_{\text{red}} = 1,48 + 0,03 = 1,51 \text{V} //$$

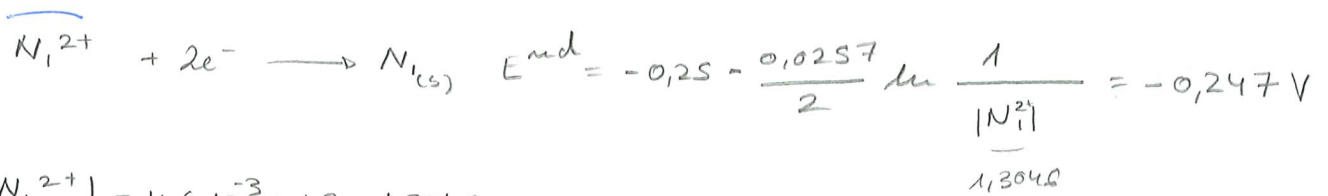


$$E_{\text{red}} = 0,93 + 0,71 = 1,64 \text{V} //$$



$$E_{\text{red}} = -0,296 - 0,44 = -0,763 //$$

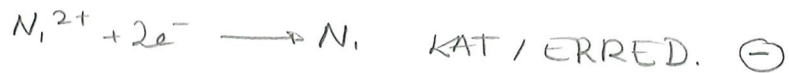
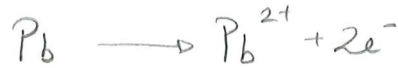




$$|Ni^{2+}| = 4,6 \cdot 10^{-3} + 1,3 = 1,3046$$

KAT

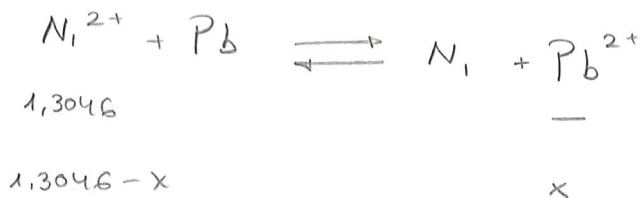
ANO



$$E_{pila}^{red} = E_{KAT}^{red} - E_{ANO}^{red} = -0,247 + 0,13 = -0,117 < 0 \quad \checkmark$$

b)

$$\text{BUKALIZIAN: } E_{pila}^{red} = 0 \quad 0 = E_{pila}^{\circ} - \frac{0,0257}{2} \ln K$$



$$\begin{aligned} E_{pila}^{\circ} &= E_{KAT}^{\circ} - E_{ANO}^{\circ} \\ &= -0,25 + 0,13 = -0,12 \end{aligned}$$

$$K = \frac{|Pb^{2+}|}{|Ni^{2+}|} = \frac{x}{(1,3046 - x)} = 8,797 \cdot 10^{-5}$$

$$x = 1,147 \cdot 10^{-4}$$

$$|Pb^{2+}| = 1,147 \cdot 10^{-4}$$



$$\begin{array}{ccc} 1,147 \cdot 10^{-4} & & 1,3 \\ 1,147 \cdot 10^{-4} - x & & 1,3 - x \end{array}$$

$$K_{ps} = |SO_4^{2-}| \cdot |Pb^{2+}| = (1,3 - x) \cdot (1,147 \cdot 10^{-4} - x) = 2,5 \cdot 10^{-8}$$

$$x = 1,147 \cdot 10^{-4}$$

$$|Pb^{2+}| = \frac{K_{ps}}{|SO_4^{2-}|} = \frac{2,5 \cdot 10^{-8}}{1,3 - 1,147 \cdot 10^{-4}} = 1,923 \cdot 10^{-8} \text{ mol/l}$$

$$\boxed{|Pb^{2+}| = 1,923 \cdot 10^{-8} \text{ M} \quad |Ni^{2+}| = 1,3 \text{ M}}$$

(A) $V = 0,25 \text{ L}$ $T = 298 \text{ K}$ $d = 978 \text{ g/L}$ $P_d^0 = 44 \text{ mmHg} = 0,05789 \text{ atm}$

a) $10_2 |_{\text{aq}} = 2,5 \cdot 10^{-4} \text{ mol/l}$ $P_{\text{tot}}?$

$$P_g = K_n \cdot X_g \quad 1,175 \cdot 10^5 \cdot 4,45 \cdot 10^{-4} = P_{O_2} = 0,0522 \text{ atm}$$

$$P_d = P_d^0 \cdot X_d \rightarrow \Delta P = P_d^0 \cdot X_s \rightarrow P_d^0 - P_d = P_d^0 \cdot X_s$$

$$X_s = \frac{n_s}{n_s + n_d} \quad n_s = M \cdot V = 6,25 \cdot 10^{-5} \text{ mol STO}$$

$$0,25 \text{ L} \frac{d}{V} = 244,5 \text{ g} \quad n = \frac{g}{PM} = \frac{244,5}{46} = 5,32 \text{ mol}$$

$$X_s = \frac{6,25 \cdot 10^{-5}}{5,32 + 6,25 \cdot 10^{-5}}$$

$$n_d = 5,32 \text{ mol}$$

$$X_s = 1,175 \cdot 10^{-5}$$

$$P_d = P_d^0 - P_d^0 X_s = 0,05789 - 0,05789 \cdot 1,175 \cdot 10^{-5}$$

$$P_d = 0,05788 \text{ atm}$$

$$P_{\text{tot}} = P_{O_2} + P_A = 0,0522 + 0,05788 = \boxed{0,11008 \text{ atm} = P_{\text{tot}}}$$

b)



$$\pi_{\text{DSL}} = 3,2 \text{ atm}$$

1 : 1

$$n_{\text{sto}} = \frac{g}{PM} = \frac{1}{80+20} = 0,0125$$



$$\pi = MRT \rightarrow \pi = \frac{n}{V} RT$$

$n(1-\alpha)$

$n\alpha$

$n\alpha$

$$3,2 = \frac{(0,0125 + 0,0125(1-\alpha) + 0,0125\alpha + 0,0125\alpha) \cdot 0,082 \cdot 298}{0,125}$$

$$\boxed{\alpha = 0,5 \quad i = 1,6}$$

1

$$P_{\text{BURBUIL}} = 760 \text{ mmHg} \quad T = 85^\circ\text{C}$$

$$a) \quad P_P^\circ = 246 \text{ mmHg} \quad P_T^\circ = 970 \text{ mmHg}$$

$$P = P_P^\circ x_P + P_T^\circ (1 - x_P) \rightarrow 760 = 246 x_P + 970 (1 - x_P)$$

$$100 \text{ mol} \rightarrow 29 \text{ mol } C_2Cl_4 \quad g = 4814$$

$$71 \text{ mol } CCl_4 \quad g = 10934$$

$$\boxed{\begin{array}{l} x_P = 0,29 \quad \text{LIKIDOA} \\ x_T = 0,71 \end{array}}$$

$$\boxed{w_T(C_2Cl_4) = 30,56\%}$$

$$\boxed{w_T(CCl_4) = 69,44\%}$$

$$Y = \frac{P_P}{P_T} = \frac{P_P^\circ \cdot x_P}{P_T} = \frac{246 \cdot 0,29}{760} = 0,094$$

$$\boxed{Y_P = 0,094 \quad \text{GASA}}$$

$$\boxed{Y_T = 0,906}$$

$$100 \text{ mol} \rightarrow 9,4 \text{ mol } C_2Cl_4 \quad g = 1560,4$$

$$90,6 \text{ mol } CCl_4 \quad g = 13952,4$$

$$\boxed{w_T(C_2Cl_4) = 10,06\%}$$

$$\boxed{w_T(CCl_4) = 89,94\%}$$

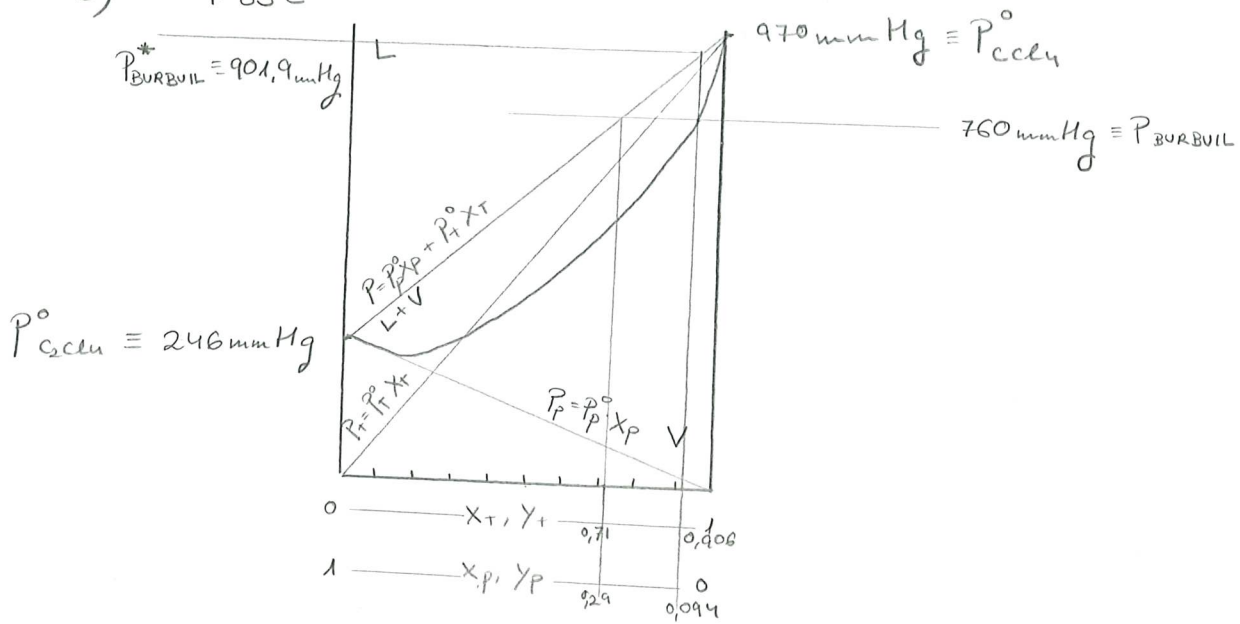
b)

$$x_P = 0,094 \quad x_T = 0,906$$

$$P_{\text{BURBUIL}} = P_P^\circ \cdot x_P + P_T^\circ \cdot x_T = 246 \cdot 0,094 + 0,906 \cdot 970 =$$

$$\boxed{= 901,94 \text{ mmHg} = P_{\text{BURBUIL}}}$$

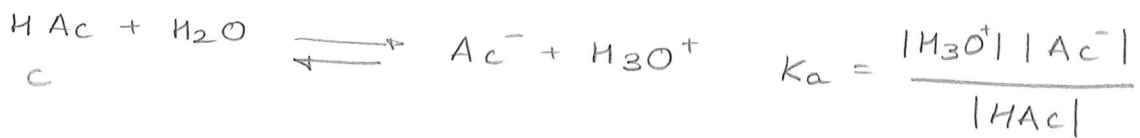
c) $T = 85^\circ\text{C}$



2

HAc 0,15 m $T_c = -0,28^\circ\text{C}$ $d = 1000 \text{ g/L}$

$K_c = 1,855^\circ\text{C/m}$



$$i = \frac{c(1-\alpha + \alpha + \alpha)}{c}$$

$$i = 1 + \alpha$$

$$K_a = \frac{(9,332 \cdot 10^{-4})^2}{0,1476}$$

$$K_a = 5,9 \cdot 10^{-6}$$

$$\Delta T_c = K_c \cdot m \cdot i \rightarrow T_c^\circ - T_c = K_c \cdot m(1 + \alpha)$$

$$0,28 = 1,855 \cdot 0,15 (1 + \alpha) \quad \alpha = 0,00628$$

0,15 mol STO
kg DBZ

0,15 mol \rightarrow STO \rightarrow $g = n \cdot PM = 9 \text{ g}$

PSLU = 9 + 1000 = 1009 g

\xrightarrow{d} 1,009 L DSLU

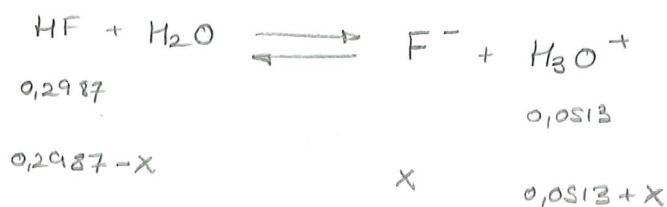
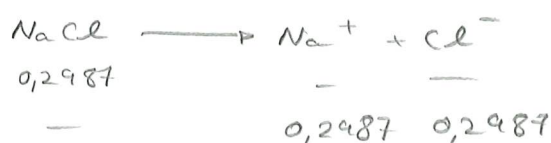
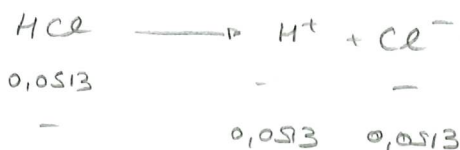
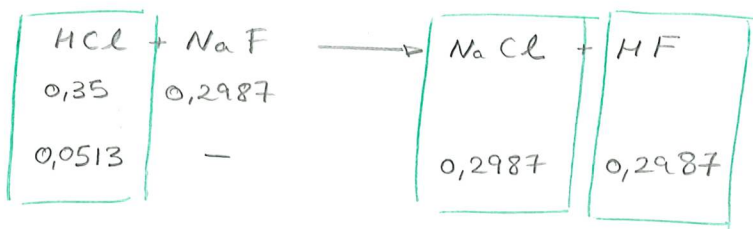
$$M = \frac{0,15}{1009} = 0,1486 \text{ M STO}$$

$$[\text{HAc}]_{\text{on}} = 0,1476 \text{ M} \quad [\text{H}_3\text{O}^+]_{\text{on}} = 9,332 \cdot 10^{-4} \quad [\text{Ac}^-]_{\text{on}} = 9,332 \cdot 10^{-4}$$

3

a) 0,35 M HCl 0,275 L
 3,45 g NaF $\rightarrow n = \frac{g}{PM} = 0,0821 \text{ mol}$ $|NaF| = 0,2987 \text{ M}$

A	HCl
G	NaF
	$\bar{N} \quad \bar{B}$



$$K_a = \frac{|H_3O^+| \cdot |F^-|}{|HF|} = \frac{x \cdot (0,0513 + x)}{0,2987 - x} = 6,71 \cdot 10^{-4}$$

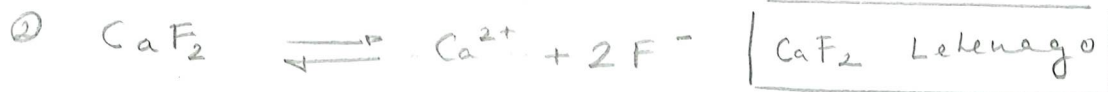
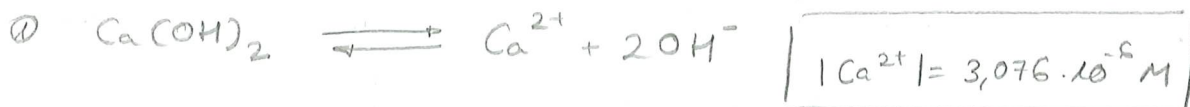
$$pH = -\log(0,0513 + 3,606 \cdot 10^{-3}) =$$

$$x = 3,606 \cdot 10^{-3}$$

$$= \boxed{1,26 = pH}$$

$ H^+ = 5,49 \cdot 10^{-2} \text{ M}$	$ HF = 0,295 \text{ M}$
$ OH^- = 1,82 \cdot 10^{-13} \text{ M}$	$ Cl^- = 0,35 \text{ M}$
$ F^- = 3,606 \cdot 10^{-3} \text{ M}$	$ Na^+ = 0,2987 \text{ M}$

b)



$$K_{ps①} = |OH^-|^2 \cdot |Ca^{2+}| \rightarrow |Ca^{2+}| = \frac{K_{ps}}{|OH^-|^2} = 1,66 \cdot 10^{-20} \text{ M}$$

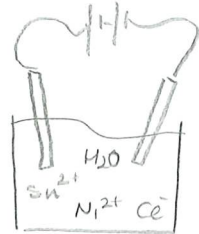
$$K_{ps②} = |F^-|^2 \cdot |Ca^{2+}| \rightarrow |Ca^{2+}| = \frac{K_{ps}}{|F^-|^2} = 3,076 \cdot 10^{-6} \text{ M}$$

② pH ↑ $[\text{OH}^-]$ ↑ $\text{Ca}(\text{OH})_2$ lehenago
hauspeatu

pH ↓ $[\text{OH}^-]$ ↓ $\text{Ca}(\text{OH})_2$ berandago
hauspeatu

4

pH = 1 $[\text{H}^+] = 10^{-1} = 0,1 \text{ M}$



a) $[\text{NiCl}_2] = 0,05 \text{ M}$ $[\text{SnCl}_2] = 0,01 \text{ M}$



$[\text{Ni}^{2+}] = 0,05 \text{ M}$ $[\text{Sn}^{2+}] = 0,01 \text{ M}$ $[\text{Cl}^-] = 0,12 \text{ M}$

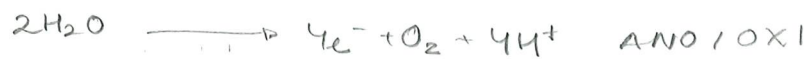
$\text{Sn}^{2+} + 2e^- \longrightarrow \text{Sn}(s)$ $E_{\text{red}} = -0,14 - \frac{0,0257}{2} \ln \frac{1}{[\text{Sn}^{2+}]}$ $= -0,199 \text{ V}$
 $E_{\text{red}} = -0,199 \text{ V} //$

$\text{Ni}^{2+} + 2e^- \longrightarrow \text{Ni}(s)$ $E_{\text{red}} = -0,25 - \frac{0,0257}{2} \ln \frac{1}{[\text{Ni}^{2+}]}$ $= -0,288 \text{ V}$
 $E_{\text{red}} = -0,288 \text{ V} //$

$4e^- + \text{O}_2 + 4\text{H}^+ \longrightarrow 2\text{H}_2\text{O}$ $E_{\text{red}} = 1,23 - \frac{0,0257}{4} \ln \frac{1}{[\text{H}^+]^4 \cdot P_{\text{O}_2}}$ $= 1,17 \text{ V}$
 $E_{\text{red}} = 1,17 \text{ V} //$

$2\text{H}^+ + 2e^- \longrightarrow \text{H}_2$ $E_{\text{red}} = 0 - \frac{0,0257}{2} \ln \frac{1}{[\text{H}^+]^2}$ $= -0,059 \text{ V}$
 $E_{\text{red}} = -0,399 \text{ V} //$

$\text{Cl}_2 + 2e^- \longrightarrow 2\text{Cl}^-$ $E_{\text{red}} = 1,36 - \frac{0,0257}{2} \ln \frac{1}{[\text{Cl}^-]^2}$ $= 1,41 \text{ V}$
 $E_{\text{red}} = 1,81 \text{ V} //$



$$E_{\text{pile}}^{\text{red}} = -1,669 \text{ V}$$

$$E_{\text{pile}}^{\text{red}} = E_{\text{KAT}} - E_{\text{ANO}} =$$

b)

Sn^{2+} enneduzitzean, bene % bat kentuko dugu

Sn^{2+} bakatuko du enneduzitzean, Ni^{2+} lasten denean.

$$-0,288 = -0,14 - \frac{0,0257}{2} \ln \frac{1}{|\text{Sn}^{2+}|} \quad |\text{Sn}^{2+}| = 9,95 \cdot 10^{-6}$$

$$\text{BERRESKURATU} = \frac{0,01 - 9,95 \cdot 10^{-6}}{0,01} \cdot 100 = 99,9 \%$$

Sn 99,9% BERRESKURATU

1

$A \ 0,25 \text{ L} \quad T = 25^\circ \text{C} \quad d = 978 \text{ g/L} \quad P_A^\circ = 44 \text{ mmHg} = 0,0579 \text{ atm}$

a)

$[O_2] = 2,5 \cdot 10^{-4} \text{ mol/L} \quad K_h = 4,45 \cdot 10^4 \text{ atm}$

$P_{O_2} = K_h \cdot X_{O_2} \quad X_{O_2} = \frac{n_{O_2}}{n_A + n_{O_2}}$

$n_{O_2} = M \cdot V = 0,25 \cdot 2,5 \cdot 10^{-4} = 6,25 \cdot 10^{-5} \text{ mol} \quad \left| \quad X_{O_2} = 1,176 \cdot 10^{-5}\right.$
 $n_A = \frac{0,25 \cdot 978}{46} = 5,315 \text{ mol}$

$P_{O_2} = 4,45 \cdot 10^4 \cdot 1,176 \cdot 10^{-5} = 0,52 \text{ atm}$

$P_A = P_A^\circ \cdot X_A = 0,0579 \cdot (1 - X_{O_2}) = 0,0578$

$P_{tot} = P_A + P_{O_2} = 0,52 + 0,0578 = \boxed{0,578 \text{ atm} = P_{tot}}$

$T \downarrow \quad \text{DISOLBAGARRITASUNA} \uparrow \quad [O_2] \uparrow$

b)



$n(1-\alpha) \quad n\alpha \quad n\alpha \quad \begin{matrix} \text{STO } 1g \\ \pi = 3,2 \text{ atm} \\ \pi = MRT \dot{\epsilon} \end{matrix}$

$n_{BCD} = \frac{g}{PM} = \frac{1}{80} = 0,0125 \text{ mol}$

$P_A = P = P_A^\circ \cdot X_d \rightarrow P = 0,0579 \cdot 0,997 = \boxed{0,0577 = P_{tot}}$

$X_d = \frac{5,315}{0,0125 + 5,315} = 0,997$

ii)

$$\pi = MRT \dot{c}$$

$$3,2 = \frac{0,0125 + 0,0125\alpha + 0,0125}{0,25} \cdot 0,082 \cdot 298$$

$$\boxed{\alpha = 0,6}$$

$$\Delta T_c = k_c \cdot m \dot{c} \rightarrow T_c^\circ - T_c = k_c \cdot m \dot{c}$$

$$m = \frac{0,0125}{0,25 \cdot 978 \cdot 10^{-3}} = 0,051 \quad -115 - T_c = 1,99 \cdot 0,051 \cdot 1,6$$

$$\boxed{T_c = -115,2^\circ\text{C}}$$

c)

$$E: d = 792 \text{ g/L} \quad P_E^\circ = 0,124 \text{ atm} \quad 0,2 \text{ L}$$

$$A: 0,25 \text{ L}$$

i)

$$P = x_e P_e^\circ + x_A P_A^\circ$$

$$x_e = \frac{n_e}{n_e + n_A}$$

$$n_A = 5,31 \text{ mol}$$

$$n_e = \frac{0,2 \cdot 792}{32} = 4,95$$

$$x_e = 0,48$$

$$x_A = 0,52$$

$$P = 0,48 \cdot 0,124 + 0,52 \cdot 0,0579$$

$$\boxed{P = 0,0896 \text{ atm}}$$

$$y_e = \frac{P_e}{P} = \frac{P_e^\circ \cdot x_e}{P} = \frac{0,124 \cdot 0,48}{0,0896} = 0,66$$

$$y_e = 0,66$$

$$y_A = 0,34$$

2

a) pH = 1,5 HCl V = 2L

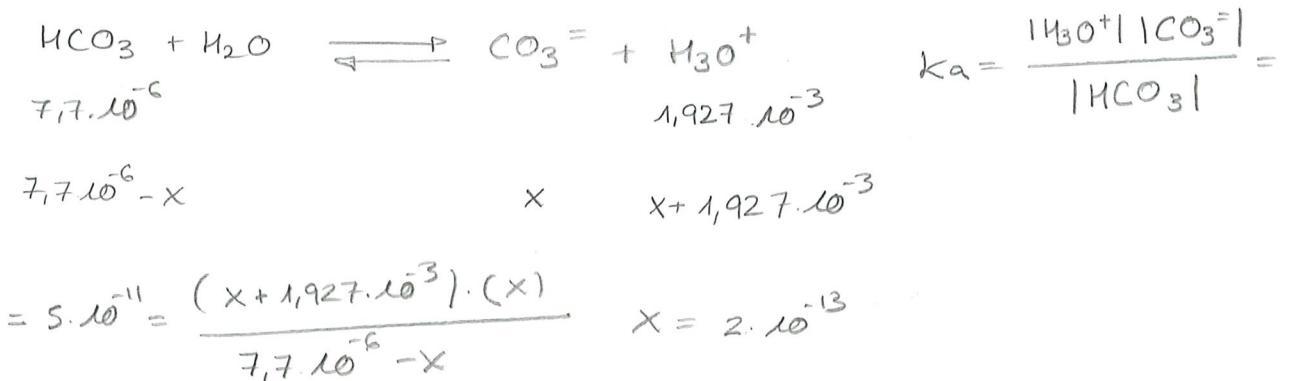
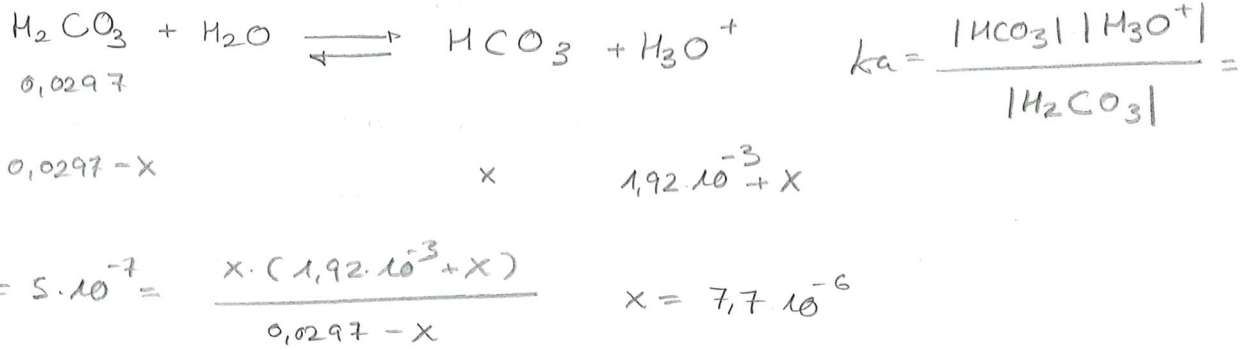
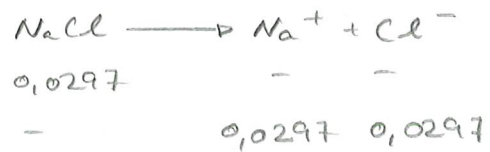
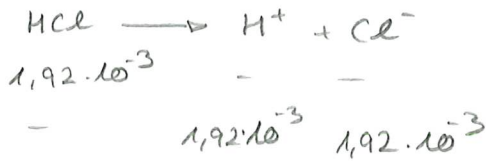
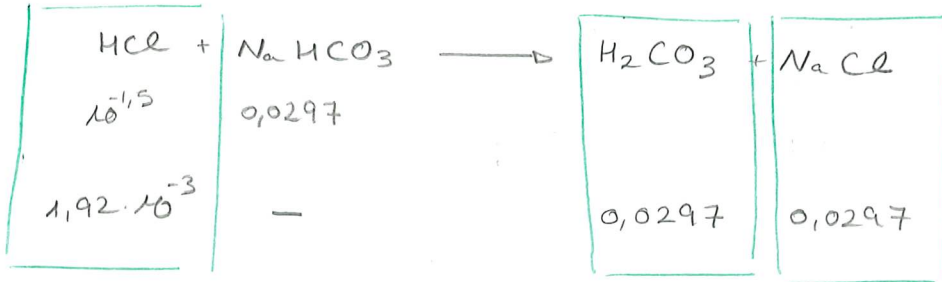
$$5g \text{ NaHCO}_3 \rightarrow n = \frac{g}{PM} = \frac{5}{84} = 0,0595 \text{ mol}$$

A

HCl
NaHCO ₃
N 12/ka

$$[\text{NaHCO}_3] = 0,0297 \text{ M}$$

$$[\text{HCl}] = 10^{-1,5} \text{ M}$$



$$[\text{H}_3\text{O}^+] = 1,927 \cdot 10^{-3}$$

pH = 2,715

b)

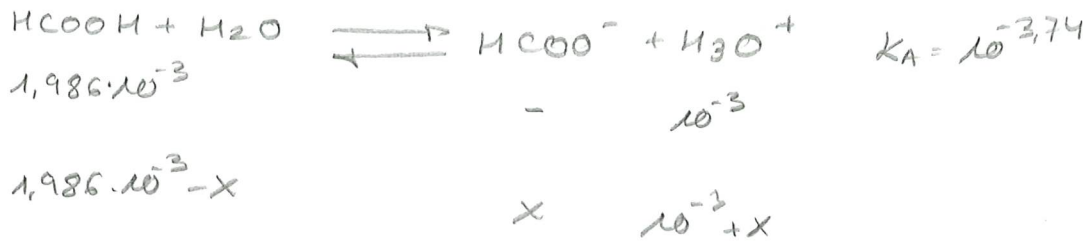
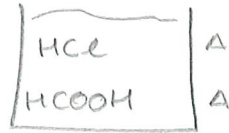
pH=3 HCl 2L

HCOOH $1,5 \cdot 10^{-4}$ L $d = 1218,3 \text{ g/L}$ $T = 25^\circ\text{C}$

$$n_{\text{HCOOH}} = \frac{1,5 \cdot 10^{-4} \cdot 1218,3}{46} = 3,973 \cdot 10^{-3} \text{ mol}$$

$$|\text{HCl}| = 10^{-3} \text{ M}$$

$$|\text{HCOOH}| = 1,986 \cdot 10^{-3} \text{ M}$$



$$10^{-3,74} = \frac{x \cdot (10^{-3} + x)}{1,986 \cdot 10^{-3} - x} \quad x = 2,52 \cdot 10^{-4}$$

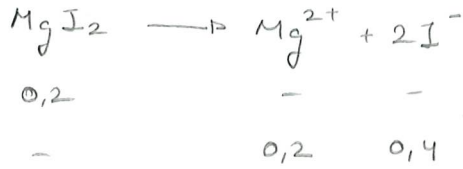
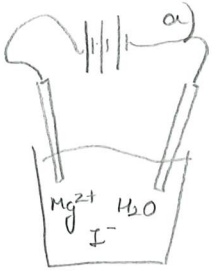
pH = 2,9

3

$V = 0,5 L$

$0,2 M = [MgI_2]$

$pH = 7 \quad [H^+] = [OH^-] = 10^{-7} M$



$Q_{ps} = (0,2) \cdot (10^{-7})^2 = 2 \cdot 10^{-15}$



$Q_{ps} < K_{ps}$ | EZ DU HAUSREAZIEN



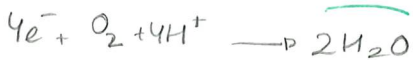
$E_{med} = -2,37 - \frac{0,0257}{2} \ln \frac{1}{[Mg^{2+}]} = -2,39$
 $E_{med} = -2,39 V //$



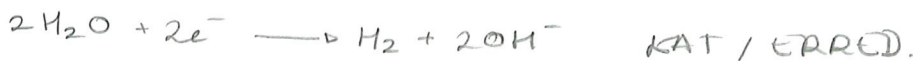
$E_{med} = 0,53 - \frac{0,0257}{2} \ln \frac{[I^-]^2}{[I_2]} = 0,55$
 $E_{med} = 0,55 V //$



$E_{med} = -0,83 - \frac{0,0257}{2} \ln \frac{[OH^-]^2 \cdot P_{H_2}}{1} = -0,856$
 $E_{med} = -0,856 V //$



$E_{med} = 1,23 - \frac{0,0257}{4} \ln \frac{1}{P_{O_2} \cdot [H^+]^4} = 0,8157$
 $E_{med} = 1,526 V //$



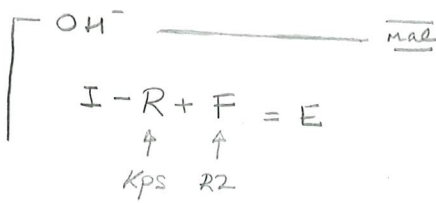
$E_{med} \text{ pila} = E_{KAT} - E_{ANO} = -1,406 V // = E_{med} \text{ pila}$

b)

$$I = 1,2 A$$

$$V = 0,5 L$$

$$|Mg^{2+}|_{eq} = 0,2 \cdot 0,965 = 0,193 M$$



- 1- Mg^{2+} ERLAZIOA OH^-
- 2- Mg^{2+} $\xrightarrow{Kps} I - R = E \rightarrow 10H^-|_E$
- 3- GATZAN \xrightarrow{Kps} BUKAERAN \rightarrow EZ BERRISKURATUTA.
- 4- $F? \rightarrow R2$

Eg:

$$Kps = 10H^-|^2 \cdot |Mg^{2+}| \Rightarrow 1,2 \cdot 10^{-11} = 10H^-|^2 \cdot 0,193 M$$

$$10H^-| = 7,88 \cdot 10^{-6} M \quad n_{eq} = 3,94 \cdot 10^{-6} mal$$

I:

$$n_I = 10^{-7} \cdot 0,5 = 5 \cdot 10^{-8} mal = n_I$$

R:

- 1. 96,5 Mg^{2+} \rightarrow BERRISKURATU
- 1. 3,5 Mg^{2+} \rightarrow GATZERA $I - R = E$

$$0,2 \cdot 0,035 \cdot 0,5 L \cdot \frac{2mal OH^-}{1mal Mg^{2+}} = 0,007$$

$$\left[5 \cdot 10^{-7} - 0,007 + F = 3,94 \cdot 10^{-6} \quad F \approx 0,007 \right.$$

Z:

$$0,007 \cdot \frac{2mal e^-}{2mal OH^-} \cdot 96500 \cdot \frac{1}{1,2} = 562,92 s \equiv \boxed{9,38 min = Z}$$

1

$$P_{\text{TOT}} = 101 \text{ kPa}$$

a)

T (°C)	X_H	X_0	Y_H	Y_0
68,7	1	0	1	0
79,4	0,68	0,32	0,92	0,08
93,3	0,4	0,6	0,78	0,22
107,2	0,19	0,81	0,53	0,47
121,1	0,045	0,955	0,178	0,822
125,7	0	1	0	1

$$101 = 101 X_H + 16(1 - X_H) \quad X_H = 1 \quad X_0 = 0$$

$$Y_H = \frac{P_H}{P} = \frac{P_H^0 \cdot X_H}{P} = \frac{101 \cdot 1}{101} = 1 \quad Y_0 = 0$$

$$101 = 137 X_H + 23(1 - X_H) \Rightarrow X_H = 0,68 \quad X_0 = 0,32$$

$$Y_H = \frac{137 \cdot 0,68}{101} = 0,92 \quad Y_0 = 0,08$$

$$101 = 197 X_H + 37(1 - X_H) \quad X_H = 0,4 \quad X_0 = 0,6$$

$$Y_H = \frac{197 \cdot 0,4}{101} = 0,78 \quad Y_0 = 0,22$$

$$101 = 284 X_H + 58(1 - X_H) \quad X_H = 0,19 \quad X_0 = 0,81$$

$$Y_H = \frac{284 \cdot 0,19}{101} = 0,53 \quad Y_0 = 0,47$$

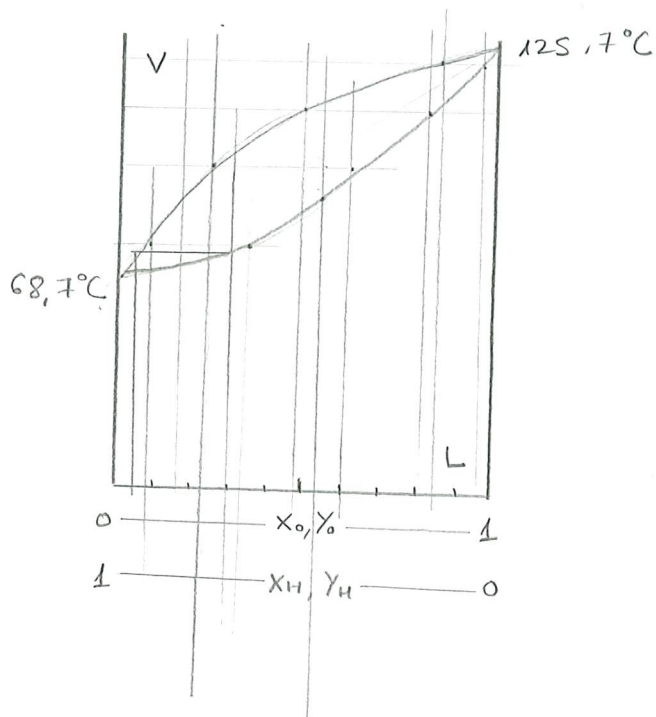
$$101 = 400 X_H + 87(1 - X_H) \Rightarrow X_H = 0,045 \quad X_0 = 0,955$$

$$Y_H = \frac{400 \cdot 0,045}{101} = 0,178 \quad Y_0 = 0,822$$

$$101 = 456 X_H + 101(1 - X_H) \quad X_H = 0 \quad X_0 = 1$$

$$Y_H = \frac{456 \cdot 0}{101} = 0 \quad Y_0 = 1$$

b)



d)

$$x_H = 0,7 \quad T = 93,3^\circ\text{C}$$

$$P = 101$$

$$x_H = 0,4 \quad y_H = 0,78$$

$$\% L = \frac{0,78 - 0,7}{0,78 - 0,4} \times 100 = 21,05\%$$

$$\% V = 78,94\%$$

2

a) $V = 2,5 \text{ L}$ $w_z(\text{etilen}) = 7,13,8$ $d = 1110 \text{ g/L}$

$$T_c = -2^\circ\text{C} \quad k_c = 1,86 \text{ kg/K/mal}$$

$$T_c^\circ - T_c = k_c \cdot m$$

$$0 - (-2) = 1,86 \cdot m \quad m = 1,075 = \frac{\text{mal STO}}{\text{kg DBTZ}}$$

$$2,5 \text{ L} \xrightarrow{d} 2775 \text{ g} \xrightarrow{\%} 382,95 \text{ g} \xrightarrow{\div PM} n = 6,18 \text{ mal STO}$$

$$6,18 > 1,075 \implies (+) \text{ DBTZ}$$

BEHAR DUGUNA: $\frac{6,18}{x} = 1,075 \quad x = \underline{\underline{5,74 \text{ kg H}_2\text{O}}}$

DAKAGUNA: $2775 \cdot 0,862 = 2392,05 \text{ g} \quad \underline{\underline{\text{kg} = 2,39 \text{ kg H}_2\text{O}}}$

$$5,74 - 2,39 = 3,35 \text{ kg H}_2\text{O} \text{ gahitu bekar 20,12 kg}$$

3

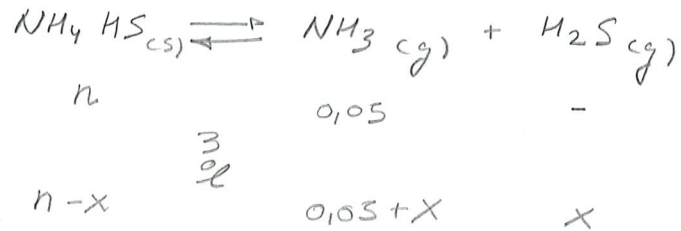
$$V = 2,5 \text{ L}$$

$$n_{\text{N}_2} = 0,2 \text{ mol}$$

$$n_{\text{NH}_3} = 0,05 \text{ mol}$$

$$K_p = 0,108$$

$$T = 298 \text{ K}$$



$$a) \quad P_{\text{NH}_3} = \frac{(0,05+x) \cdot 0,082 \cdot 298}{2,5}$$

$$P_{\text{H}_2\text{S}} = \frac{x \cdot 0,082 \cdot 298}{2,5}$$

$$K_p = P_{\text{NH}_3} \cdot P_{\text{H}_2\text{S}} = (0,05+x) \cdot 9,774 \cdot x \cdot 9,774 = 0,108$$

$$x = 0,0169 \text{ mol}$$

$$Y_{\text{NH}_3} = \frac{0,05 + 0,0169}{0,2 + 2 \cdot 0,0169 + 0,05} = 0,235$$

$$Y_{\text{N}_2} = \frac{0,2}{0,2 + 2 \cdot 0,0169 + 0,05} = 0,7055$$

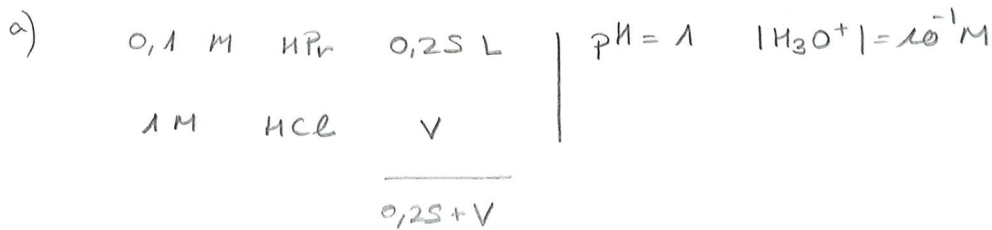
$$Y_{\text{H}_2\text{S}} = \frac{0,0169}{0,2 + 2 \cdot 0,0169 + 0,05} = 0,0595$$

b)

$$0,5 \text{ g NH}_4\text{HS} \rightarrow n = 0,0098 \text{ mol}$$

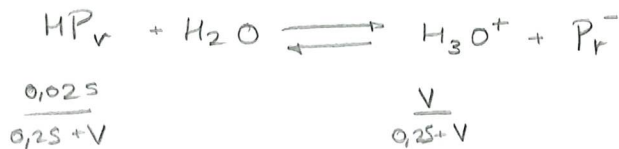
Ez, ez daude NH₄HS mol nahikoenik

1



$$n_{\text{HP}_r} = 0,025 \text{ mol} \quad |\text{HP}_r| = \frac{0,025}{0,25 + V}$$

$$n_{\text{HCl}} = V \text{ mol} \quad |\text{HCl}| = \frac{V}{0,25 + V} = |\text{H}^+|$$



$$\frac{V}{0,25 + V} + X = 10^{-1}$$

$$\frac{V}{0,25 + V} = 10^{-1} - X \rightarrow V = (10^{-1} - X)(0,25 + V)$$

$$V = 0,025 - 0,25X + 10^{-1}V - VX \rightarrow$$

$$\rightarrow V - 10^{-1}V + VX = 0,025 - 0,25X$$

$$V(1 - 10^{-1} + X) = 0,025 - 0,25X$$

$$V = \frac{0,025 - 0,25X}{0,9 + X} \rightarrow V = \frac{0,25(10^{-1} - X)}{0,9 + X}$$

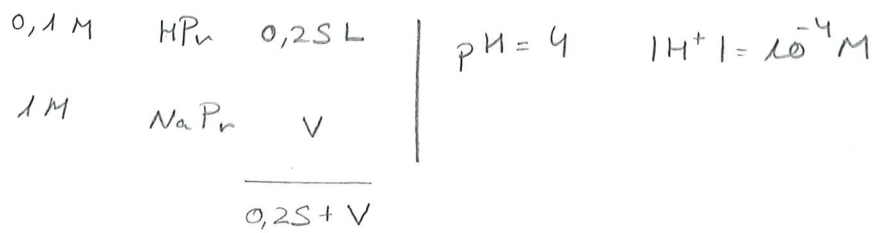
$$K_A = \frac{X \cdot \left(\frac{\frac{0,25(10^{-1} - X)}{0,9 + X}}{\frac{0,25 + 0,25(10^{-1} - X)}{0,9 + X}} + X \right)}{\frac{0,025}{0,25 + 0,25(10^{-1} - X)} - X} =$$

$$= 1,35 \cdot 10^{-5}$$

$$X = 1,21 \cdot 10^{-5}$$

$$V = 0,028 \text{ L}$$

b)



$$n_{HPr} = 0,1 \cdot 0,25 = 0,025 \quad |HPr| = \frac{0,025}{0,25+V}$$

$$n_{NaPr} = 1 \cdot V = V \text{ mol} \quad |NaPr| = \frac{V}{0,25+V} \quad |Pr^-| = \frac{V}{0,25+V}$$



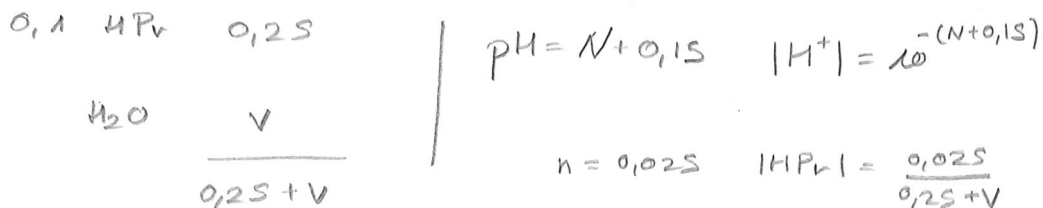
$$\frac{0,025}{0,25+V} - x \qquad x \qquad x \frac{V}{0,25+V} + x$$

$$[H^+] = 10^{-4} = x$$

$$K_a = 1,35 \cdot 10^{-5} = \frac{10^{-4} \cdot \left(\frac{V}{0,25+V} + 10^{-4} \right)}{\frac{0,025}{0,25+V} - 10^{-4}}$$

$$V = 3,34 \cdot 10^{-3} L$$

c)



$$n = 0,025 \quad |HPr| = \frac{0,025}{0,25+V}$$



0,1

V

0,1 - x

x

x

$$pH = 2,93 \rightarrow pH = 3,08$$

$$[H^+] = 10^{-3,08}$$

$$K_a = \frac{x^2}{0,1-x} = 1,35 \cdot 10^{-5}$$

$$x = 1,16 \cdot 10^{-3}$$

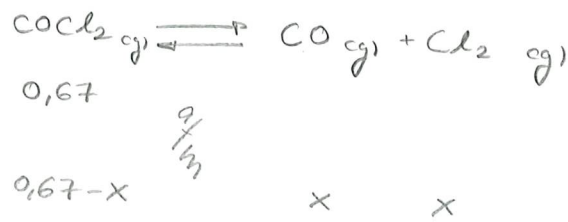
$$V - 0,25 = 0,23 L = V_{ura}$$

$$K_a = 1,35 \cdot 10^{-5} = \frac{(10^{-3,08})^2}{C - 10^{-3,08}}$$

$$C = 0,052 = \frac{0,025}{V} \quad V = 0,48$$

3

a) $V = 10L$ $P_{\text{COCl}_2} = 0,67 \text{ atm}$ $T = 1000K$ $P_{\text{tot, eq}} = 1 \text{ atm}$



$P_{\text{tot}} = 1 = 0,67 - x + x + x$ $x = 1 - 0,67 = 0,33 \text{ atm}$

$$K_p = \frac{0,33^2}{0,67 - 0,33} = \boxed{0,32 = K_p}$$

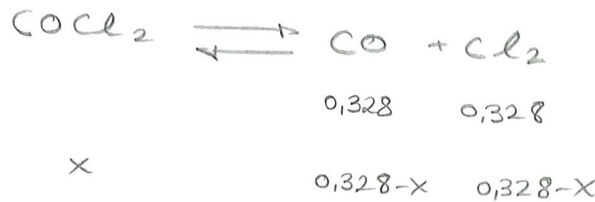
b)

$[V \downarrow \Leftrightarrow P \uparrow]$ → Honek eragingo duena
da, erreakzioa gas mal gutxiu sortzen den aldeara desplazatzen.

c) $V = 5L$ $T = 1000K$

$n_{\text{CO}} = \frac{0,56}{28} = 0,02 \text{ mol}$ $P_{\text{CO}} = \frac{0,02 \cdot 0,082 \cdot 1000}{5} = 0,328 \text{ atm}$

$n_{\text{Cl}_2} = \frac{1,42}{2 \cdot 35,5} = 0,02 \text{ mol}$ $P_{\text{Cl}_2} = \frac{0,02 \cdot 0,082 \cdot 1000}{5} = 0,328 \text{ atm}$



$$K_p = \frac{(0,328 - x)^2}{x} = 0,32$$

$x = 0,13 \text{ atm}$

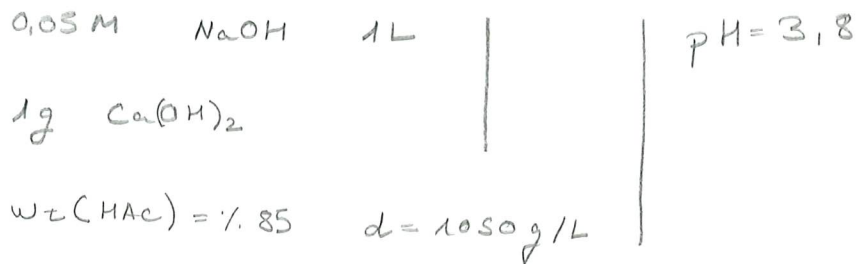
$$n_x = \frac{PV}{RT} = \frac{0,13 \cdot 5}{0,082 \cdot 1000} = 7,93 \cdot 10^{-3} \text{ mol}$$

$$\boxed{\bar{X}_{\text{CO}} = \bar{X}_{\text{Cl}_2} = 39,65 \%}$$

$$\boxed{P_{\text{tot, eq}} = 0,526 \text{ atm}}$$

$$\boxed{P_{\text{CO, eq}} = P_{\text{Cl}_2, eq} = 0,198 \text{ atm}}$$

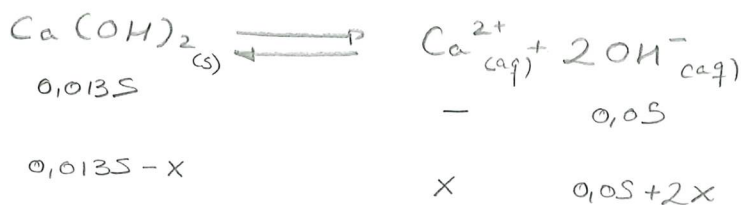
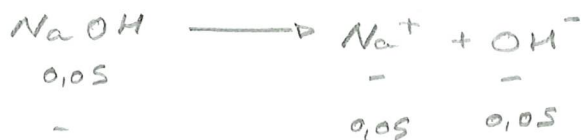
2



a) a.1)

$$n_{\text{Ca(OH)}_2} = g/PM = \frac{1}{74} = 0,0135 \text{ mol}$$

$$[\text{Ca(OH)}_2] = \frac{0,0135}{1 \text{ L}} = 0,0135 \text{ M}$$

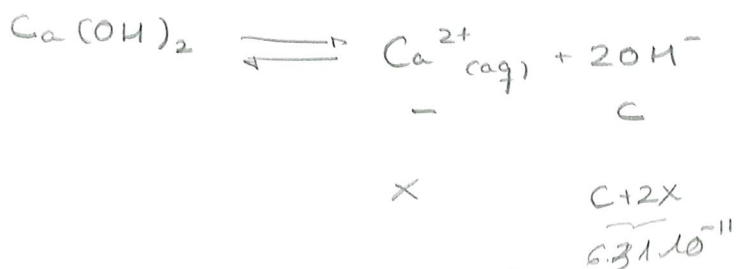


$$K_{ps} = (0,05 + 2x)^2 \cdot x = 1,3 \cdot 10^{-6} \quad X = S = 5,22 \cdot 10^{-4} \text{ M}$$

$$S = 5,22 \cdot 10^{-4} \text{ M}$$

a.2.)

$$\text{pH} = 3,8 \rightarrow |\text{H}^+| = 10^{-3,8} \text{ M} \rightarrow |\text{OH}^-| = \frac{10^{-14}}{10^{-3,8}} = 6,31 \cdot 10^{-11} \text{ M}$$



$$K_{ps} = 1,3 \cdot 10^{-6} = (6,31 \cdot 10^{-11})^2 \cdot x$$

$$x = 3,27 \cdot 10^{-14} \rightarrow \text{DNA DISOLBATU}$$

b)

$$n_{\text{NaOH}} = 0,05 \text{ mol}$$

$$n_{\text{Ca(OH)}_2} = 0,0135 \text{ mol}$$

$$[\text{H}^+] = 1,58 \cdot 10^{-4} \text{ M}$$

$$[\text{OH}^-] = 6,31 \cdot 10^{-11} \text{ M}$$

$$V \cdot 1050 \text{ g DSW}_{\text{HAc}} \xrightarrow{V} V \cdot 892,5 \text{ g HAc}$$

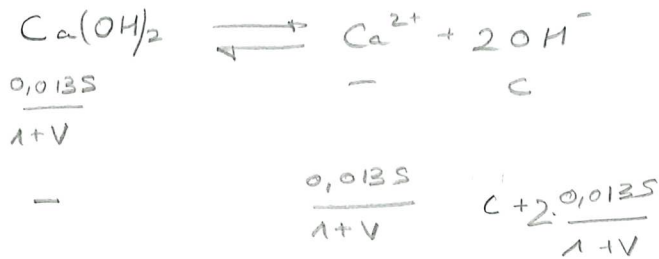
$$n_{\text{HAc}} = \frac{V \cdot 892,5}{60} = V \cdot 14,875$$

(1+V) L



$$[\text{H}^+] = \frac{10^{-14}}{\frac{0,05}{1+V}} = \frac{10^{-14} (1+V)}{0,05} = \frac{V \cdot 14,88}{1+V} - x \quad \times \quad 2 \cdot 10^{-3} (1+V) + x$$

$$= 2 \cdot 10^{-13} \cdot (1+V)$$



$$\frac{10^{-14}}{6,31 \cdot 10^{-11} - \frac{0,027}{1+V}} = 2 \cdot 10^{-3} (1+V) \cdot x$$

$$C + 2 \cdot \frac{0,0135}{1+V} = 6,31 \cdot 10^{-11}$$

$$C = 6,31 \cdot 10^{-11} - \frac{0,027}{1+V}$$

$$\frac{10^{-14}}{6,31 \cdot 10^{-11} - \frac{0,027}{1+V}} = x$$

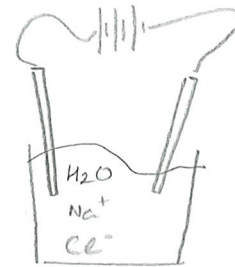
$$K_a = 1,8 \cdot 10^{-5} = \frac{\left(\frac{10^{-14}}{6,31 \cdot 10^{-11} - \frac{0,027}{1+V}} \right) \cdot \left(2 \cdot 10^{-3} (1+V) + 11 \right)}{\frac{V \cdot 14,88}{1+V} - 11}$$

$$V = 0$$

1

$T = 25^\circ\text{C}$ $V = 0,2 \text{ L}$ $0,5 \text{ M NaCl}$ $t = 20 \text{ min} = 1200 \text{ s}$

$I = 40 \cdot 10^{-3} \text{ A}$ $P_g = 1 \text{ atm}$



$\text{Na}^+_{(aq)} + e^- \rightarrow \text{Na}_{(s)}$ $E_{\text{red}} = -2,71 - \frac{0,0257}{1} \ln \frac{1}{1 \text{ Na}^+}$ $= -2,73 \text{ V}$
 $E_{\text{red}} = -2,73 \text{ V} //$

$2 \text{H}_2\text{O}_{(l)} + 2e^- \rightarrow \text{H}_{2(g)} + 2 \text{OH}^-_{(aq)}$ $E_{\text{red}} = -0,83 - \frac{0,0257}{2} \ln \frac{10^{-7} P_{\text{H}_2}}{1}$ $= -0,92$
 $E_{\text{red}} = -0,855 \text{ V} //$

$\text{Cl}_{2(g)} + 2e^- \rightarrow 2 \text{Cl}^-_{(aq)}$ $E_{\text{red}} = 1,36 - \frac{0,0257}{2} \ln \frac{1 \text{ Cl}^-^2}{P_{\text{Cl}_2}}$ $= 1,378 \text{ V}$
 $E_{\text{red}} = 1,41 \text{ V} //$

$4e^- + \text{O}_2 + 4\text{H}^+ \rightarrow 2 \text{H}_2\text{O}$ $E_{\text{red}} = 1,23 - \frac{0,0257}{4} \ln \frac{1}{10^{-7} P_{\text{O}_2}}$ $= 0,81$
 $E_{\text{red}} = 1,53 \text{ V} //$



$E_{\text{pile}} = E_{\text{kat}} - E_{\text{ano}} =$
 $= -0,855 - 1,41 = -2,27 \text{ V}$

$E_{\text{pile}} = -2,27 \text{ V}$

b)

SORTUTAKON: $V = 6 \cdot 10^{-3} \text{ L} \rightarrow P = 1 \text{ atm} \quad T = 25^\circ \text{C}$

$$n = \frac{PV}{RT} = \frac{1 \cdot 6 \cdot 10^{-3}}{0,082 \cdot 298} = 2,45 \cdot 10^{-4} \text{ mol}$$

$$n: 1200 \text{ s} \cdot I \text{ A} \cdot \frac{1}{96500 \text{ C/mol e}^-} \cdot \frac{1}{\frac{2 \text{ mol e}^-}{1 \text{ mol C}_2}} = 2,45 \cdot 10^{-4}$$

$$\boxed{39,4 \cdot 10^{-3} \text{ A} = I}$$

$$E = \frac{40 \cdot 10^{-3} - 39,4 \cdot 10^{-3}}{40 \cdot 10^{-3}} \cdot 100 = \boxed{1,5\% = E}$$

c)

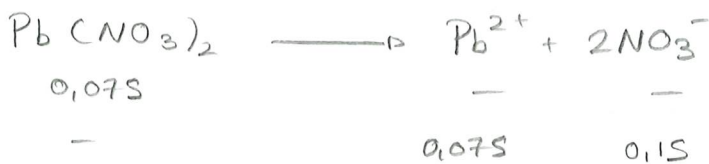
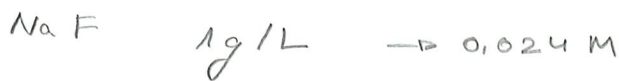
SORTUTAKON n_{OH^-} : $1200 \cdot 39,4 \cdot 10^{-3} \cdot \frac{1}{96500} \cdot \frac{1}{\frac{2}{2}} = 4,89 \cdot 10^{-4} \text{ mol}$

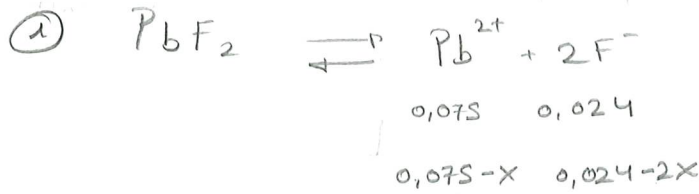
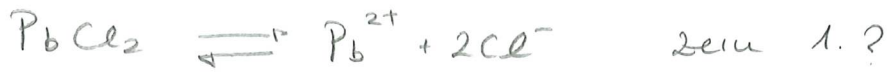
$$[\text{OH}^-] = \frac{4,89 \cdot 10^{-4}}{0,2} = 2,44 \cdot 10^{-3} \text{ M}$$

$$[\text{OH}^-] = 10^{-7} + 2,44 \cdot 10^{-3} = 2,44 \cdot 10^{-3} \quad | \text{H}^+ | = 4,098 \cdot 10^{-12}$$

$$\boxed{\text{pH} = 11,4}$$

2





$$K_{\text{PS Cl}_2} = 1,6 \cdot 10^{-5} = 0,075 \cdot (\text{Cl}^-)^2$$

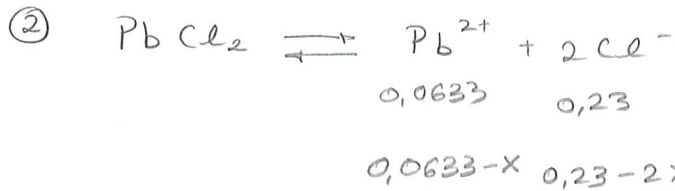
$$|\text{Cl}^-| = 0,0146 \text{ M}$$

$$K_{\text{PS F}^-} = 2,7 \cdot 10^{-8} = 0,07 \cdot (\text{F}^-)^2$$

$$|\text{F}^-| = 6,21 \cdot 10^{-4} \text{ M}$$

$$K_{\text{PS}} = 2,7 \cdot 10^{-8} = (0,024-2x)^2 \cdot (0,075-x)$$

$$x = 0,01167 \quad |\text{Pb}^{2+}| = 0,0633 \text{ M}$$



$$K_{\text{PS}} = 1,6 \cdot 10^{-5} = (0,0633-x) \cdot (0,23-2x)^2$$

$$x = 0,0618 \quad |\text{Pb}^{2+}| = 0,0633 - 0,0618 = 1,5 \cdot 10^{-3} \text{ M}$$

MURRIZKETA: $\frac{0,075 - 1,5 \cdot 10^{-3}}{0,075} \times 100 = \boxed{\% 98 \text{ BAI}}$

1)

KAT // 13 g Cu(s)

V = 1 L

N_2SO_4 1,3 M

$T = 10 \text{ min} = 600 \text{ s}$

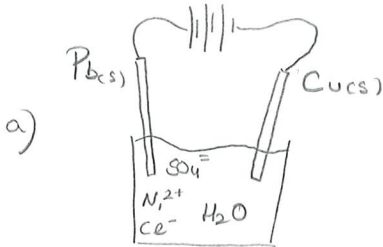
ANO // 16 g Pb(s)

N_2Cl_2 $4,6 \cdot 10^{-3}$

$I = 12 \text{ A}$

$pH = 5$ $[H^+] = 10^{-5} \text{ M}$

$P_g = 1 \text{ atm}$



$$E_{med} = 1,36 - \frac{0,0257}{2} \ln \frac{[Cl^-]^2}{P_{Cl_2}}$$

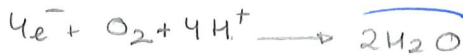
$$= 1,36 - \frac{0,0257}{2} \ln \frac{(9,2 \cdot 10^{-3})^2}{1 \text{ atm}} = 1,48 \text{ V} //$$



$4,6 \cdot 10^{-3}$

$4,6 \cdot 10^{-3}$ $9,2 \cdot 10^{-3}$

$$E_{med} = 1,48 \text{ V} //$$



$$E_{med} = 1,23 - \frac{0,0257}{4} \ln \frac{1}{[H^+]^4 P_{O_2}} = 0,93 \text{ V}$$

$$E_{med} = 0,93 \text{ V} //$$



$$E_{med} = 0,34 - \frac{0,0257}{2} \ln \frac{1}{[Cu^{2+}]} = 0,34 \text{ V}$$

$$E_{med} = 0,34 \text{ V} //$$



$$E_{med} = 0 - \frac{0,0257}{1} \ln \frac{P_{H_2}^{1/2}}{[H^+]} = -0,29 \text{ V}$$

$$E_{med} = -0,29 \text{ V} //$$



$$E_{med} = -0,13 - \frac{0,0257}{2} \ln \frac{1}{[Pb^{2+}]} = -0,13 \text{ V}$$

$$E_{med} = -0,13 \text{ V} //$$



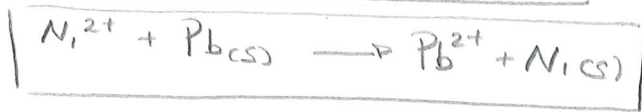
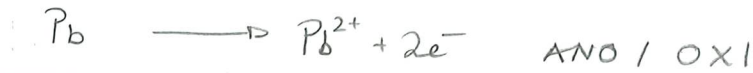
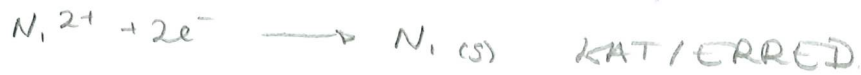
$$E_{med} = -0,25 - \frac{0,0257}{2} \ln \frac{1}{[Ni^{2+}]} = -0,246 \text{ V} //$$



1,3

1,3 1,3

$$E_{med} = -0,246 \text{ V} //$$



$$E_{pila}^{need} = E_{KAT}^{need} - E_{ANO}^{need} = -0,248 + 0,13 = -0,116 \text{ V}$$

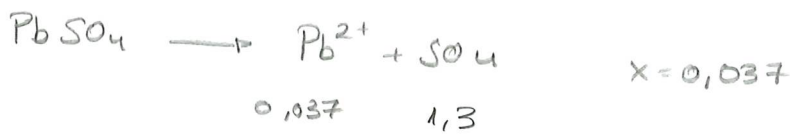
$$E_{pila}^{need} = -0,116 \text{ V}$$

b) $V = IL$

$$n_{Pb^{2+}} : 600 \cdot 12 \cdot \frac{1}{96500 \text{ C/mole}^-} \cdot \frac{1}{\frac{2 \text{ mole}^-}{1 \text{ mol } Pb^{2+}}} = 0,037 \text{ mol}$$

$$K_{ps}(PbSO_4) = 2,5 \cdot 10^{-8} = (0,037 - x) \cdot (1,3 - x)$$

$$|Pb^{2+}| = 0,037 \text{ M}$$



$$|Pb^{2+}| = \frac{2,5 \cdot 10^{-8}}{1,3 - 0,037} = 1,98 \cdot 10^{-8} \text{ M}$$

$$n_{Ni^{2+}} : 600 \cdot 12 \cdot \frac{1}{96500 \text{ C/mole}^-} \cdot \frac{1}{\frac{2}{1}} = 0,037 \text{ mol erweek 10}$$

$$|Ni^{2+}| = 1,3046 - 0,037 = 1,267 \text{ M}$$

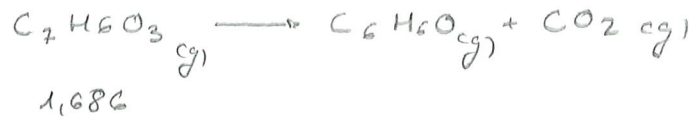
$$|Ni^{2+}| = 0,037 \text{ M}$$

$$|Pb^{2+}| = 1,98 \cdot 10^{-8} \text{ M}$$

$$|Ni^{2+}| = 1,267 \text{ M}$$

2)

HSa ($C_7H_6O_3$)



$$V = 0,5L$$

$$3g \text{ HSa} \rightarrow n_{\text{HSa}} = 0,0217$$

$$1,686 - x$$

$$x \quad x \quad x$$

$$T = 200^\circ C = 473K$$

$$P_{\text{HSa}} = \frac{0,0217 \cdot 0,082 \cdot 473}{0,5} = 1,686 \text{ atm}$$

$$T = 20^\circ C = 293K$$

$$P_{\text{CO}_2} = 730 \text{ mmHg}$$

$$n_{\text{CO}_2 \text{ (cg)}} = \frac{PV}{RT} = \frac{0,96 \cdot 0,485}{0,082 \cdot 293} = 0,01938 \text{ mol}$$

$$V = 0,485L$$

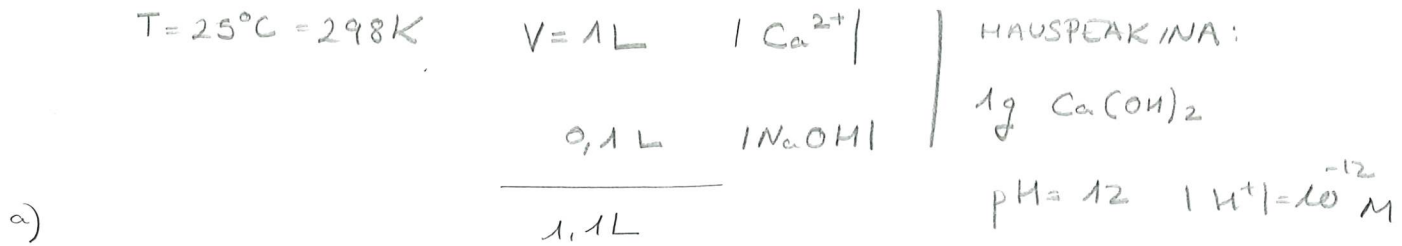
$$P_{\text{CO}_2 \text{ (200}^\circ\text{C)}} = \frac{0,01938 \cdot 0,082 \cdot 473}{0,5} = 1,503 \text{ atm}$$

$$x = 1,503 \text{ atm}$$

$$K_p = \frac{1,503^2}{1,686 - 1,503} = \boxed{12,34 = K_p} \quad K_c = \frac{K_p}{(RT)^{\Delta n}} \quad \Delta n(2-1) \quad \boxed{K_c = 0,32}$$

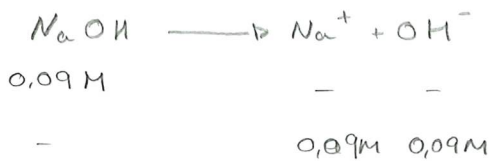
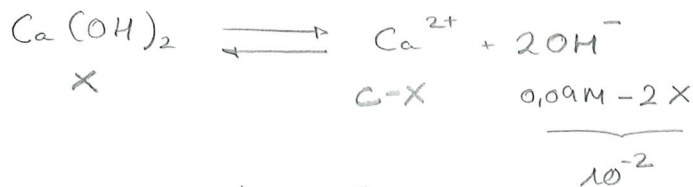
$$\bar{X}_{C_7H_6O_3} = \frac{1,503}{1,686} \cdot 100 = \boxed{89,14\% = \bar{X}_{C_7H_6O_3}}$$

1



$$n_{\text{Ca(OH)}_2} = \frac{1}{(40 + 2 \cdot 17)} = 0,0135 \text{ mol} \rightarrow |\text{Ca(OH)}_2| = 0,01227\text{M}$$

$$\text{pH} = 12 \rightarrow |\text{H}^+| = 10^{-12} \quad |\text{OH}^-| = 10^{-2}\text{M}$$



$$x = 0,01227$$

$$M = 0,384 \text{ mol/l NaOH}$$

$$K_{ps} = 5,5 \cdot 10^{-6} = (10^{-2})^2 \cdot (c - 0,0123) \quad c = 0,0673 \text{ mol/l}$$

$|\text{Ca}^{2+}|_H = 0,0673\text{M}$

$|\text{Ca}^{2+}|_{eq} = 0,055\text{M}$

b)

$$\text{Aber(NaOH)} = \% 98$$

$$n = M \cdot V = 0,384 \cdot 0,1 = 0,0384 \text{ mol}$$

$$g = n \cdot PM = 0,0384 \cdot (23 + 17) = 1,536\text{g}$$

$$\frac{1,536\text{g}}{0,98} = 1,56\text{g NaOH}$$

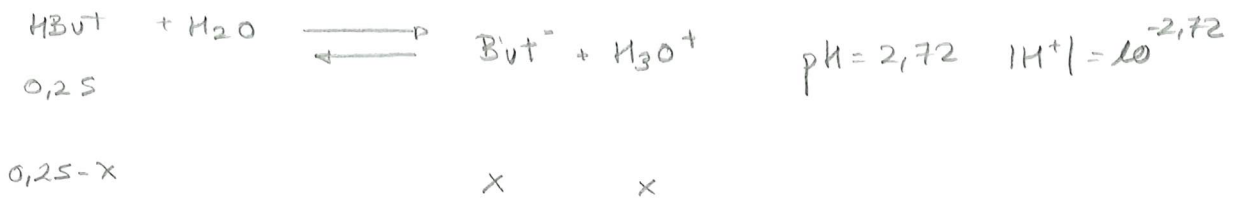
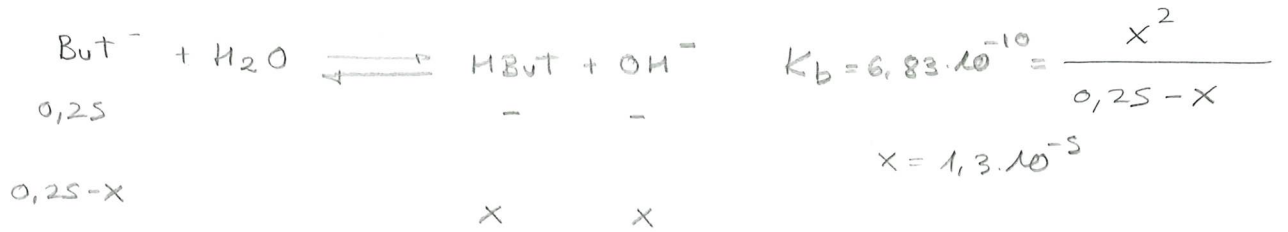
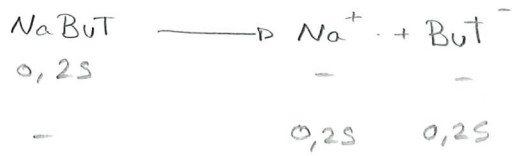
$$\rightarrow \boxed{1,56\text{g NaOH}}$$

2

0,25 M HBut pH = 2,72

a)

0,25 M NaBut



$$K_a = \frac{(10^{-2,72})^2}{0,25 - 10^{-2,72}} = 1,46 \cdot 10^{-5}$$

$$\uparrow |\text{H}^+| = x = 10^{-2,72}$$

$$K_b = \frac{10^{-14}}{1,46 \cdot 10^{-5}} = 6,83 \cdot 10^{-10} \quad |\text{H}^+| = 7,69 \cdot 10^{-10} \quad \boxed{\text{pH} = 9,11}$$

b)

0,250 L NaBut 0,25 M n = M · V = 0,25 · 0,25 = 0,0625 mol

0,5 L HCl 0,25 M n = M · V = 0,25 · 0,5 = 0,125 mol

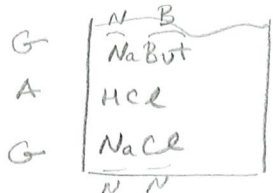
0,25 L NaCl 0,2 M n = M · V = 0,2 · 0,25 = 0,05 mol

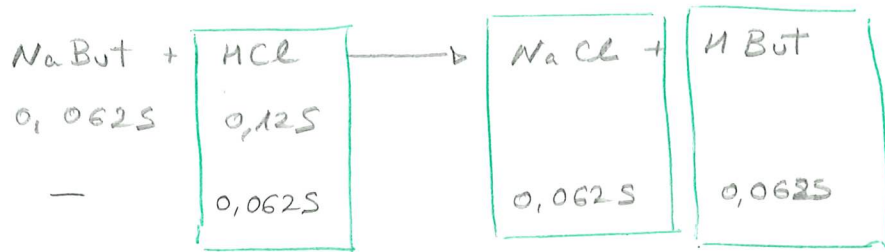
1 L

|NaBut| = 0,0625 M

|HCl| = 0,125 M

|NaCl| = 0,05 M

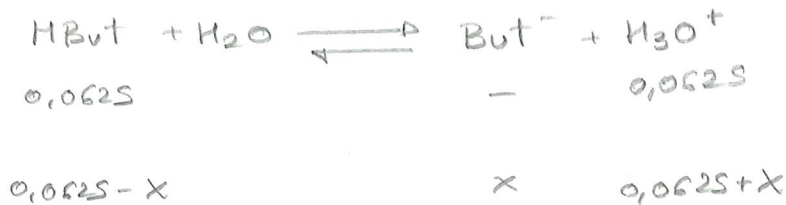
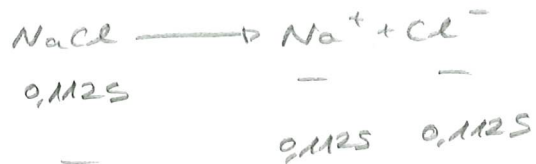
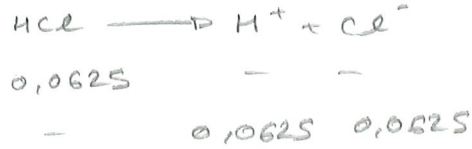




$$|\text{HCl}| = 0,0625 \text{ M}$$

$$|\text{NaCl}| = 0,1125 \text{ M}$$

$$|\text{HBut}| = 0,0625$$



$$K_a = 1,46 \cdot 10^{-5} = \frac{x \cdot (0,0625 + x)}{0,0625 - x} \quad x = 1,46 \cdot 10^{-5}$$

$$|\text{H}_3\text{O}^+| = 0,06252 \text{ M} \quad \boxed{\text{pH} = 1,2}$$

3



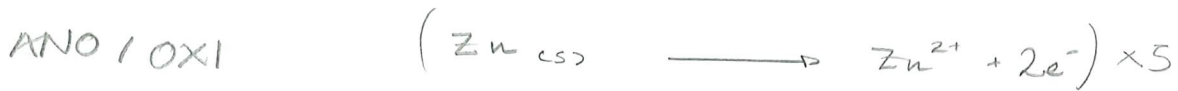
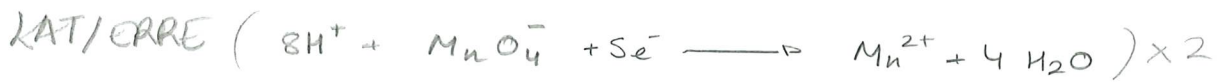
$$E_{\text{red}} = 1,507 - \frac{0,0257}{5} \ln \frac{|\text{Mn}^{2+}|}{|\text{H}^+|^8 |\text{MnO}_4^-|} = 0,844 \text{ V} \quad \text{KAT}$$



$$E_{\text{red}} = -0,76 - \frac{0,0257}{2} \ln \frac{1}{|\text{Zn}^{2+}|} = -0,756 \text{ V} \quad \text{ANO}$$

$$n = \frac{218 \cdot 0,98}{(25 + 32 + 4 \cdot 16)} = 1,33 \text{ mol}$$

$$|\text{Zn}^{2+}| = 1,33 \text{ M}$$



$$E_{\text{pile}}^{\text{red}} = E_{\text{KAT}}^{\text{red}} - E_{\text{ANO}}^{\text{red}} = 0,844 + 0,756 = \boxed{1,6\text{V} = E_{\text{pile}}^{\text{red}}}$$

b)

$$I = 4\text{A}$$

$$T = 10\text{h} = 36000\text{s}$$

$$n_{\text{Zn}^{2+}} = 36000 \cdot 4 \cdot \frac{1}{96500 \text{ C/mol e}^-} \cdot \frac{1}{\frac{2 \text{ mol e}^-}{1 \text{ mol Zn}^{2+}}} = 0,746 \text{ mol}$$

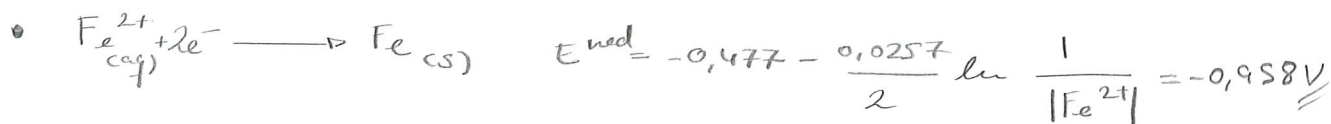
$$m_{\text{Zn}^{2+}} = n \cdot PM = 0,746 \cdot 65,4 = \boxed{48,79\text{g} = \text{Zn}^{2+}}$$

3

$70 \text{ A} \times \text{h} = 2,52 \cdot 10^5 \text{ C}$ $T = 25^\circ \text{C}$

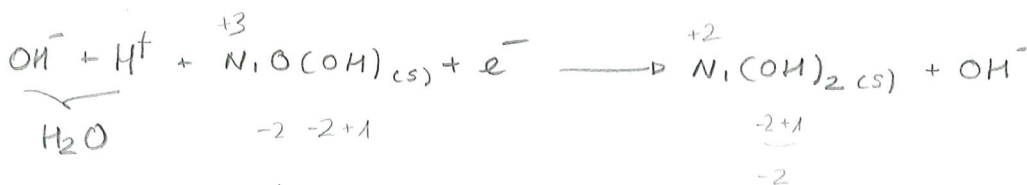
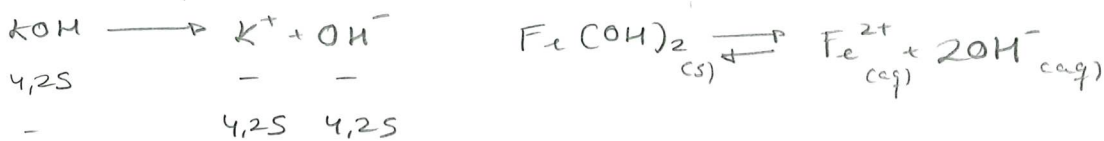
$w_L(\text{KOH}) = 4,20$ $0,15 \text{ L} = V$ $d = 1190 \text{ g/L}$

a)

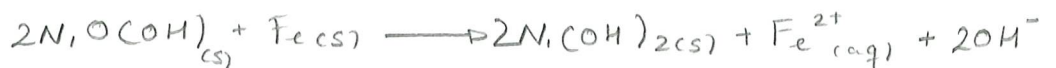
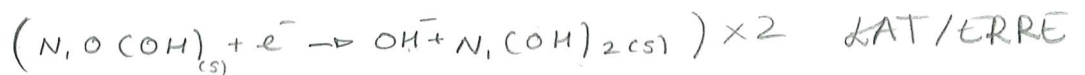


$K_{ps}(\text{Fe}(\text{OH})_2) = 1,10^{-15} = \underbrace{[\text{Fe}^{2+}]}_{4,25} \cdot [\text{OH}^-]^2 \quad |\text{Fe}^{2+}| = 5,54 \cdot 10^{-17} \text{ M}$

$n \text{ KOH} \rightarrow \frac{0,15 \cdot 1190 \cdot 0,20}{56} = 0,6375 \text{ mol} \quad |\text{KOH}| = \frac{0,6375}{0,15} = 4,25 \text{ M}$



$E_{\text{red}} = 0,28 - \frac{0,0257}{1} \ln [\text{OH}^-] = 0,243 \text{ V}$



$E_{\text{pila}}^{\text{red}} = E_{\text{cat}}^{\text{red}} - E_{\text{ano}}^{\text{red}} = 0,243 + 0,958 = 1,2 \text{ V} = E_{\text{pila}}^{\text{red}}$

$E_{\text{pila}}^{\text{red}} = 1,2 \quad E_{\text{BATERIA}} = 6 \text{ V}$

1

$$[0,2 \text{ M } \text{CaCl}_2 \quad V = 3 \text{ L} \quad T = 25^\circ\text{C} = 298 \text{ K}]$$



CaCl_2 : 1,80 punutasunen

a)

$$n_{\text{CaCl}_2} = 3 \cdot 0,2 = 0,6 \text{ mol DSLU-an}$$

$$n = \frac{25}{40 + 2 \cdot 35,5 + 218} = 0,17 \text{ mol } \text{CaCl}_2 \cdot 2\text{H}_2\text{O}$$

$$0,6 - 0,17 = 0,43 \text{ mol } \text{CaCl}_2 \text{ anhidro}$$

$$g = n \cdot \text{PM} = 0,43 \cdot (40 + 2 \cdot 35,5) = 47,73 \text{ g punuak}$$

$$\text{Ez-punutasunekim: } \frac{47,73}{0,8} = \boxed{59,66 \text{ g } \text{CaCl}_2 \text{ anhidro} \\ \text{ez-punutasun } 1,80}$$

b)

$$d = 1020 \text{ g/L}$$

- 0,6 mol STO \rightarrow 66,6 g STO CaCl_2
- 1,80 59,66 \rightarrow 11,93 g Ez punutasun
- 3L $d = 1020 \text{ g} \rightarrow$ 3060 g DSLU
- 3060 - 66,6 - 11,93 = 2981,47 g DBTZ

$$m(\text{CaCl}_2) = \frac{0,6}{2,98147} = \boxed{0,2012 \text{ mol/kg} = m(\text{CaCl}_2)}$$

c)

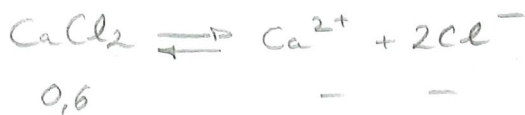
$$T_c = -0,95^\circ\text{C}$$

$$\Delta T_c = K_c \cdot m_i$$

$$0,95 = 1,86 m \quad m_{\text{total}} = 0,5108 \text{ mol/kg}$$

$$n_{\text{tot}} = 0,5108 \cdot 2,98 = 1,522 \text{ mol tot}$$

$$1,522 \text{ mol} = \underbrace{n_{\text{CaCl}_2} + n_{\text{Ca}^{2+}} + n_{\text{Cl}^-}}_{1,488 \text{ mol}} + \underbrace{n_{\text{O}_2 \text{ puru}}}_{\downarrow}$$



$$0,6 \qquad \qquad \qquad 0,6\alpha \qquad 1,2\alpha$$

$$n = \frac{11,93 \text{ g}}{350} = 0,034 \text{ mol} //$$

$$1,488 = 0,6(1-\alpha) + 0,6\alpha + 1,2\alpha$$

$$\alpha = 0,74$$

$$\bar{X} = 74\%$$

2

$$T = 1000 \text{ K}$$

$$P_{\text{SO}_3 \text{ eq}} = 0,4 \text{ atm} \quad P_{\text{N}_2 \text{ eq}} = 2 \text{ atm} \quad \frac{n_{\text{O}_2}}{n_{\text{SO}_2}} = 48 \quad P_{\text{Tot eq}} = 7,3 \text{ atm}$$

$$n_{\text{O}_2} = 48 n_{\text{SO}_2}$$

$$P_{\text{Tot eq}} = P_{\text{SO}_3} + P_{\text{N}_2} + P_{\text{O}_2 + \text{SO}_2}$$

$$7,3 - 0,4 - 2 = P_{\text{O}_2 + \text{SO}_2} = 4,9 \text{ atm} \longrightarrow P_{\text{O}_2} + P_{\text{SO}_2} = 4,9 \text{ atm}$$

$$\frac{48 n_{\text{SO}_2} \cdot 0,082 \cdot 1000}{V} + \frac{n_{\text{SO}_2} \cdot 0,082 \cdot 1000}{V} = 4,9$$

$$48 P_{\text{SO}_2} + P_{\text{SO}_2} = 4,9 \quad P_{\text{SO}_2} = \frac{4,9}{49} = 0,1 \quad P_{\text{O}_2} = 4,8 \text{ atm}$$

$$K_p = \frac{0,4^2}{4,8 \cdot 0,1^2} = \boxed{3,33 = K_p}$$

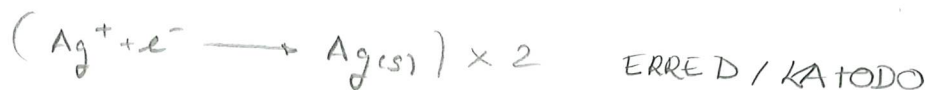
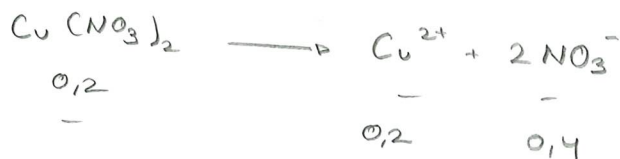
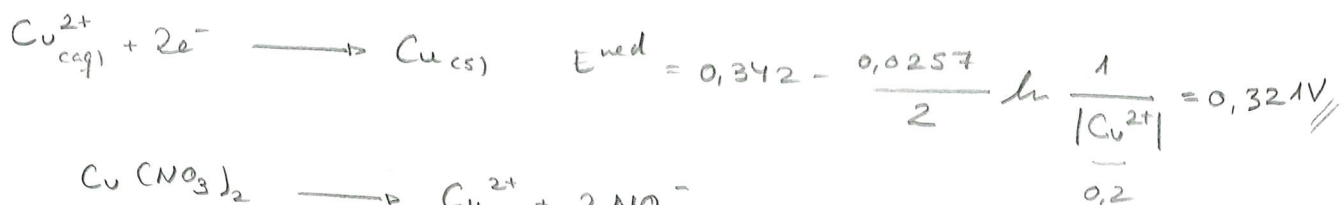
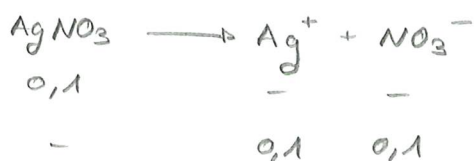
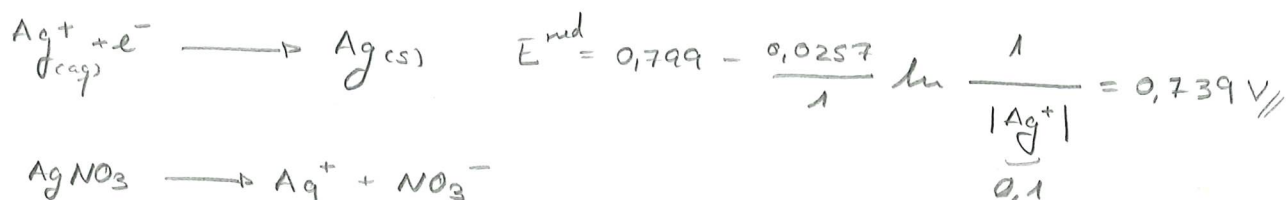
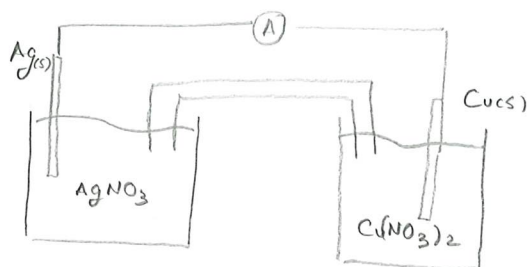
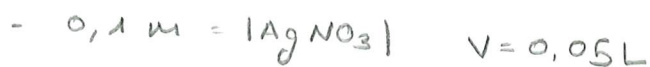
DATOS TERMODINÁMICOS

Valores de los parámetros de la ecuación de Antoine:

$$\ln P^{\text{sat}} = A - B/(C+T) \quad (\text{donde } T \text{ en K y } P^{\text{sat}} \text{ en mm de Hg})$$

Compuesto:	A	B	C	Rango de T
Etano	15.6937	1520.15	- 16.76	130 - 230
Propano	15.7863	1892.47	- 24.33	180 - 280
n-Butano	15.7374	2151.63	- 36.24	220 - 310
i-Butano	15.4481	1989.35	- 36.31	210 - 310
n-Pentano	15.6663	2374.19	- 46.24	270 - 350
n-Hexano	15.8366	2697.55	- 48.78	245 - 370
n-Heptano	15.8737	2911.32	- 56.51	270 - 400
n-Octano	16.1427	3220.75	- 60.02	360 - 430
Propileno	15.7240	1821.01	- 24.90	180 - 270
Benceno	15.8647	2769.42	- 53.26	300 - 400
Tolueno	15.9808	3076.65	- 54.65	330 - 430
Metanol	18.3366	3477.90	- 40.53	290 - 380
Etanol	18.1645	3615.06	- 48.60	300 - 380
n-Propanol	17.5026	3145.72	- 80.95	320 - 410
i-Propanol	18.6867	3636.82	- 53.66	300 - 400
Acetona	16.5145	2850.59	- 40.82	290 - 370
Amoniaco	17.1902	2227.37	- 28.74	200 - 270
Agua	18.3104	3826.36	- 45.47	290 - 500
Tetracloruro de C	15.8572	2799.61	- 46.37	290 - 380

1

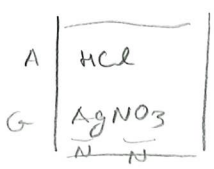


$$E_{\text{pila}}^{\text{red}} = E_{\text{KAT}}^{\text{red}} - E_{\text{ANO}}^{\text{red}} =$$

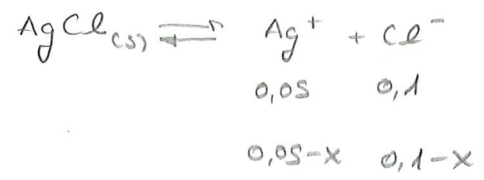
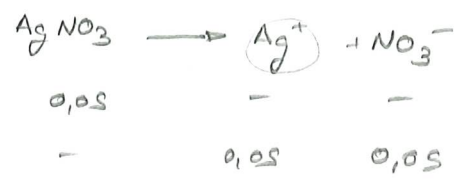
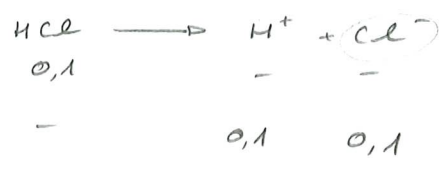
$$= 0,739 - 0,321 =$$

$$\boxed{E_{\text{pila}} = 0,418 \text{ V}} > 0 \text{ V}$$

0,05 L	0,2 M	HCl	$n = M \cdot V = 0,2 \cdot 0,05 = 0,01 \text{ mol}$
0,05 L	0,1 M	AgNO ₃	$n = M \cdot V = 0,1 \cdot 0,05 = 0,005 \text{ mol}$
<hr/>			
0,1 L			



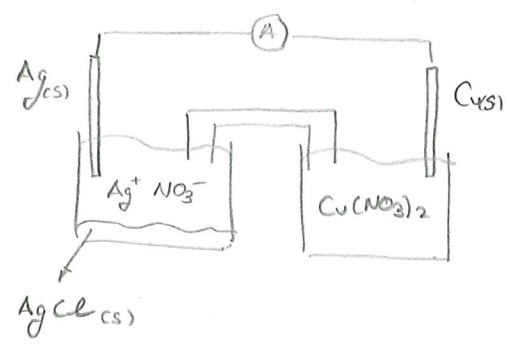
$|HCl| = 0,1 M$
 $|AgNO_3| = 0,05 M$



$$K_{ps} = |Ag^+| \cdot |Cl^-| = (0,05-x) \cdot (0,1-x) = 1,8 \cdot 10^{-10}$$

$$x = 0,049999 \approx 0,05$$

$$|Ag^+| = \frac{K_{ps}}{|Cl^-|} = \frac{1,8 \cdot 10^{-10}}{0,1-0,05} = 3,6 \cdot 10^{-9}$$

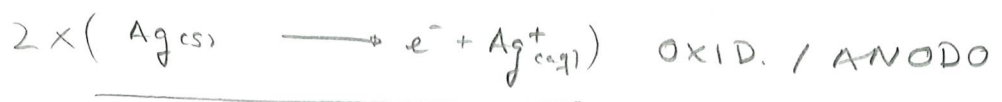


$$E_{red} = 0,799 - \frac{0,0257}{1} \ln \frac{1}{|Ag^+|} = 0,299 V //$$



$$E_{red} = 0,342 - \frac{0,0257}{2} \ln \frac{1}{|Cu^{2+}|} = 0,321 V //$$

ERRED. / KATODO



$$E_{pila} = E_{kat} - E_{ano} = 0,321 - 0,299 = 0,022 V = E_{pila} > 0 \checkmark$$

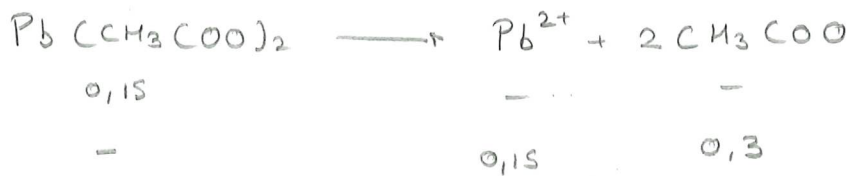
2

0,15M $Pb(CH_3COO)_2$ 0,2L $T = 25^\circ C = 298K$

0,15g $AgCH_3COO$

$$n_{AgAc} = \frac{0,15g}{166,9} = 8,98 \cdot 10^{-4} \text{ mol zider 12.}$$

$$|AgCH_3COO| = \frac{8,98 \cdot 10^{-4}}{0,2} = 4,49 \cdot 10^{-3} M$$



$$K_{ps} = |Ag^+| \cdot |CH_3COO| = x \cdot (0,3 + x) = 1,94 \cdot 10^{-3}$$

$$x = 6,33 \cdot 10^{-3} > 4,49 \cdot 10^{-3}$$

↳ Buar, ASETU GABE DAGO

$$T = 90^{\circ}\text{C}$$

$$P_A^{\circ} = 250 \text{ mmHg}$$

$$P_{\text{BURBUIL}} = 760 \text{ mmHg}$$

$$P_B^{\circ} = 1610 \text{ mmHg}$$

a)

$$P_{\text{BURBUIL}} = P_A^{\circ} \cdot X_A + P_B^{\circ} \cdot X_B$$

$$760 = 250 \cdot X_A + 1610 \cdot (1 - X_A)$$

$$X_A = 0,625$$

$$X_B = 0,375$$

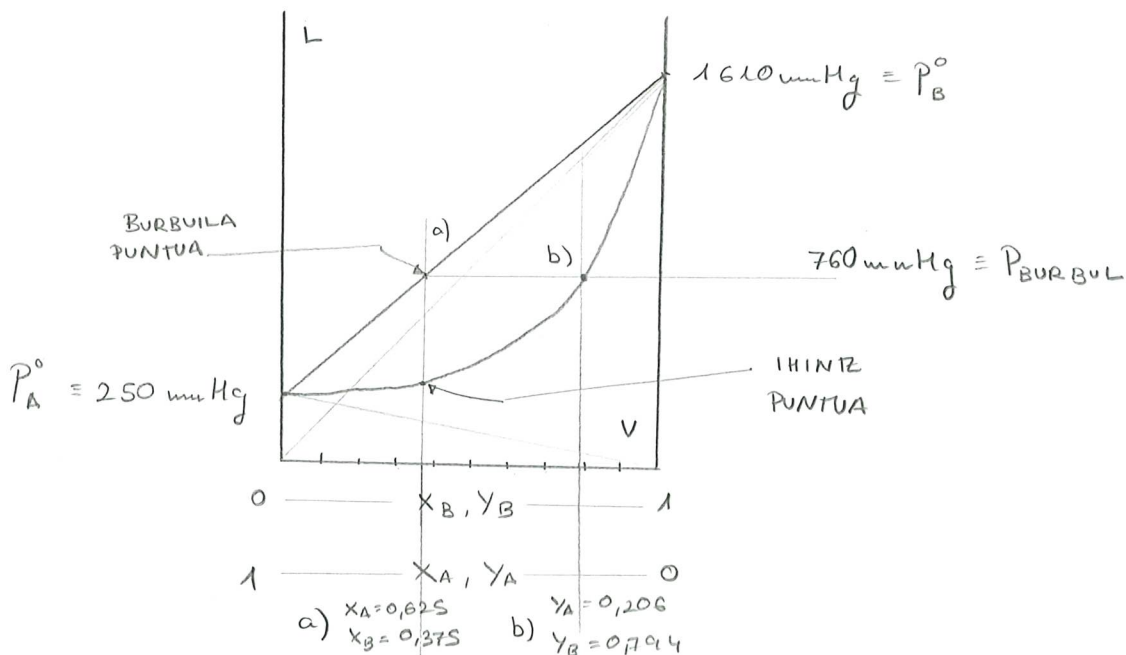
b)

$$P_A = Y_A P_{\text{TOT}}$$

$$Y_A = \frac{P_A}{P_{\text{BURBUIL}}} = \frac{P_A^{\circ} \cdot X_A}{P_{\text{BURBUIL}}} = \frac{250 \cdot 0,625}{760} = 0,206$$

$$Y_A = 0,206 \quad Y_B = 0,794$$

c)



$$X_e = 0,05$$

$V(\text{etanol}) \%$?

$$X_e = \frac{n_e}{n_d + n_e}$$

$$\frac{100 \text{ mol}}$$

→ 5 mol etanol

→ 95 mol H_2O

$$J_{\text{etanol}} = n \cdot PM = 5 \cdot 46,1 = 230,5 \text{ g}$$

$$J_{H_2O} = n \cdot PM = 95 \cdot 18 = 1710 \text{ g}$$

$$\rightarrow V_{\text{etanol}} = g/d = 230,5 / 789 \text{ g/L} = 0,292 \text{ L}$$

$$\rightarrow V_{H_2O} = 1710 \text{ g} = 1,71 \text{ L}$$

$$V(\text{etanol}) = \frac{0,292}{1,71 + 0,292} \times 100 = \boxed{14,59 \% = V(\text{etanol})}$$

$$0,5 \text{ m HA } d = 988 \text{ g/L } T_c = 271,96 \text{ K}$$

$$T_c^\circ - T_c = k_c \cdot m \cdot \dot{c}$$

$$273 - 271,96 = 1,86 \cdot 0,5 \dot{c} \quad \dot{c} = 1,118$$

$$0,5 = \frac{\text{mal STO}}{\text{kg DBTZ}}$$

$$1000 \text{ g DBTZ}$$

$$0,5 \text{ mal} \rightarrow g = n \cdot PM = 0,5 \cdot 88 = 44 \text{ g}$$

$$DSLW = 1044 \text{ g} \xrightarrow{d} 1,057 \text{ L}$$

$$\dot{c} = 1,118 = \frac{N_{\text{OREKAN}}}{N_{\text{HASILAN}}} = \frac{0,5}{n} \quad n = 0,447 \text{ mal}$$

$$K_a = \frac{\frac{0,447 \cdot 0,118}{1,057} \cdot \frac{0,447 \cdot 0,118}{1,057}}{\frac{0,447 \cdot (1 - 0,118)}{1,057}} = \boxed{6,67 \cdot 10^{-3} = K_a}$$

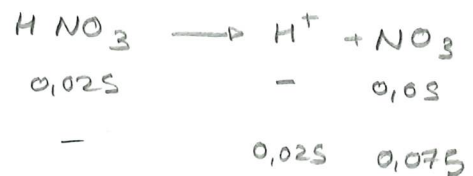
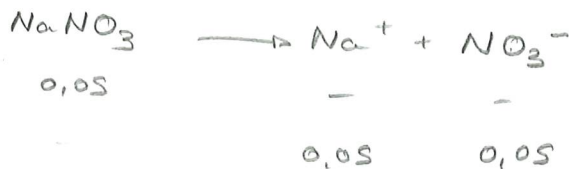
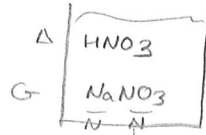
a)



0,5 L

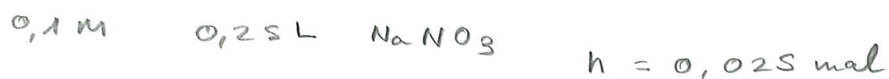
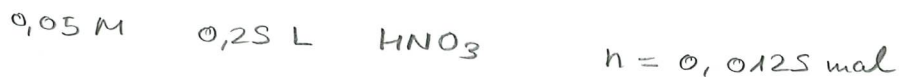
|HNO₃| = 0,025 M

|NaNO₃| = 0,05 M



pH = -log [H⁺] = 1,6 = pH

b)

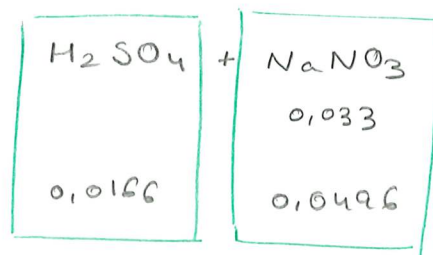
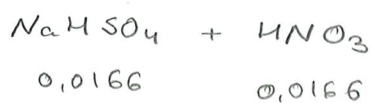
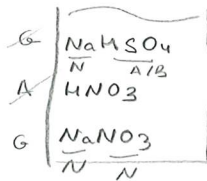


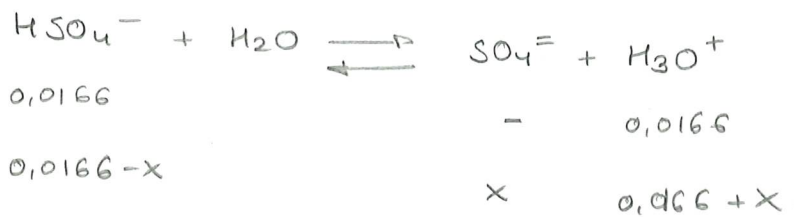
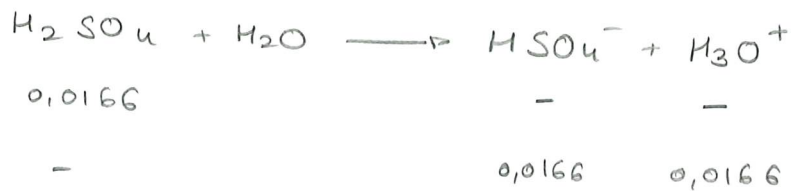
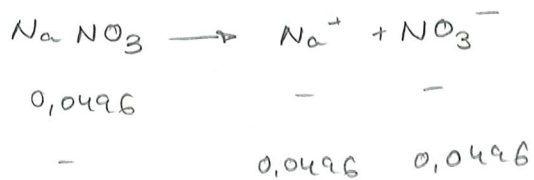
0,75 L

|NaHSO₄| = 0,0166 M

|HNO₃| = 0,0166 M

|NaNO₃| = 0,033 M





$$K_{a2} = \frac{10^{-14}}{K_b2} = \frac{10^{-14}}{7,94 \cdot 10^{-13}} = 1,259 \cdot 10^{-2} = \frac{|\text{SO}_4^{2-}| \cdot |\text{H}_3\text{O}^+|}{|\text{HSO}_4^-|}$$

$$= \frac{x \cdot (0,0166 + x)}{0,0166 - x} = 1,259 \cdot 10^{-2} \quad x = 5,948 \cdot 10^{-3}$$

$$|\text{H}_3\text{O}^+| = 0,0166 + 5,948 \cdot 10^{-3} = 0,0225$$

$$\text{pH} = -\log(|\text{H}_3\text{O}^+|) = \boxed{1,65 = \text{pH}}$$