

KEEMIAÜLESANNETE LAHENDAMISE LAHTINE VÕISTLUS

Vanem rühm (11. ja 12. klass)

Tallinn, Tartu, Kuressaare, Narva, Pärnu, Kohtla-Järve 6. november 2010

Ülesannete lahendused

1. a) **B** – NaNO₃, tšiiil salpeeter
C – KNO₃, india salpeeter
H – NH₄HCO₃, põdrasarvesool

- b) **X** – N, lämmastik
A – N₂, lämmastik
B – NaNO₃, naatriumnitraat
C – KNO₃, kaaliumnitraat
D – NH₃, ammoniaak

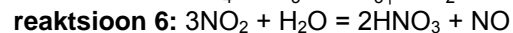
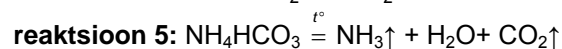
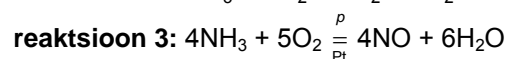
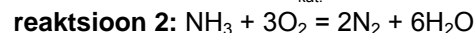
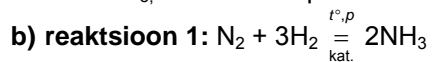
E – $\overset{\text{II}}{\text{N}}\overset{\text{-II}}{\text{O}}$, lämmastikmonooksiid $\%(\text{N}) = \frac{16}{30} \cdot 100 = 53,3$

F – O₂, hapnik

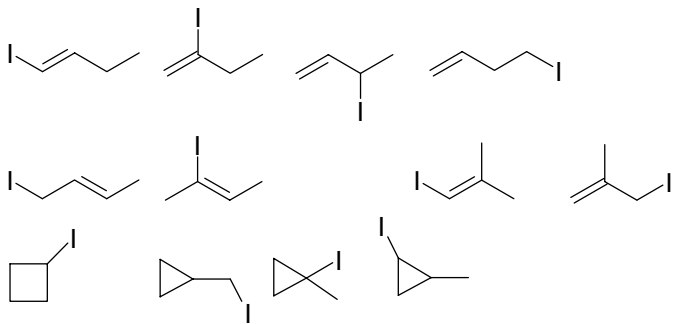
G – NO₂, lämmastikdioksiid

H – NH₄HCO₃, ammooniumvesinikkarbonaat

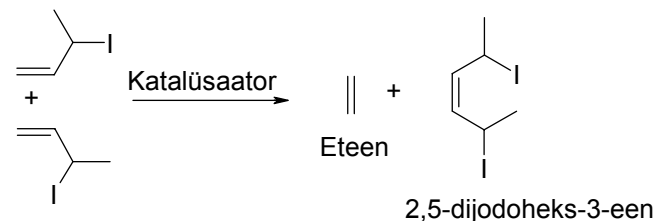
I – HNO₃, lämmastikhape



2. a)



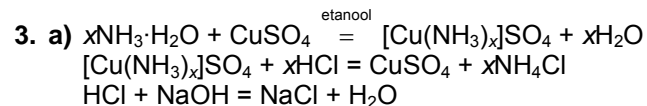
b)



c) $c(\text{3-jodobut-1-een}) = 1 \text{ mmol} \cdot (1 - 0,97) \cdot \frac{1}{0,025 \text{ dm}^3} = 1,2 \text{ mM} \approx$

$\approx 1 \text{ mM}$
 $c(\text{2,5-dijodoheks-3-een}) = \frac{1}{2} \cdot 1 \text{ mmol} \cdot 0,97 \cdot \frac{1}{0,025 \text{ dm}^3} = 19 \text{ mM}$

Eteen lendub reaktsiooni segust.



b) $n(\text{NH}_3) = n(\text{HCl}) = (20 \text{ cm}^3 \cdot 0,2097 \text{ M} - 12,19 \text{ cm}^3 \cdot 0,1 \text{ M}) \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} =$
 $= 2,975 \cdot 10^{-3} \text{ mol}$

$M([\text{Cu}(\text{NH}_3)_x]\text{SO}_4) = M(\text{CuSO}_4) + x \cdot M(\text{NH}_3)$

$M([\text{Cu}(\text{NH}_3)_x]\text{SO}_4) = (159,62 + 17,03x) \text{ g/mol}$

$n([\text{Cu}(\text{NH}_3)_x]\text{SO}_4) = \frac{0,1805 \text{ mol}}{(159,62 + 17,03x)} = \frac{1}{x} n(\text{NH}_3) = \frac{2,975 \cdot 10^{-3} \text{ mol}}{x}$

$x = \frac{159,62 \cdot 2,975 \cdot 10^{-3}}{0,1805 - 17,03 \cdot 2,975 \cdot 10^{-3}} = 3,7 \approx 4$

Komplekssoola valem on [Cu(NH₃)₄]SO₄ (227,73 g/mol).

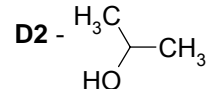
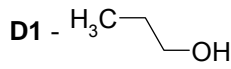
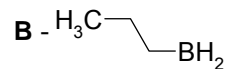
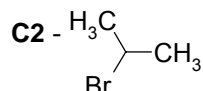
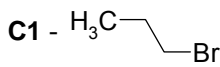
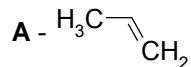
c) $m(\text{H}_2\text{O}) = 0,1805 \text{ g} - \frac{1}{4} \cdot 2,975 \cdot 10^{-3} \text{ mol} \cdot \frac{227,73 \text{ g}}{1 \text{ mol}} = 0,01112 \text{ g}$

$\%(\text{H}_2\text{O}) = \frac{0,01112 \text{ g}}{0,1805 \text{ g}} \cdot 100 = 6,16$

4. a) $n(\text{A}) > \frac{101000 \text{ Pa} \cdot 0,003 \text{ m}^3}{298,15 \text{ K} \cdot 8,314 \text{ J mol}^{-1} \text{ K}^{-1}} = 0,122 \text{ mol}$

$M(\text{A}) < \frac{6,4 \text{ g}}{0,122 \text{ mol}} = 52 \text{ g/mol}$

b)



5. I a) $n(\text{HCl}) = \frac{100 \text{ cm}^3}{20 \text{ cm}^3} \cdot 0,0127 \text{ dm}^3 \cdot \frac{0,1015 \text{ mol}}{1 \text{ dm}^3} = 0,006445 \text{ mol} \approx$

$\approx 6,45 \cdot 10^{-3} \text{ mol}$

b) $V(\text{tilk}) = 0,006445 \text{ mol} \cdot \frac{36,5 \text{ g}}{1 \text{ mol}} \cdot \frac{1}{0,394} \cdot \frac{1 \text{ cm}^3}{1,195 \text{ g}} \cdot \frac{1}{10} = 0,04996 \text{ cm}^3 \approx$

$\approx 5,00 \cdot 10^{-2} \text{ cm}^3$

II a) i) $[\text{H}^+] = \sqrt{2,1 \cdot 10^{-13}} = 4,58 \cdot 10^{-7} \text{ M}$

$\text{pH} = -\log 4,58 \cdot 10^{-7} = 6,34 \approx 6,3$

ii) Neutraalne, sest $[\text{H}^+] = [\text{OH}^-]$

b) Summaarne $[\text{H}^+] = 10^{-\log[\text{H}^+]} = 10^{-6} = [\text{H}^+, \text{HCl-st}] + [\text{H}^+, \text{H}_2\text{O-st}]$

$[\text{H}^+, \text{H}_2\text{O-st}] = [\text{OH}^-, \text{antud pH juures}]$

$[\text{OH}^-] = \frac{2,1 \cdot 10^{-13}}{10^{-6}} = 2,1 \cdot 10^{-7} = [\text{H}^+, \text{H}_2\text{O-st}]$

$n(\text{H}^+, 1 \text{ tilgas}) = 6,445 \cdot 10^{-4} \text{ mol}$

$10^{-6} \frac{\text{mol}}{\text{dm}^3} = \frac{6,445 \cdot 10^{-4} \text{ mol}}{V} + 2,1 \cdot 10^{-7} \frac{\text{mol}}{\text{dm}^3}$

$10^{-6} \frac{\text{mol}}{\text{dm}^3} \cdot V = 6,445 \cdot 10^{-4} \text{ mol} + 2,1 \cdot 10^{-7} \frac{\text{mol}}{\text{dm}^3} \cdot V$

$V = \frac{6,445 \cdot 10^{-4} \text{ mol}}{(10^{-6} - 2,1 \cdot 10^{-7}) \text{ mol/dm}^3} = 0,8158 \cdot 10^3 \approx 820 \text{ dm}^3$

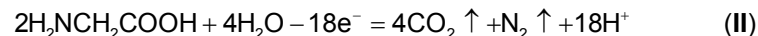
6. a) Lähtevõrrandiks on tasakaalustamata võrrand:



i) Redutseerumine:



Oksüdeerumine:

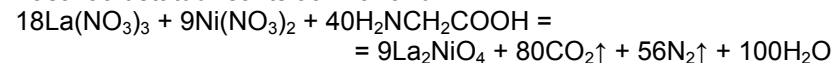


ii) Oksüdeerija: NO_3^-

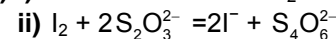
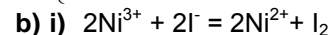
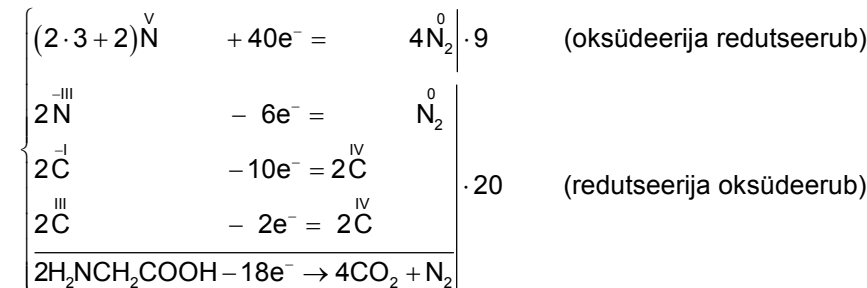
Redutseerija: $\text{H}_2\text{NCH}_2\text{COOH}$

iii) Tasakaalustamiseks korrutada I võrrandit 9-ga ja II võrrandit 20-ga.

Tasakaalustatud reaktsioonivõrrand:



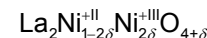
Võib ka lähtuda elektronbilansi meetodist:



c) 0,200 g LNO-s sisaldub:

$n(\text{Ni}^{3+}) = 2n(\text{I}_2) = n(\text{S}_2\text{O}_3^{2-})$

$n(\text{Ni}^{3+}) = \frac{2}{2} \cdot 29,50 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot 0,00100 \frac{\text{mol}}{\text{dm}^3} \cdot \frac{50,00 \text{ cm}^3}{10,00 \text{ cm}^3} = 0,000148 \text{ mol}$



Saame võrrandi:

$2\delta \frac{m(\text{LNO})}{M(\text{LNO})} = 2\delta \frac{m(\text{LNO})}{2M(\text{La}) + M(\text{Ni}) + M(\text{O}) \cdot (4 + \delta)} = n(\text{Ni}^{3+})$

$m(\text{LNO}) = 0,200 \text{ g}$

$2\delta m(\text{LNO}) = n(\text{Ni}^{3+}) [2M(\text{La}) + M(\text{Ni}) + 4M(\text{O}) + \delta M(\text{O})]$

$2\delta m(\text{LNO}) - \delta M(\text{O}) n(\text{Ni}^{3+}) = n(\text{Ni}^{3+}) [2M(\text{La}) + M(\text{Ni}) + 4M(\text{O})]$

$\delta = \frac{n(\text{Ni}^{3+}) [2M(\text{La}) + M(\text{Ni}) + 4M(\text{O})]}{2m(\text{LNO}) - M(\text{O}) n(\text{Ni}^{3+})}$

$\delta = \frac{0,000148 \text{ mol} \cdot 400,5 \text{ g/mol}}{2 \cdot 0,200 \text{ g} - 16 \text{ g/mol} \cdot 0,000148 \text{ mol}} = 0,149$