

# KEEMIAÜLESANNETE LAHENDAMISE LAHTINE VÕISTLUS

Vanem rühm

8. november 2014

Lahendused

1. a)  $a = 75 \text{ m}^2 \cdot 2,5 \text{ m} \cdot 96 \frac{\text{Bq}}{\text{m}^3} = \underline{18000 \text{ Bq}}$  (1)

b)  $N = a \cdot T_{1/2} / \ln(2) = 18000 \text{ Bq} \cdot 3,82 \text{ p} \cdot 24 \frac{\text{h}}{\text{p}} \cdot 3600 \frac{\text{s}}{\text{h}} \cdot \frac{1}{0,693} = \underline{8,6 \cdot 10^9 \text{ osakest}}$  (2)

c)  $N/N_0 = e^{-(4 \text{ p}/3,82 \text{ p})} = 0,35 = \underline{35\%}$  (2)

d)  $t = T_{1/2} \cdot \ln \frac{N_0}{N} \cdot \frac{1}{\ln(2)} = T_{1/2} \cdot \ln \frac{a_0}{a} \cdot \frac{1}{\ln(2)} = 3,82 \text{ p} \cdot \ln \frac{200 \text{ Bq}}{96 \text{ Bq}} \cdot \frac{1}{0,693} = \underline{4 \text{ päeva}}$  (2)



2. a)  $m(\text{NaCl}) = 10\,000 \cdot 0,035 = 350 \frac{\text{kg}}{\text{h}}$  (1)

$m(\text{välja}) = \frac{350}{0,054} = 6481,5 \text{ kg/h}$  (1)

$m(\text{aurustub kokku}) = 10\,000 - m_{\text{välja}} = 3518,5 \text{ kg/h}$  (1)

$m(\text{aur igas astmes}) = \frac{m(\text{aurustub kokku})}{3} = 1172,8 \frac{\text{kg}}{\text{h}} \approx \underline{1200 \text{ kg/h}}$  (1)

b)  $\%(\text{NaCl}_{\text{aste}}) = \frac{m(\text{NaCl})}{10000 - m(\text{aur igas astmes})} \cdot 100\% = \frac{350}{10000 - 1172,8} \cdot 100\% = 3,965\% \approx \underline{4,0\%}$  (1)

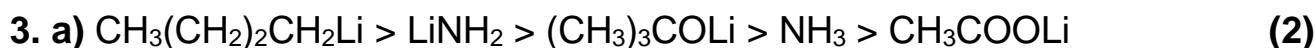
$\%(\text{NaCl}_{\text{aste}}) = \frac{m(\text{NaCl})}{10000 - 2 \cdot m(\text{aur igas astmes})} \cdot 100\% = \frac{350}{10000 - 2 \cdot 1172,8} \cdot 100\% = 4,573\% \approx \underline{4,6\%}$  (1)

c)  $n(\text{NaCl}) = \frac{m(\text{NaCl})}{M(\text{NaCl})} = 5,98 \frac{\text{kmol}}{\text{h}}$  (1)

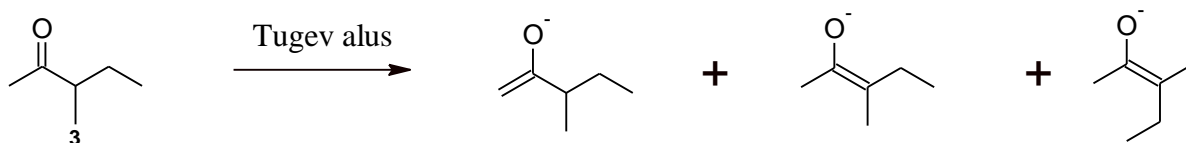
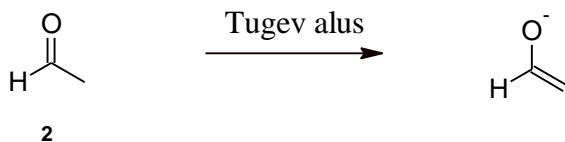
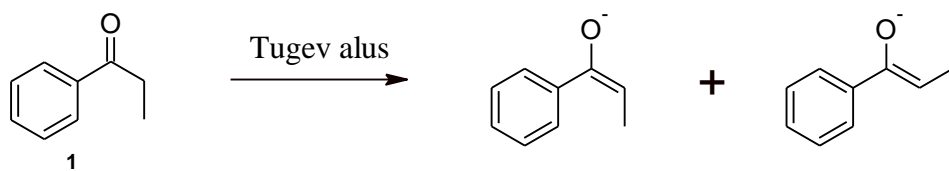
$n(\text{H}_2\text{O}) = \frac{m(\text{välja}) - m(\text{NaCl})}{M(\text{H}_2\text{O})} = 340,6 \frac{\text{kmol}}{\text{h}}$  (1)

$\%(\text{NaCl, mol}) = \frac{n(\text{NaCl})}{n(\text{H}_2\text{O}) + n(\text{NaCl})} \cdot 100\% = 1,725\% \approx \underline{1,7\%}$  (1)

d) Tekkivat auru saaks kasutada protsessi siseneva vee soojendamiseks, mis vähendaks küttekulusid. (1)

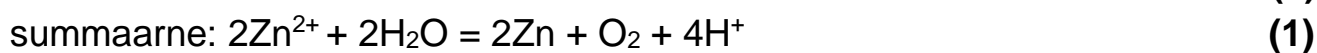
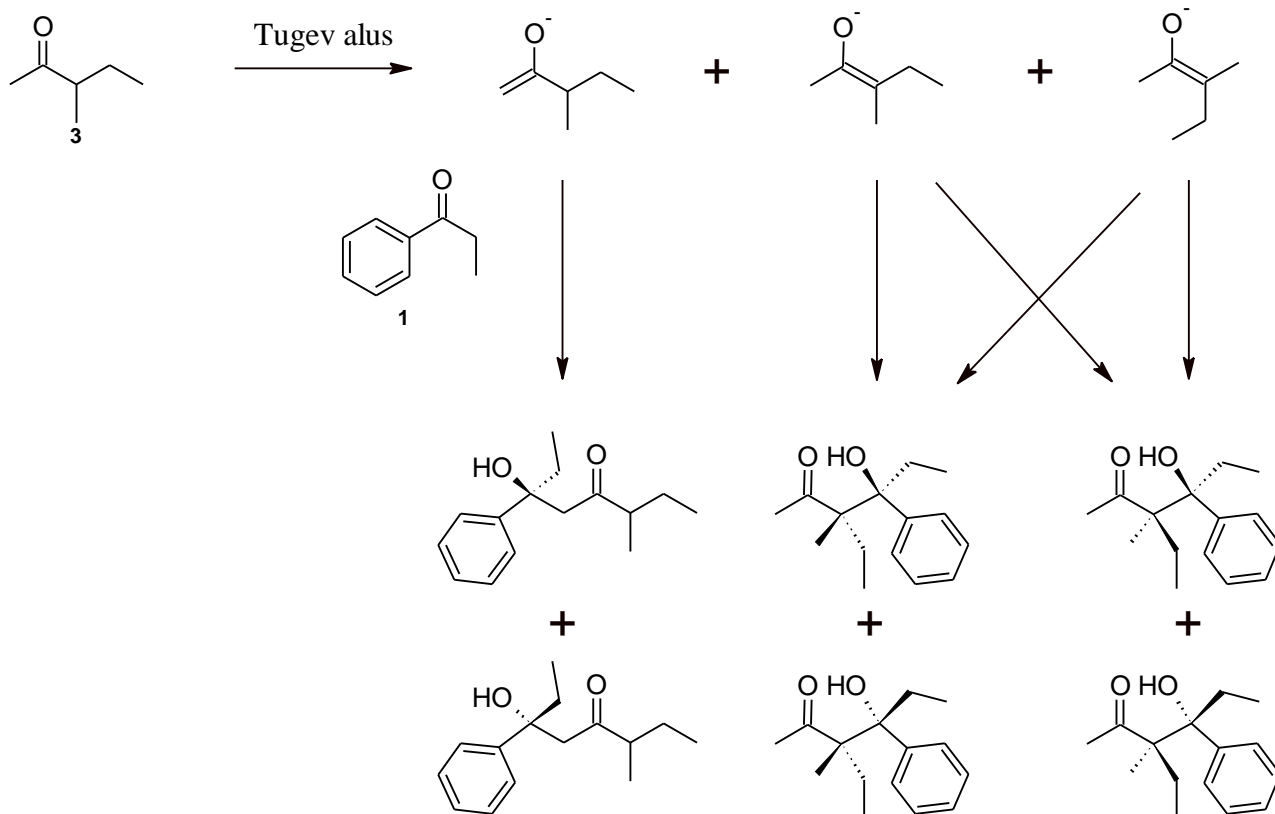


b) (1p iga õige reaktsiooni eest ja 0,5p kui pole kõiki isomeere) (3)



c) (1p iga õige isomeeri eest)

(6)

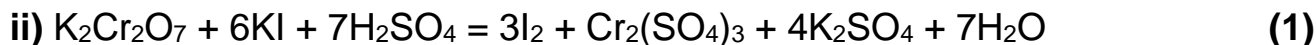
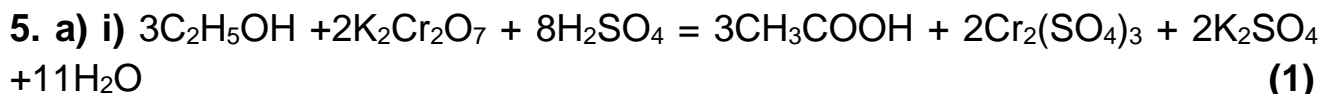


b)  $V_{\text{lisa}} = \frac{m}{\rho} = \frac{n \cdot M}{\rho} = \frac{I \cdot t \cdot M}{z \cdot F \cdot \rho} = \frac{2 \text{ A} \cdot 2 \cdot 60 \cdot 60 \text{ s} \cdot 65 \text{ g} \cdot \text{mol}^{-1}}{2 \cdot 96485 \text{ s} \cdot \text{A} \cdot \text{mol}^{-1} \cdot 7,14 \text{ g} \cdot \text{cm}^{-3}} = 0,679 \text{ cm}^3$  (2)

$S = 2S_p + S_k = 2 \cdot 3,14 \cdot 1 \cdot \text{cm}^2 + 20 \text{ cm} \cdot 2 \text{ cm} \cdot 3,14 = 131,88 \text{ cm}^2$  (1)

$$\Delta l = V_{\text{liisa}}/S = 0,679 \text{ cm}^3/131,88 \text{ cm}^2 = 0,005 \text{ cm} = \mathbf{50 \mu\text{m}} \quad (2)$$

c) Ioonid sadenevad järjekorras  $\text{Hg}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Cd}^{2+}$ . (2)



b)

$$n(\text{Na}_2\text{S}_2\text{O}_3) = 37,52 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot 0,652 \frac{\text{mol}}{\text{dm}^3} \cdot \frac{1000 \text{ mmol}}{1 \text{ mol}} = 24,463 \text{ mmol}$$

$$\Delta n(\text{K}_2\text{Cr}_2\text{O}_7) = \frac{1}{2} \cdot \frac{1}{3} \cdot 24,463 \text{ mmol} = 4,077 \text{ mmol}$$

$$n(\text{K}_2\text{Cr}_2\text{O}_7)_{\text{alg}} = 18,00 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot 0,672 \frac{\text{mol}}{\text{dm}^3} \cdot \frac{1000 \text{ mmol}}{1 \text{ mol}} = 12,096 \text{ mmol}$$

$$\Delta n(\text{K}_2\text{Cr}_2\text{O}_7)_{\text{reag}} = 12,096 \text{ mmol} - 4,077 \text{ mmol} = 8,019 \text{ mmol}$$

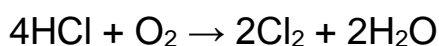
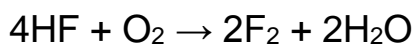
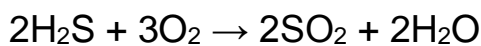
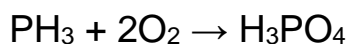
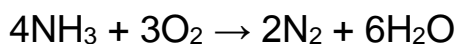
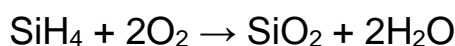
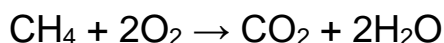
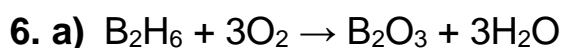
$$n(\text{EtOH}) = \frac{3}{2} \cdot 8,019 \text{ mmol} = 12,03 \text{ mmol}$$

$$n(\text{EtOH})_{\text{brändi}} = \frac{100 \text{ cm}^3}{10 \text{ cm}^3} \cdot 12,03 \text{ mmol} = 120,3 \text{ mmol}$$

$$m(\text{EtOH})_{\text{brändi}} = 120,3 \text{ mmol} \cdot \frac{1 \text{ mol}}{1000 \text{ mmol}} \cdot \frac{46,08 \text{ g}}{1 \text{ mol}} = 5,543 \text{ g}$$

$$\%(\text{EtOH})_{\text{brändi}} = \frac{5,543 \text{ g}}{10 \text{ cm}^3 \cdot 0,923 \frac{\text{g}}{\text{cm}^3}} \cdot 100 = \mathbf{60,0}$$

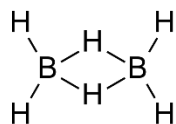
(iga arvutuse eest 1p, kokku 8p)



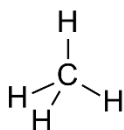
(iga õige reaktsiooni eest 0,5p, kokku 2p)

b)

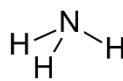
(2)



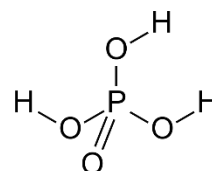
B<sub>2</sub>H<sub>6</sub>



CH<sub>4</sub>



NH<sub>3</sub>



H<sub>3</sub>PO<sub>4</sub>

c) **A**  $Q(\text{B}_2\text{H}_6) = [8 \cdot 314 + 3 \cdot 494 - 6 \cdot 536 - 6 \cdot 459] \text{ kJ/mol} = -1976 \text{ kJ/mol}$  (0,5)

**B**  $Q(\text{CH}_4) = [4 \cdot 411 + 2 \cdot 494 - 2 \cdot 799 - 4 \cdot 459] \text{ kJ/mol} = -802 \text{ kJ/mol}$  (0,5)

**C**  $Q(\text{SiH}_4) = [4 \cdot 318 + 2 \cdot 494 - 4 \cdot 452 - 4 \cdot 459] \text{ kJ/mol} = -1384 \text{ kJ/mol}$  (0,5)

**E**  $Q(\text{PH}_3) = [3 \cdot 322 + 2 \cdot 494 - 3 \cdot 459 - 3 \cdot 335 - 544] \text{ kJ/mol} = -972 \text{ kJ/mol}$  (0,5)

d) HF ei põle hapnikus. Isesüttivad on B<sub>2</sub>H<sub>6</sub>, SiH<sub>4</sub> ja PH<sub>3</sub> (virvatuli). (2)

e) B<sub>2</sub>H<sub>6</sub> ja PH<sub>3</sub> annavad enim soojust, kuid nad on isesüttivad ning happelised B<sub>2</sub>O<sub>3</sub> ja H<sub>3</sub>PO<sub>4</sub> võivad olla Hambutule kahjulikud. SiH<sub>4</sub> ja B<sub>2</sub>H<sub>6</sub> reageerivad aktiivselt ka veega ja annavad kahjulikke ühendeid. Seega soovitame Kokutisel jätkata loodusliku metaani kasutamist. (2)