

2003/2004 õa keemiaolümpiaadi lõppvooru ülesannete lahendused

9. klass

1. a) i) **A** – S^{2-} , sulfiidioon, $18e^-$ ii) ${}_{16}S$, väävel
B – Ar, argoon, $18e^-$ ${}_{18}Ar$, argoon
C – Ca^{2+} , kaltsiumioon, $18e^-$ ${}_{20}Ca$, kaltsium
D – Cl^- , kloriidioon, $18e^-$ ${}_{17}Cl$, kloor
E – K^+ , kaaliumioon, $18e^-$ ${}_{19}K$, kaalium

b) CaS, kaltsiumsulfiid, ei lahustu vees (neutraalne)

K_2S , kaaliumsulfiid, aluseline

$CaCl_2$, kaltsiumkloriid, neutraalne

KCl, kaaliumkloriid, neutraalne

c) i) $Ca^{2+} + S^{2-} = CaS$ (ühend **X**)

ii) $CaCl_2 + Na_2CO_3 = CaCO_3 \downarrow$ (ühend **Q**) + $2NaCl$

iii) $2CaS + 3O_2 = 2CaO$ (ühend **Z**) + $2SO_2$ (ühend **Y**)

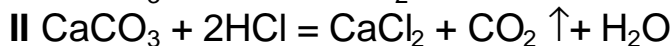
d) $M(Y) = 29,0 \text{ g/mol} \cdot 2,21 = 64,1 \text{ g/mol}$

$M(SO_2) = 32,1 + 2 \cdot 16,0 = 64,1 \text{ g/mol}$

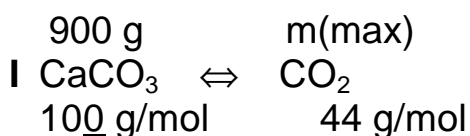
$M(Z) = 56,1 \text{ g/mol}$

$M(CaO) = 40,1 + 16,0 = 56,1 \text{ g/mol}$

2. a) I ${}^0_t{}^0_t$



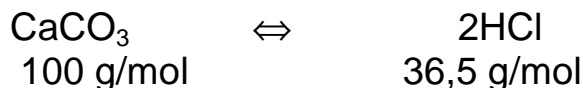
b) $m(CaCO_3) = 1,00 \text{ kg} \cdot 0,90 = 900 \text{ g}$



$$m(CO_2, \text{max}) = \frac{1}{1} \cdot 900 \text{ g} \cdot \frac{1 \text{ mol}}{100 \text{ g}} \cdot 44 \text{ g/mol} = 396 \text{ g} \approx \underline{400 \text{ g}}$$

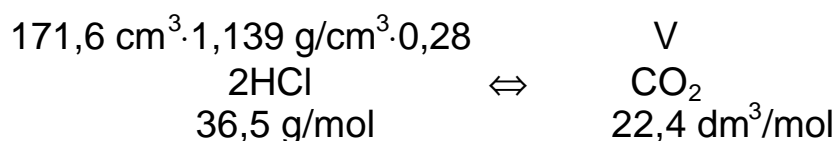
II Arvutame soolhappele vastava $CaCO_3$ massi

$$m \quad 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28$$



$$m(CaCO_3) = \frac{1}{2} \cdot 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 100 \text{ g/mol} = 75 \text{ g}$$

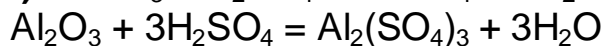
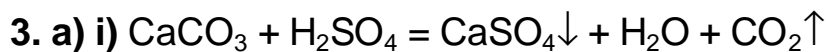
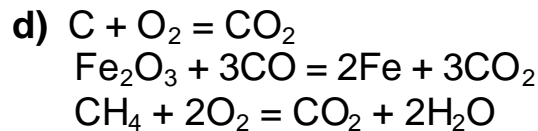
$CaCO_3$ on liias. Arvutused tuleb teha HCl järgi.



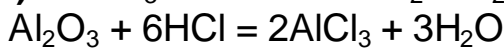
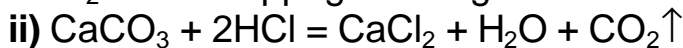
$$V(\text{CO}_2) = \frac{1}{2} \cdot 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} = 16,79 \text{ dm}^3 \approx \mathbf{17 \text{ dm}^3}$$

c) I **%(saagis)** = $\frac{277 \text{ g}}{396 \text{ g}} \cdot 100 = 69,9 \approx \mathbf{70}$

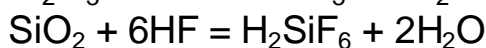
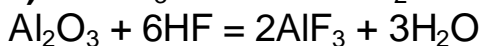
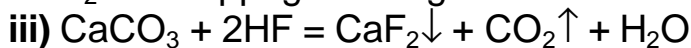
II **%(saagis)** = $\frac{13,44 \text{ dm}^3}{16,79 \text{ dm}^3} \cdot 100 = \mathbf{80}$



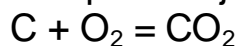
SiO_2 väävelhappega ei reageeri.



SiO_2 soolhappega ei reageeri.



b) Ahi läks põlema ja hunt põgenes.



4. a) A – NaNO_3 , tšiili salpeeter, põllumajandus.

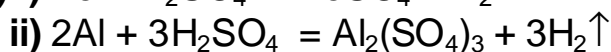
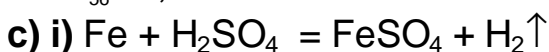
B – KNO_3 , india salpeeter, musta püssirohu põhikomponent.

C – AgNO_3 , pörgukivi (?????), fotograafia - meditsiin

b) X – $^{56}_{26}\text{Fe}$, raud

Y – $^{27}_{13}\text{Al}$, alumiinium

Z – $^{137}_{56}\text{Ba}$, baarium



d) Kontsentreeritud väävel- ja lämmastikhappega reageerimisel moodustub raua ja alumiiniumi pinnale mittelahustuv hapetega mittereageeriv kaitsekile.

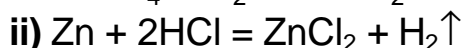
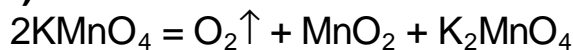
5. a) A – O_2 , hapnik

B – H_2 , vesinik

D – CO_2 , süsinikdioksiid

E – CO , süsinikmonooksiid

b) i) ^0t

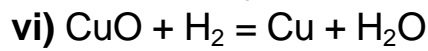
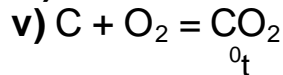
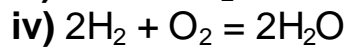
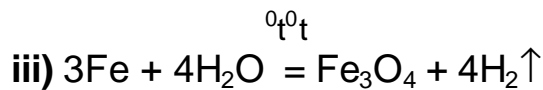


X – K_2MnO_4 , kaaliummanganaat

Y – H_2O , vesi

Z – Fe_3O_4 , raud(II,III)oksiid

Q – C, süsi, grafiit



$$\text{6. I } 10^\circ\text{C i) } \%(\text{KNO}_3) = \frac{21,5}{121,5} \cdot 100 = 17,7$$

$$20^\circ\text{C ii) } L(\text{KNO}_3) = \frac{24,1}{75,9} \cdot 100 \text{ g} = 31,8 \text{ g}$$

$$30^\circ\text{C i) } \%(\text{KNO}_3) = \frac{115}{365} \cdot 100 = 31,5$$

$$\text{ii) } L(\text{KNO}_3) = \frac{115}{250} \cdot 100 \text{ g} = 46,0 \text{ g}$$

$$40^\circ\text{C i) } \%(\text{KNO}_3) = \frac{25,8}{65,8} \cdot 100 = 39,2 \text{ g}$$

$$\text{ii) } L(\text{KNO}_3) = \frac{25,8}{40,0} \cdot 100 \text{ g} = 64,5 \text{ g}$$

$$50^\circ\text{C i) } \%(\text{KNO}_3) = \frac{344}{744} \cdot 100 = 46,2 \text{ g}$$

$$\text{ii) } L(\text{KNO}_3) = \frac{344}{400} \cdot 100 \text{ g} = 86,0 \text{ g}$$

$$\text{II } m(\text{KNO}_3, \text{kuumas}) - m(\text{KNO}_3, \text{jahedas}) = m(\text{KNO}_3, \text{puhas})$$

Ümberkristalliseerimisel vee mass ei muutu.

$$100 \text{ g (H}_2\text{O)} \Leftrightarrow 110 \text{ g (KNO}_3)$$

Kuumas lahuses

$$m(\text{H}_2\text{O}) = 100 \text{ g (KNO}_3) \cdot \frac{100 \text{ g}}{110 \text{ g (KNO}_3)} = 90,9 \text{ g}$$

$$\begin{aligned} m(\text{KNO}_3, \text{puhas}) &= \frac{110 \text{ g}}{100 \text{ g (H}_2\text{O)}} \cdot 90,9 \text{ g (H}_2\text{O)} - \frac{21,5 \text{ g}}{100 \text{ g (H}_2\text{O)}} \cdot 90,9 \text{ g (H}_2\text{O)} = \\ &= 100 \text{ g} - 19,5 \text{ g} = 80,5 \text{ g} \approx \mathbf{81 \text{ g}} \end{aligned}$$

Y – S, väävel

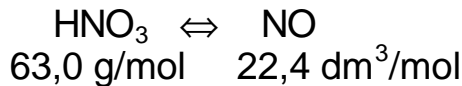
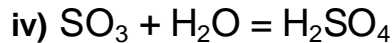
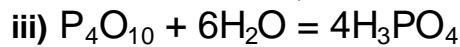
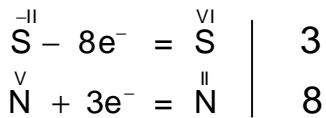
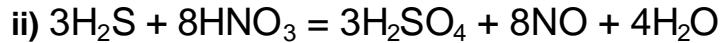
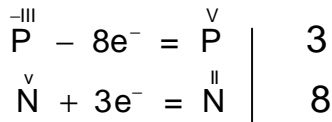
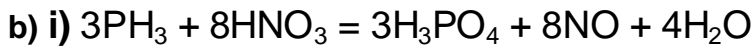
D – H₂SO₄, väävelhape

A – PH₃, fosfiin, 34 g/mol

E – P₄O₁₀, tetrafosfordekaoksiid,
14 aatomit molekulis

B – H₂S, divesiniksulfiid, 34 g/mol

F – SO₃, vääveltrioksiid,
4 aatomit molekulis



$$\begin{aligned} V(\text{NO}) &= \frac{1}{1} \cdot 1 \text{ L} \cdot \frac{1000 \text{ cm}^3}{1 \text{ L}} \cdot 1,387 \text{ g/cm}^3 \cdot 0,640 \cdot \frac{1 \text{ mol}}{63,0 \text{ g}} \cdot 22,4 \text{ dm}^3/\text{mol} = \\ &= 315,6 \text{ dm}^3 \approx \mathbf{316 \text{ dm}^3} \end{aligned}$$

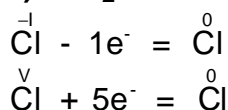
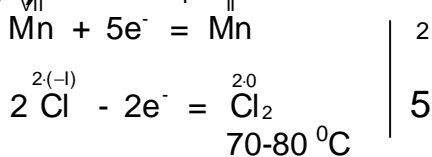


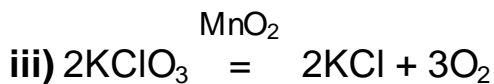
$$\begin{aligned} \text{b) } \Delta H_c(\text{glükoos}) &= [6 \text{ mol} \cdot (-393,5 \text{ kJ/mol}) + 6 \text{ mol} \cdot (-285,8 \text{ kJ/mol}) - \\ &\quad - 1 \text{ mol} \cdot (-1268 \text{ kJ/mol})] \cdot \frac{1}{\text{mol}} = \mathbf{-2808 \text{ kJ/mol}} \end{aligned}$$

$$\begin{aligned} \text{c) } \text{Energia(süda)} &= 1,00 \text{ J/löök} \cdot 365 \text{ päeva} \cdot \frac{24 \text{ h}}{\text{päev}} \cdot \frac{60 \text{ min}}{\text{h}} \cdot 70 \text{ lööki/min} = \\ &= 3,68 \cdot 10^7 \text{ J} \end{aligned}$$

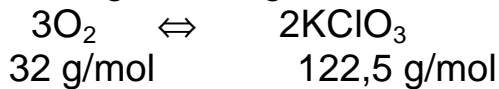
$$m(\text{glükoos}) = 3,68 \cdot 10^7 \text{ J} \cdot \frac{1 \text{ mol}}{2,808 \cdot 10^6 \text{ J}} \cdot 180 \text{ g/mol} = 2358 \text{ g} = 2,36 \text{ kg}$$

$$\begin{aligned} \text{d) } N(\text{hingetõmme}) &= \frac{6}{1} \cdot 2358 \text{ g} \cdot 1 \text{ mol}/180 \text{ g} \cdot 25,4 \text{ dm}^3/\text{mol} \cdot \frac{1}{0,05} \cdot \frac{1}{0,5 \text{ dm}^3} = 79900 \sim \\ &\sim \mathbf{80000} \end{aligned}$$





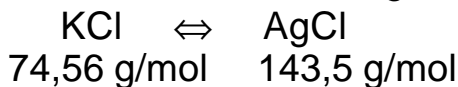
$$\text{b) i) } 25,80 \text{ g} - 22,43 \text{ g} = m$$



$$m(\text{KClO}_3) = \frac{2}{3} \cdot 3,37 \text{ g} \cdot \frac{1 \text{ mol}}{32 \text{ g}} \cdot 122,5 \text{ g/mol} = \mathbf{8,60 \text{ g}}$$

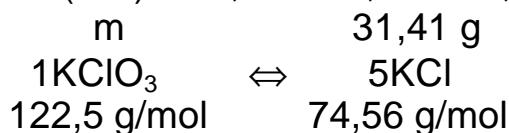
$$\text{ii) } m(\text{KCl}) = 25,80 \text{ g} - 8,60 \text{ g} = \mathbf{17,20 \text{ g}}$$

$$\text{c) } m = 27,35 \text{ g}$$



$$m(\text{KCl}) = \frac{1}{1} \cdot 27,35 \text{ g} \cdot \frac{1 \text{ mol}}{143,5 \text{ g}} \cdot 74,56 \text{ g/mol} = \mathbf{14,21 \text{ g}}$$

$$\text{d) } \Sigma m(\text{KCl}) = 17,20 + 14,21 = 31,41 \text{ g}$$



$$m(\text{KClO}_3) = \frac{1}{5} \cdot 31,41 \text{ g} \cdot \frac{1 \text{ mol}}{74,56 \text{ g}} \cdot 122,5 \text{ g/mol} = \mathbf{10,32 \text{ g}}$$

$$m(\text{KClO}_3, \text{Z}) = 10,32 \text{ g} - 8,60 \text{ g} = \mathbf{1,72 \text{ g}}$$

$$\text{e) } m(\text{H}_2\text{O}) = 65,90 \text{ g} - 14,21 \text{ g} - 1,72 \text{ g} = 49,97 \text{ g}$$

$$\text{i) } L(\text{KCl}) = 14,21 \text{ g} \cdot \frac{1}{49,97} \cdot 100 = \mathbf{28,44 \text{ g}}$$

$$\text{ii) } L(\text{KClO}_3) = 1,72 \text{ g} \cdot \frac{1}{49,97} \cdot 100 = \mathbf{3,44 \text{ g}}$$

6. a) A – CO₂, süsinikdioksiid

B – SO₃, vääveltrioksiid

C – H₂S, divesiniksulfiid

X – MgCO₃, magneesiumkarbonaat

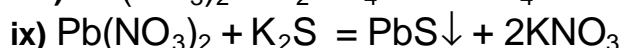
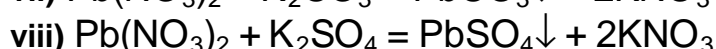
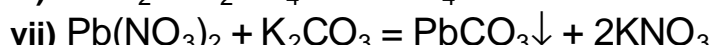
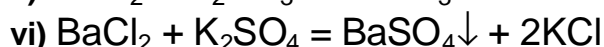
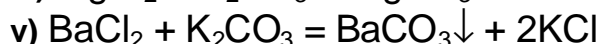
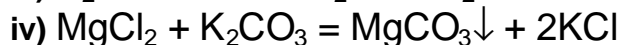
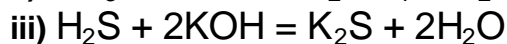
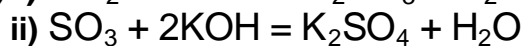
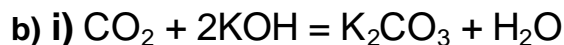
Y – BaCO₃, baariumkarbonaat

Z – BaSO₄, baariumsulfaat

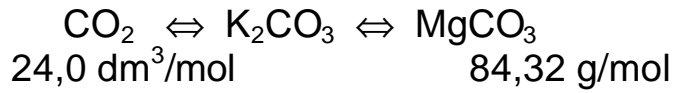
P – PbCO₃, pliiikarbonaat

Q – PbSO₄, pliiisulfaat

R – PbS, pliiisulfiid



$$\text{c) i) } \quad \quad \quad \text{V} \qquad \qquad \qquad 3 \cdot 11,24 \text{ g}$$

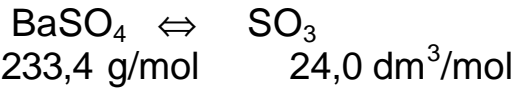


$$V(\text{CO}_2) = \frac{1}{1} \cdot 11,24 \text{ g} \cdot \frac{1 \text{ mol}}{84,32 \text{ g}} \cdot 3 \cdot 24,0 \text{ dm}^3 / \text{mol} = 0,1333 \text{ mol} \cdot 3 \cdot 24,0 \text{ dm}^3 / \text{mol} = \mathbf{9,60 \text{ dm}^3}$$

$$\text{ii) } m(\text{BaCO}_3) = \frac{1}{1} \cdot 0,1333 \text{ mol} \cdot 197,3 \text{ g/mol} = 26,30 \text{ g}$$

$$m(\text{BaSO}_4) = 119,9 \text{ g} - 26,3 \text{ g} = 93,6 \text{ g}$$

$$3 \cdot 93,6 \text{ g} \quad \quad \quad \text{V}$$



$$V(\text{SO}_3) = \frac{1}{1} \cdot 93,6 \text{ g} \cdot \frac{1 \text{ mol}}{233,4 \text{ g}} \cdot 3 \cdot 24,0 \text{ dm}^3 / \text{mol} = 0,401 \text{ mol} \cdot 3 \cdot 24,0 \text{ dm}^3 / \text{mol} =$$

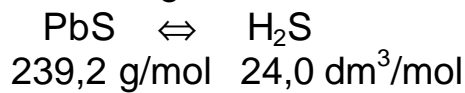
$$= \mathbf{28,9 \text{ dm}^3}$$

$$\text{iii) } m(\text{PbCO}_3) = \frac{1}{1} \cdot 0,1333 \text{ mol} \cdot 267,2 \text{ g/mol} = 35,62 \text{ g}$$

$$m(\text{PbSO}_4) = \frac{1}{1} \cdot 0,401 \text{ mol} \cdot 303,3 \text{ g/mol} = 121,6 \text{ g}$$

$$m(\text{PbS}) = 171,2 \text{ g} - 35,62 \text{ g} - 121,6 \text{ g} = 14,0 \text{ g}$$

$$3 \cdot 14,0 \text{ g} \quad \quad \quad \text{V}$$



$$V(\text{H}_2\text{S}) = \frac{1}{1} \cdot 14,0 \text{ g} \cdot \frac{1 \text{ mol}}{239,2 \text{ g}} \cdot 3 \cdot 24,0 \text{ dm}^3 / \text{mol} = \mathbf{4,21 \text{ dm}^3}$$

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11. klass

1. a) **A** – H₂, vesinik

B – Cl₂, kloor

C – HCl, vesinikkloriid

D – F₂, fluor

E – HF, vesinikfluoriid

F – H₂SiF₆, heksafluororänihape

G – P₄, valge fosfor

H – PCl₃, fosfortrikloriid

I – PCl₅, fosforpentakloriid

J – Sb, antimon

K – SbCl₅, antimon(V)kloriid

L – H₃PO₄, ortofosforhape

b) i) H₂ + Cl₂ = 2HCl

ii) H₂ + F₂ = 2HF

iii) 6HF + SiO₂ = H₂SiF₆ + 2H₂O

iv) P₄ + 6Cl₂ = 4PCl₃

v) P₄ + 10Cl₂ = 4PCl₅

vi) 2Sb + 5Cl₂ = 2SbCl₅

vii) PCl₅ + 4H₂O = 5HCl + H₃PO₄

2. a)

A – N₂, lämmastik

B – NH₃, ammoniaak

C – H₂N–NH₂, hüdrasiin

D – HNO₂, lämmastikushape

E – HN₃, lämmastikvesinikhape,
vesiniktrinitriid, vesinikasiid

F – NaNH₂, naatriumamiid

G – H₂, vesinik

X – NaN₃, naatriumasiid

b) i) $\overset{p,0t}{N_2 + 3H_2 = 2NH_3}$

ii) 2NH₃ + NaClO = H₂N–NH₂ + NaCl + H₂O

iii) H₂N–NH₂ + HNO₂ = HN₃ + 2H₂O

iv) 2NH₃ + 2Na = 2NaNH₂ + H₂↑

v) NaNH₂ + N₂O = NaN₃ + H₂O

vi) 2HN₃ + 2Na = 2NaN₃ + H₂

3. a) C₁₂H₂₂O₁₁ + 12O₂ = 12CO₂ + 11H₂O (v)

i) $DH^0 = \Delta H_c^0(C_{12}H_{22}O_{11}) = 11 \text{ mol} \cdot (-286 \text{ kJ/mol}) + 12 \text{ mol} \cdot (-394 \text{ kJ/mol}) -$
 $- 1 \text{ mol} \cdot (-2222 \text{ kJ/mol}) \Rightarrow -5652 \text{ kJ} \cdot \frac{1}{\text{mol}} = \mathbf{-5652 \text{ kJ/mol}}$

ii) $\Delta S^0 = 11 \text{ mol} \cdot 70 \frac{\text{J}}{\text{K} \cdot \text{mol}} + 12 \text{ mol} \cdot 214 \frac{\text{J}}{\text{K} \cdot \text{mol}} - 12 \text{ mol} \cdot 205 \frac{\text{J}}{\text{K} \cdot \text{mol}} -$
 $- 1 \text{ mol} \cdot 360 \frac{\text{J}}{\text{K} \cdot \text{mol}} = \mathbf{518 \text{ J/K}}$

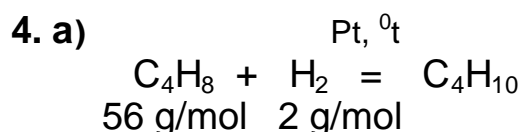
iii) T = 36,85 °C + 273,15 °C = 310,00 K

DG = ΔG_c(C₁₂H₂₂O₁₁) = -5652 kJ - 310 K · 0,518 kJ/K =

-5652 kJ - 160,58 kJ ⇒ ≈ -5813 kJ · $\frac{1}{\text{mol}}$ = **-5813 kJ/mol**

$$\text{b) } n(\text{peptiidsidemed}) = 5813 \text{ kJ} \cdot 0,4 \cdot \frac{1 \text{ mol}}{17,0 \text{ kJ}} \approx \mathbf{137 \text{ mol}}$$

Tähelepanu: Sahharoosi oksüdeerumisel vabaneb, kuid peptiidsidemete sünteesil neeldub energia.



$$\text{b) } n(\text{C}_4\text{H}_8) \cdot 56 \text{ g/mol} + [2 \text{ mol} - n(\text{C}_4\text{H}_8)] \cdot 2 \text{ g/mol} = 2,5 \cdot 17 \text{ g/mol} \cdot 2 \text{ mol}$$

$$n(\text{C}_4\text{H}_8) = \frac{85 \text{ mol} - 4 \text{ mol}}{56 - 2} = \mathbf{1,5 \text{ mol}}$$

$$n(\text{H}_2) = 2 \text{ mol} - 1,5 \text{ mol} = \mathbf{0,5 \text{ mol}}$$

c) Kui reageerib y vesinikku, siis

$$n(\text{H}_2, \text{lõpus}) = 0,5 \text{ mol} - y$$

$$n(\text{C}_4\text{H}_8, \text{lõpus}) = 1,5 \text{ mol} - y$$

$$n(\text{C}_4\text{H}_{10}, \text{lõpus}) = y$$

$$0,5 \text{ mol} - y + 1,5 \text{ mol} - y + y = 2,0 \text{ mol}(1-0,2)$$

$$y = 0,4 \text{ mol}$$

%(saagis) = 100, kui reageerib ära kogu vesinik

$$\text{%(saagis)} = \frac{0,4 \text{ mol}}{0,5 \text{ mol}} \cdot 100 = \mathbf{80}$$

$$\text{d) } K = \frac{[\text{C}_4\text{H}_{10}]}{[\text{C}_4\text{H}_8] \cdot [\text{H}_2]}$$

Et reaktsiooninõu maht on 1 dm³, siis kontsentratsioon on võrdne aine hulgaga.

$$K = \frac{0,4}{0,1 \cdot 1,1} = 3,6 \text{ dm}^3/\text{mol}$$

$$\text{e) } n'(\text{C}_4\text{H}_8) \cdot 56 \text{ g/mol} + [2 \text{ mol} - n'(\text{C}_4\text{H}_8)] \cdot 2 \text{ g/mol} = 3 \cdot 17 \text{ g/mol} \cdot 2 \text{ mol}$$

$$n'(\text{C}_4\text{H}_8) = 1,81 \text{ mol}$$

$$n'(\text{H}_2) = 2 \text{ mol} - 1,81 \text{ mol} = 0,19 \text{ mol}$$

Kui reageerib x vesinikku, siis

$$3,6 = \frac{x}{(1,81 - x) \cdot (0,19 - x)}$$

$$3,6x^2 - 8,2x + 1,238 = 0$$

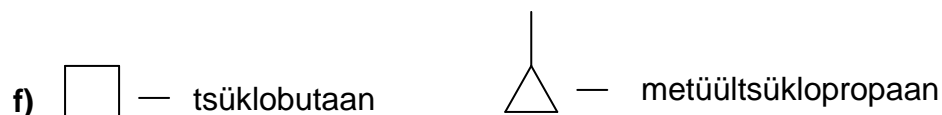
$$x_1 = 0,16$$

$x_2 = 2,11$ ei sobi, sest vesinikku on 0,19 mol

$$\Sigma n'(\text{lõpus}) = (1,81 - 0,16) + (0,19 - 0,16) + 0,16 = 1,84 \text{ mol}$$

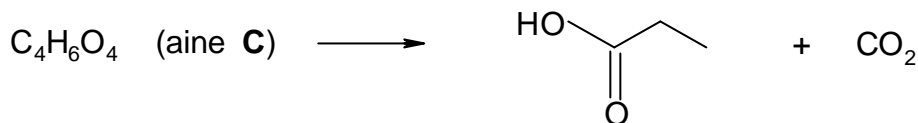
Rõhk ja hulk on omavahel võrdelises sõltuvuses.

$$\text{Dp} = \frac{2 \text{ mol} - 1,84 \text{ mol}}{2 \text{ mol}} \cdot 100\% \approx \mathbf{8\%}$$

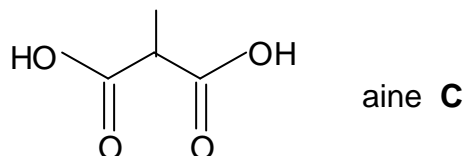


$$n(\text{O}) = 64 \text{ g} \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 4 \text{ mol}$$

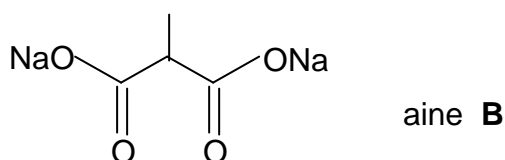
Aine **X** brutovalem on $\text{C}_{12}\text{H}_{22}\text{O}_4$



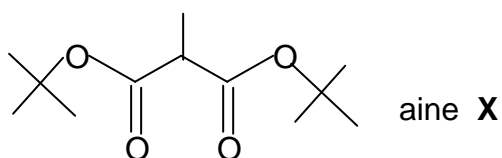
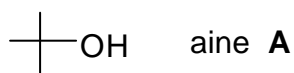
Aine **C** oli hargnenud ahelaga hape, mis dekarboksüleerus. Järelikult saab see olla dihape, sest tekkis propaanhape.



Aine **B** on järelikult dihape sool



Aine **X** andis leelise toimet tertsiaarse alkoholi ja happe soola. Soola **B** aniooni brutovalem on $\text{C}_4\text{H}_4\text{O}_4$. Aine **X** jääb järgi brutovalem C_8H_{18} . Et aine **X** on dihape ester, siis alkoholi alküülrühma brutovalem on C_4H_9 , mis vastab tert-alküülrühmale.



2003/2004 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. Ratsionaalne on lähtuda täpselt 1 liitrist õllest.

$$m_{\text{ass}}(\text{õlu}) = 1 \text{ liiter} \cdot \frac{988 \text{ g}}{1 \text{ liiter}} = 988 \text{ g}$$

$$V(\text{alc}) = 1 \text{ liiter} \cdot 0,074 = 74 \text{ cm}^3$$

$$m_{\text{ass}}(\text{alc}) = 74 \text{ cm}^3 \cdot 0,791 \text{ g/cm}^3 = 58,53 \text{ g} \approx 59 \text{ g}$$

$$m_{\text{ass}}(\text{H}_2\text{O}) = 988 \text{ g} - 59 \text{ g} = 929 \text{ g}$$

$$m(\text{alc}) = 59 \text{ g} \cdot \frac{1 \text{ mol}}{46 \text{ g}} \times \frac{1}{0,929 \text{ kg}}$$

$$\Delta T = 59 \text{ g} \cdot \frac{1 \text{ mol}}{46 \text{ g}} \times \frac{1}{0,929 \text{ kg}} \times 1,86 \frac{\text{K} \cdot \text{kg}}{\text{mol}} = 2,57 \text{ K} \approx 2,6 \text{ K}$$

Märkus: Õlles on ka muid lisandeid, mistõttu võib ΔT väärtust ümardada ülespoole.

$$T = 0 \text{ } ^\circ\text{C} - \Delta T = -2,6 \text{ } ^\circ\text{C}$$

2. a) $\text{C}_8\text{H}_{18}(\text{v}) + 12,5\text{O}_2(\text{g}) = 8\text{CO}_2(\text{g}) + 9\text{H}_2\text{O}(\text{v})$

$$\text{b) } \Delta H_c^\circ(\text{C}_8\text{H}_{18}) = [8 \cdot (-393,5 \text{ kJ}) + 9 \cdot (-285,8 \text{ kJ}) - (-249,9 \text{ kJ})] \cdot \frac{1}{\text{mol}} =$$

$$= -5470,3 \text{ kJ/mol}$$

c) $1000 \text{ K} - 298 \text{ K} = 702 \text{ K}$

$$\Delta H_c^{1000 \text{ K}}(\text{C}_8\text{H}_{18}) = -5470,3 \text{ kJ/mol} + (9 \cdot 40,7) \text{ kJ/mol} - 41,5 \text{ kJ/mol} +$$

$$+ 702 \cdot (0,0753 \cdot 9 + 0,0371 \cdot 8 - 0,0294 \cdot 12,5 - 0,1878) \text{ kJ/mol} =$$

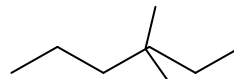
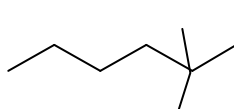
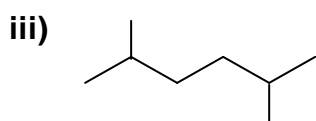
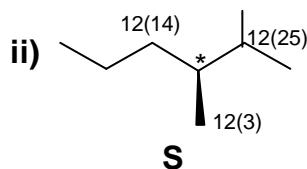
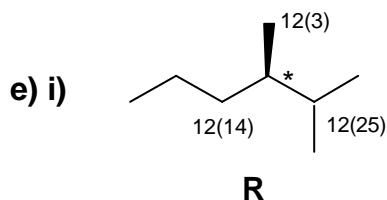
$$= -4851,2 \text{ kJ/mol}$$

$$\text{d) i) } \Delta U_c^\circ(\text{oktaan}) = -5470,3 \text{ kJ/mol} - (8 - 12,5) \text{ mol} \cdot 8,314 \frac{\text{J}}{\text{K} \cdot \text{mol}} \cdot 298 \text{ K} \cdot$$

$$\cdot \frac{1 \text{ kJ}}{1000 \text{ J}} = -5459,2 \text{ kJ/mol}$$

$$\text{ii) } \Delta U_c^{1000 \text{ K}}(\text{oktaan}) = -4851,2 \text{ kJ/mol} - (17 - 13,5) \cdot 8,314 \frac{\text{J}}{\text{K} \cdot \text{mol}} \cdot 1000 \text{ K} \cdot$$

$$\times \frac{1 \text{ kJ}}{1000 \text{ J}} = -4880,3 \text{ kJ/mol}$$



3. a) $6 \cdot 2 \cdot (-I) \quad 12 \cdot (-II)$

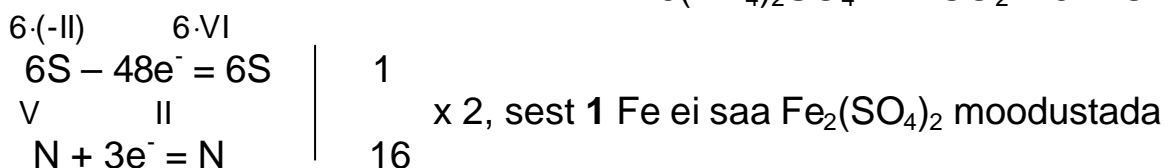
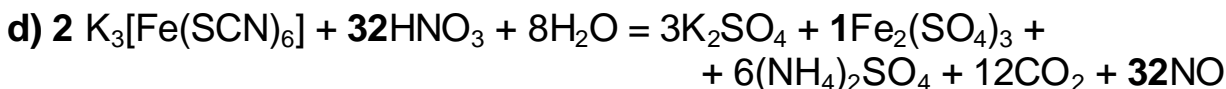
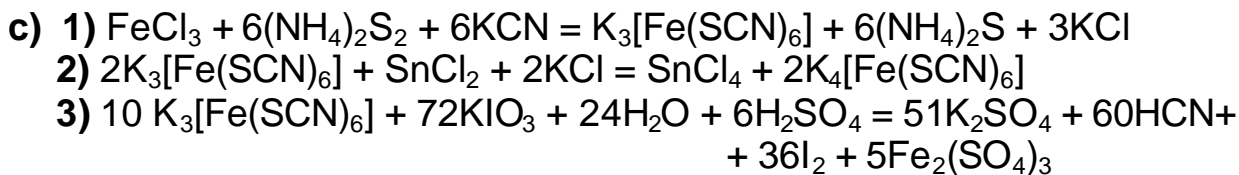
$$\mathbf{E} - 12e^- = \mathbf{E}$$

$$6 \cdot II \quad 6 \cdot z$$

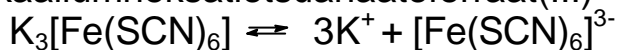
$$\mathbf{B} + 12e^- = \mathbf{B}$$

$$z = \frac{12+12}{6} = 4$$

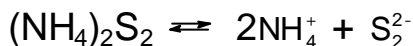
b)	A	B	C	D	E	F	G	H	I	J
	H	C	N	O	S	Cl	K	Fe	Sn	I



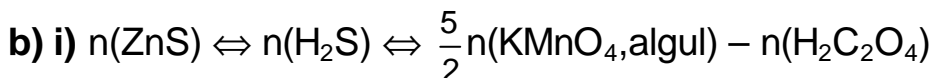
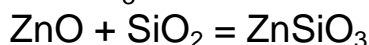
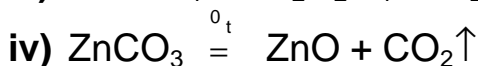
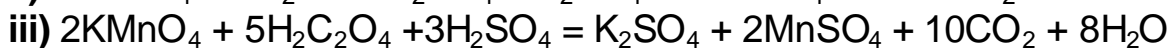
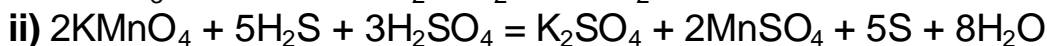
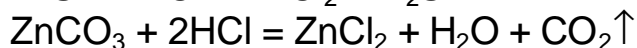
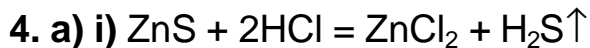
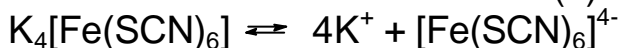
e) i) kaaliumheksatiotsüanaatoferaat(III)



ii) ammooniumdisulfiid



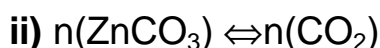
iii) kaaliumheksatiotsüanaatoferaat(II)



$$n(\text{ZnS}) = \frac{5}{2} \cdot 0,9300 \text{ mol/dm}^3 \cdot 0,05009 \text{ dm}^3 -$$

$$- 0,5070 \text{ mol/dm}^3 \cdot 0,03246 \text{ dm}^3 = 0,1000 \text{ mol}$$

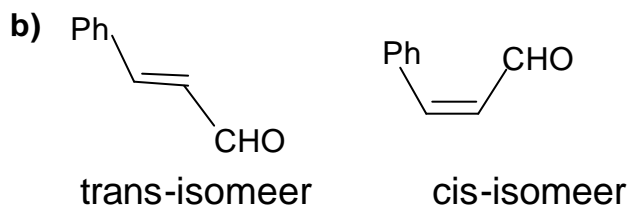
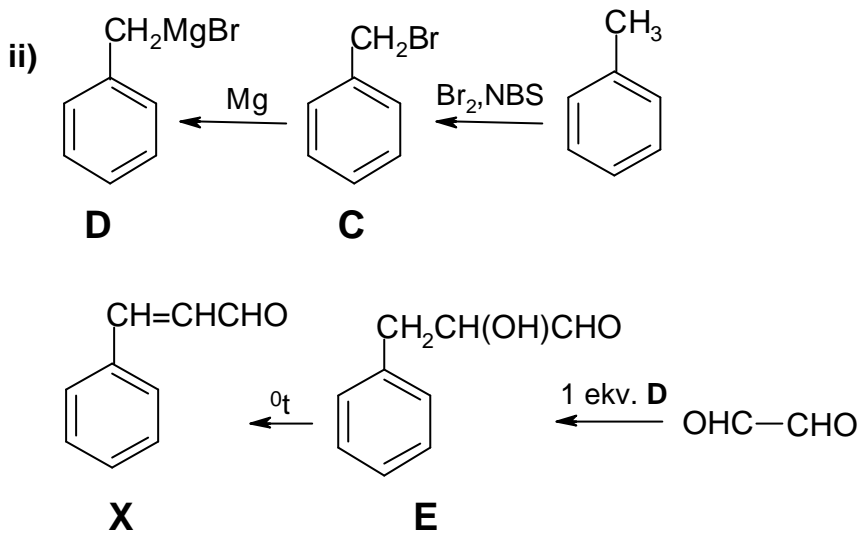
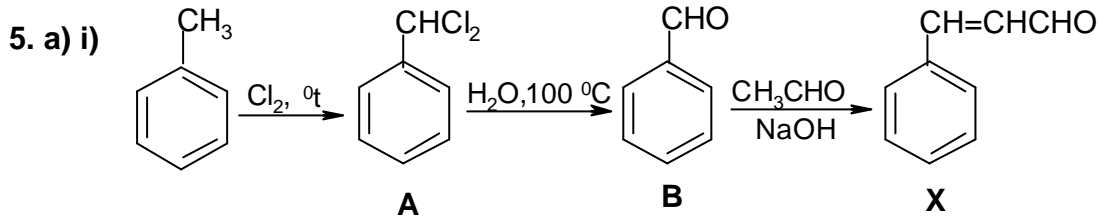
$$\%(\text{ZnS}) = 0,1000 \text{ mol} \cdot 97,46 \text{ g/mol} \cdot \frac{1}{12,00 \text{ g}} \cdot 100 = \mathbf{81,21}$$



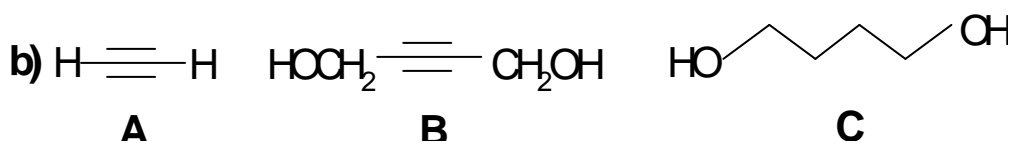
$$n(\text{ZnCO}_3) = 1,32 \text{ g} \cdot \frac{1 \text{ mol}}{44,01 \text{ g}} = 0,0300 \text{ mol}$$

$$\%(\text{ZnCO}_3) = 0,0300 \text{ mol} \cdot 125,4 \text{ g/mol} \cdot \frac{1}{48,00 \text{ g}} \cdot 100 = \mathbf{7,84}$$

iii) $\%(\text{SiO}_2) = 100 - 7,84 - 81,21 = \mathbf{10,95}$

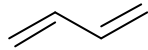


6. a) $0,413 \text{ K} = 1,86 \text{ K} \cdot \text{kg/mol} \cdot 2 \text{ g/M}(\text{ühend C}) \cdot 1/0,1 \text{ kg}$
 $M(\text{ühend C}) = 1,86 \text{ K} \cdot \text{kg/mol} \cdot 2 \text{ g} \cdot 1/0,1 \text{ kg} \cdot 1/0,413 \text{ K} = 90,1 \text{ g/mol}$
 $n(\text{C}) = 90,1 \text{ g} \cdot 0,533 \cdot \frac{1 \text{ mol}}{12 \text{ g}} = 4 \text{ mol}$
 $n(\text{H}) = 90,1 \text{ g} \cdot 0,112 \cdot \frac{1 \text{ mol}}{1 \text{ g}} = 10 \text{ mol}$
 $n(\text{O}) = 90,1 \text{ g} \cdot (1 - 0,533 - 0,112) \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 2 \text{ mol}$
 Ühend **C** on $\text{C}_4\text{H}_{10}\text{O}_2$

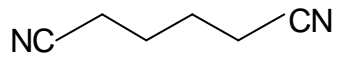




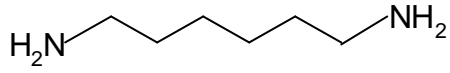
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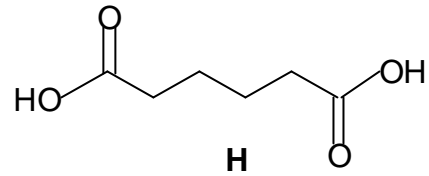
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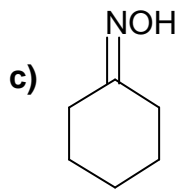
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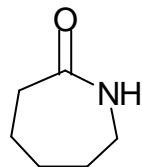
G



H



I



J

