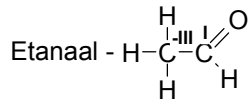
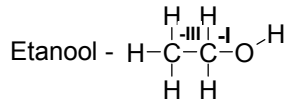
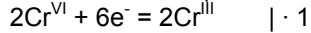
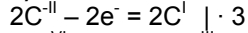
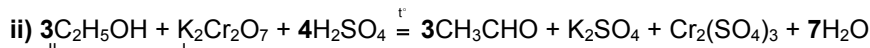
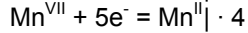
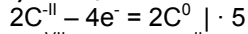
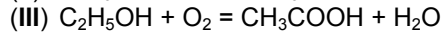
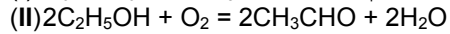
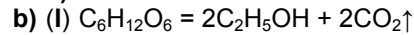
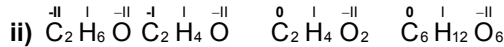
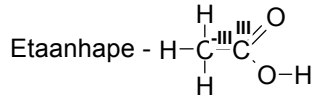


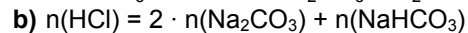
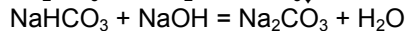
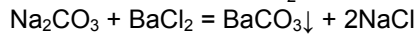
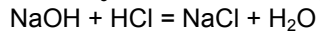
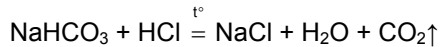
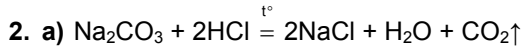
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9. klass



1. a) i)



d) KMnO_4



$$n(\text{HCl}) = \left(50 \text{ cm}^3 \cdot \frac{0,01255 \text{ mol}}{1 \text{ dm}^3} - 2,34 \text{ cm}^3 \cdot \frac{0,01063 \text{ mol}}{1 \text{ dm}^3} \right) \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} =$$

$$= (6,275 \cdot 10^{-4} - 0,2487 \cdot 10^{-4}) \text{ mol} = 6,026 \cdot 10^{-4} \text{ mol}$$

$$n(\text{NaHCO}_3) = n(\text{NaOH}) = \left(25 \text{ cm}^3 \cdot \frac{0,01063 \text{ mol}}{1 \text{ dm}^3} - 7,63 \text{ cm}^3 \cdot \frac{0,01255 \text{ mol}}{1 \text{ dm}^3} \right) \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} =$$

$$= (2,658 - 0,958) \cdot 10^{-4} \text{ mol} = 1,700 \cdot 10^{-4} \text{ mol}$$

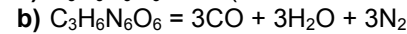
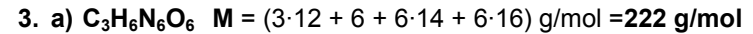
$$n(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot (6,026 \cdot 10^{-4} \text{ mol} - 1,700 \cdot 10^{-4} \text{ mol}) = 2,163 \cdot 10^{-4} \text{ mol}$$

$$m(\text{Na}_2\text{CO}_3) = \frac{250 \text{ cm}^3}{25 \text{ cm}^3} \cdot 2,163 \cdot 10^{-4} \text{ mol} \cdot \frac{105,99 \text{ g}}{1 \text{ mol}} = 0,2293 \text{ g}$$

$$m(\text{NaHCO}_3) = 10 \cdot 1,700 \cdot 10^{-4} \text{ mol} \cdot \frac{84,007 \text{ g}}{1 \text{ mol}} = 0,1428 \text{ g}$$

$$\%(\text{Na}_2\text{CO}_3) = \frac{0,2293 \text{ g}}{0,5 \text{ g}} \cdot 100 = 45,85$$

$$\%(\text{NaHCO}_3) = \frac{0,1428 \text{ g}}{0,5 \text{ g}} \cdot 100 = 28,56$$



$$c) V(\text{tahke } \text{C}_3\text{H}_6\text{N}_6\text{O}_6) = 1 \text{ mol} \cdot \frac{222 \text{ g}}{1 \text{ mol}} \cdot \frac{1 \text{ cm}^3}{1,8 \text{ g}} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 0,123 \text{ dm}^3$$

$V(\text{C}_3\text{H}_6\text{N}_6\text{O}_6 \text{ plahvatusgaasid}) =$

$$= \frac{nRT}{p} = 9 \text{ mol} \cdot 0,082 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 2600 \text{ K} \cdot \frac{1}{1 \text{ atm}} = 1920 \text{ dm}^3$$

$$\text{Ruumalade suhe} = \frac{1920 \text{ dm}^3}{0,123 \text{ dm}^3} = 15600 \approx 16000$$

4. a) Oletame, et mahla on täpselt 1 dm^3 .

$$m(\text{bensoehape}) = 1 \text{ dm}^3 \cdot \frac{200 \text{ mg}}{1 \text{ dm}^3} \cdot \frac{1 \text{ g}}{1000 \text{ mg}} = 0,2 \text{ g}$$

$$m(\text{mahl}) = 1 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{1,08 \text{ g}}{1 \text{ cm}^3} = 1080 \text{ g}$$

$$\%(\text{bensoehape}) = \frac{0,2 \text{ g}}{1080 \text{ g}} \cdot 100 = 0,0185$$

$$b) V(\text{mahl}) = 100 \text{ g} \cdot \frac{100}{0,0185} \cdot \frac{1 \text{ cm}^3}{1,08 \text{ g}} \cdot \frac{1 \text{ m}^3}{10^6 \text{ cm}^3} = 0,501 \text{ m}^3$$

$$c) m(\text{mahl, enne aurutamist}) = \frac{1080 \text{ g}}{2} = 540 \text{ g}$$

$$m(\text{bensoehape}) = 540 \text{ g} \cdot 0,000185 = 0,0999 \text{ g}$$

$$m(\text{mahl, peale aurutamist}) = 540 \text{ g} \cdot (1 - 0,03) = 523,8 \text{ g}$$

$$\%(\text{bensoehape}) = \frac{0,0999 \text{ g}}{523,8 \text{ g}} \cdot 100 = 0,0191$$

d) x – lisatava 0,05 % lahuse mass

$$900 \text{ g} \cdot 0,0001 + x \cdot 0,0005 = 0,03 \%$$

$$900 \text{ g} + x = 100 \%$$

$$900 \text{ g} \cdot 0,0001 + x \cdot 0,0005 = (900 \text{ g} + x) \cdot 0,0003$$

$$0,0002x = 0,18 \text{ g} \quad \mathbf{m(\text{lisatav } 0,05 \% \text{ lahus}) = x = 900 \text{ g}}$$

5. a) A – HgO, elavhõbe(II)oksiid

B – Hg, elavhõbe

C – O₂, hapnik

D – Hg(NO₃)₂, elavhõbe(II)nitraat

E – H₂O, vesi

F – NO₂, lämmastikdioksiid

G – H₂SO₄, väävelhape

H – SO₃, vääveltrioksiid

I – SO₂, vääveldioksiid

b) i) $2\text{HgO} \xrightarrow{t} 2\text{Hg} + \text{O}_2\uparrow$

ii) $\text{Hg} + 4\text{HNO}_3 \text{ (konts.)} = \text{Hg}(\text{NO}_3)_2 + 2\text{NO}_2\uparrow + 2\text{H}_2\text{O}$

iii) $\text{Hg} + 2\text{H}_2\text{SO}_4 = \text{HgSO}_4 + \text{SO}_2\uparrow + 2\text{H}_2\text{O}$

iv) $\text{SO}_3 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4$

v) $\text{SO}_2 + 2\text{H}_2\text{S} = 3\text{S} + 2\text{H}_2\text{O}$

6. a) X – N, element lämmastik

A – N₂, lämmastik

B – NH₄NO₂, ammooniumnitrit

C – Li, liitium

D – Li₃N, liitiumnitriid

E – N₂O, dilämmastikoksiid

F – NO, lämmastikmonooksiid

G – NO₂, lämmastikdioksiid

H – HNO₂, lämmastikhape

I – HNO₃, lämmastikhape

J – NH₃, ammoniaak

b) i) $\text{NH}_4\text{NO}_2 \xrightarrow{t} \text{N}_2\uparrow + 2\text{H}_2\text{O}$

ii) $6\text{Li} + \text{N}_2 = 2\text{Li}_3\text{N}$

iii) $2\text{NO} + \text{O}_2 = 2\text{NO}_2$

iv) $2\text{NO}_2 + \text{H}_2\text{O} = \text{HNO}_2 + \text{HNO}_3$

v) $3\text{HNO}_2 = \text{HNO}_3 + 2\text{NO} + \text{H}_2\text{O}$

vi) $\text{NH}_4\text{NO}_3 \xrightarrow{t} \text{N}_2\text{O} + 2\text{H}_2\text{O}$

vii) $2\text{NH}_3 + \text{CO}_2 = \text{CO}(\text{NH}_2)_2 + \text{H}_2\text{O}$

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10. klass

1. a) X – Cr, kroom

A – CrO, kroom(II)oksiid

B – Cr₂O₃, kroom(III)oksiid

C – CrO₃, kroom(VI)oksiid

D – Cr(OH)₃, kroom(III)hüdroksiid

E – CrCl₃, kroom(III)kloriid

F – K₃[Cr(OH)₆], kaaliumheksahüdroksükromaat(III)

G – K₂CrO₄, kaaliumkromaat

H – K₂Cr₂O₇, kaaliumdikromaat

b) i) Cr(OH)₃ + 3HCl = CrCl₃ + 3H₂O

ii) Cr(OH)₃ + 3KOH = K₃[Cr(OH)₆]

iii) 2K₃[Cr(OH)₆] + 3Br₂ + 4KOH = 2K₂CrO₄ + 6KBr + 8H₂O

iv) Cr₂O₃ + 4KOH + KClO₃ = 2K₂CrO₄ + KCl + 2H₂O

v) 2K₂CrO₄ + H₂SO₄ = K₂Cr₂O₇ + K₂SO₄ + H₂O

vi) K₂Cr₂O₇ + konts. H₂SO₄ = 2CrO₃↓ + K₂SO₄ + H₂O

c) I – [Cr(H₂O)₆]Cl₃

K – [Cr(H₂O)₅Cl]Cl₂·H₂O

L – [Cr(H₂O)₄Cl₂]Cl·2H₂O

$$2. a) V(96,2 \% \text{ vol etanooli lahus}) = \frac{4000 \text{ dm}^3}{0,962} = 4158 \text{ dm}^3 \approx 4160 \text{ dm}^3$$

$$b) i) m(\text{etanool}) = 15000 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot 0,4 \cdot \frac{0,78924 \text{ g}}{1 \text{ cm}^3} = 4,735 \cdot 10^6 \text{ g}$$

$$m(40 \% \text{ vol etanooli lahus}) = 15000 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{0,94805 \text{ g}}{1 \text{ cm}^3} = 1,422 \cdot 10^7 \text{ g}$$

$$V(\text{H}_2\text{O}) = (14,22 - 4,735) \cdot 10^6 \text{ g} \cdot \frac{1 \text{ cm}^3}{0,99820 \text{ g}} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 9502 \text{ dm}^3 \approx 9500 \text{ dm}^3$$

$$ii) m(96,2 \% \text{ vol etanooli lahus}) = \frac{15000 \text{ dm}^3 \cdot 0,4 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{0,80608 \text{ g}}{1 \text{ cm}^3}}{0,962} = 5,028 \cdot 10^6 \text{ g}$$

$$V(\text{H}_2\text{O}) = (14,22 - 5,028) \cdot 10^6 \text{ g} \cdot \frac{1 \text{ cm}^3}{0,99820 \text{ g}} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 9210 \text{ dm}^3 \approx 9200 \text{ dm}^3$$

$$c) \Delta V(\text{H}_2\text{O}) = (9502 - 9210) \text{ dm}^3 = 293 \text{ dm}^3 \approx 300 \text{ dm}^3$$

$$\% = \frac{293 \text{ dm}^3}{9210 \text{ dm}^3} \cdot 100 = 3,17 \approx 3$$

3. a) Br⁻ + Ag⁺ → AgBr↓

Ag⁺ + SCN⁻ → AgSCN↓

$$b) i) n(\text{AgNO}_3 \text{ liig}) = n(\text{NH}_4\text{SCN}) = 19,30 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot \frac{0,04480 \text{ mol}}{1 \text{ dm}^3} = 8,646 \cdot 10^{-4} \text{ mol}$$

$$ii) n(\text{AgNO}_3 \text{ üld}) = 31,20 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot \frac{0,2180 \text{ mol}}{1 \text{ dm}^3} = 6,8016 \cdot 10^{-3} \text{ mol}$$

$$n(\text{KBr}) = n(\text{AgBr}) = (6,8016 - 0,8646) \cdot 10^{-3} \text{ mol} = 5,937 \cdot 10^{-3} \text{ mol}$$

$$m(\text{KBr}) = 5,937 \cdot 10^{-3} \text{ mol} \cdot \frac{119,01 \text{ g}}{1 \text{ mol}} = 0,7066 \text{ g}$$

$$iii) \%(\text{KBr}) = \frac{0,7066 \text{ g}}{0,8230 \text{ g}} \cdot 100 = 85,85$$

c) Ei sobi.

4. a) 2LnPO₄ + 3H₂SO₄ = Ln₂(SO₄)₃ + 2H₃PO₄ (reaktsioon 1)

Th₃(PO₄)₄ + 6H₂SO₄ = 3Th(SO₄)₂ + 4H₃PO₄ (reaktsioon 1)

Ln₂(SO₄)₃ + 6NaOH = 3Na₂SO₄ + 2Ln(OH)₃↓ (reaktsioon 2)

Th(SO₄)₂ + 4NaOH = 2Na₂SO₄ + Th(OH)₄↓ (reaktsioon 2)

Ln(OH)₃ + 3HCl = LnCl₃ + 3H₂O (reaktsioon 3)

Th(OH)₄ = ThO₂ + 2H₂O (reaktsioon 4)

2LnCl₃ + 3Na₂CO₃ = Ln₂(CO₃)₃ + 6NaCl (reaktsioon 5)

b) Promeeetium, sest see on radioaktiivne ja laguneb looduses ära.

$$c) M(\text{Ln, Th}) = \frac{0,6 \cdot (31 + 4 \cdot 16)}{0,4} \text{ g/mol} = 142,46 \text{ g/mol}$$

$$M(\text{Ln}) = \left(\frac{142,46 \text{ g}}{1 \text{ mol}} - \frac{3}{4} \cdot 0,09 \cdot \frac{232,04 \text{ g}}{1 \text{ mol}} \right) \cdot \frac{1}{0,91} \text{ g/mol} = 139,33 \text{ g/mol}$$

$$n(\text{NaOH}) = \frac{6}{2} \cdot 1000 \text{ g} \cdot 0,6 \cdot 0,91 \cdot \frac{1 \text{ mol}}{139,33 \text{ g}} + \frac{4}{1} \cdot 1000 \text{ g} \cdot 0,6 \cdot 0,09 \cdot \frac{1 \text{ mol}}{232,04 \text{ g}} = 11,76 \text{ mol} + 0,9309 \text{ mol} = 12,68 \text{ mol}$$

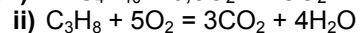
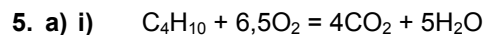
$$m(\text{NaOH}) = 12,68 \text{ mol} \cdot 40,0 \text{ g/mol} = 507,5 \text{ g} \approx 508 \text{ g}$$

d) n(HCl) = n(Ln) = 11,76 mol

$$V(\text{HCl}) = 11,76 \text{ mol} \cdot \frac{36,5 \text{ g}}{1 \text{ mol}} \cdot \frac{1}{0,37} \cdot \frac{1 \text{ cm}^3}{1,18 \text{ g}} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 0,983 \text{ dm}^3$$

$$e) m(\text{Nd}_2(\text{CO}_3)_3 \cdot 3\text{H}_2\text{O}) = 1000 \text{ g} \cdot 0,600 \cdot 0,160 \cdot \frac{1 \text{ mol}}{144,2 \text{ g}} \cdot \frac{1}{2} \cdot \frac{522,6 \text{ g}}{1 \text{ mol}} = 174 \text{ g}$$

$$f) V(\text{Nd}) = 1000 \text{ g} \cdot 0,600 \cdot 0,160 \cdot \frac{1 \text{ cm}^3}{7,01 \text{ g}} = 13,7 \text{ cm}^3$$



b) i) $\Delta H_c^\circ(\text{isobutaan}) = [5 \cdot (-285,8) + 4 \cdot (-393,5) - (-134,2)] \text{ kJ/mol} =$
 $= -2868,8 \text{ kJ/mol}$

ii) $\Delta H_c^\circ(\text{propaan}) = [4 \cdot (-285,8) + 3 \cdot (-393,5) - (-103,8)] \text{ kJ/mol} =$
 $= -2219,9 \text{ kJ/mol}$

c) $n(\text{butaan}) = 450 \text{ g} \cdot 0,6 \cdot \frac{1 \text{ mol}}{58 \text{ g}} = 4,655 \text{ mol}$

$n(\text{isobutaan}) = 450 \text{ g} \cdot 0,1 \cdot \frac{1 \text{ mol}}{58 \text{ g}} = 0,776 \text{ mol}$

$n(\text{propaan}) = 450 \text{ g} \cdot 0,3 \cdot \frac{1 \text{ mol}}{44 \text{ g}} = 3,07 \text{ mol}$

$n(\text{gaas}) = (4,655 + 0,776 + 3,07) \text{ mol} = 8,50 \text{ mol}$

$V = \frac{nRT}{p} = 8,501 \text{ mol} \cdot 0,082 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 298 \text{ K} \cdot \frac{1}{1 \text{ atm}} = 207,7 \text{ dm}^3 \approx$
 $\approx 210 \text{ dm}^3$

d) Eralduv soojushulk

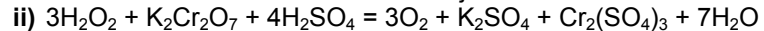
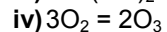
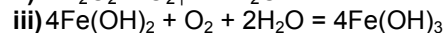
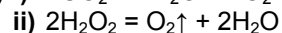
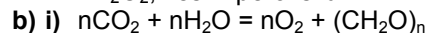
$q = - \left(4,655 \text{ mol} \cdot \frac{-2877,6 \text{ kJ}}{1 \text{ mol}} + 0,776 \text{ mol} \cdot \frac{-2868,8 \text{ kJ}}{1 \text{ mol}} + 3,07 \cdot \frac{-2219,9 \text{ kJ}}{1 \text{ mol}} \right) \cdot$
 $\cdot \frac{1 \text{ MJ}}{1000 \text{ kJ}} = 22,437 \text{ KJ} = 22 \text{ MJ}$

6. a) A – CO₂, süsinikdioksiid

B – O₂, hapnik

C – O₃, osoon

D – H₂O₂, vesnikperoksiid



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11. klass

1. a) Oletame, et mineraali valem on $(\text{FeSO}_4)_x[\text{Fe}_2(\text{SO}_4)_3]_y \cdot z\text{H}_2\text{O}$, siis

$$M_r(\text{mineraal}) = 152 \cdot x + 400 \cdot y + 18 \cdot z$$

$$M_r(\text{melanteriit}) = \frac{55,85}{0,2009} = 278 \quad \text{FeSO}_4 \cdot 7\text{H}_2\text{O} \quad (x = 1, y = 0, z = 7)$$

$$M_r(\text{szomolnokiit}) = \frac{55,85}{0,3286} = 170 \quad \text{FeSO}_4 \cdot \text{H}_2\text{O} \quad (x = 1, y = 0, z = 1)$$

$$M_r(\text{römeriit}) = \frac{55,85(x + 2y)}{0,2084} = 268(x + 2y)$$

$$\text{Kui } x = y = 1, \text{ siis } M_r(\text{römeriit}) = 804 \text{ ja } z = 14 \quad \text{FeFe}_2(\text{SO}_4)_4 \cdot 14\text{H}_2\text{O}$$

$$M_r(\text{korneliit}) = \frac{55,85(x + 2y)}{0,2123} = 263(x + 2y)$$

$$\text{Kui } x = 0 \text{ ja } y = 1, \text{ siis } M_r(\text{korneliit}) = 526 \text{ ja } z = 7 \quad \text{Fe}_2(\text{SO}_4)_3 \cdot 7\text{H}_2\text{O}$$

b) $M_r(\text{kopiapiit}) = 152 \cdot x + 400 \cdot y + 18 \cdot y - w \cdot (96,07 - 2 \cdot 17,02)$

$$M_r(\text{kopiapiit}) = \frac{55,85(x + 2y)}{0,2234} = 250(x + 2y) \quad \text{FeFe}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$$

$$(x = w = 1, y = 2, z = 20)$$

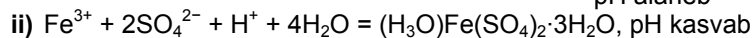
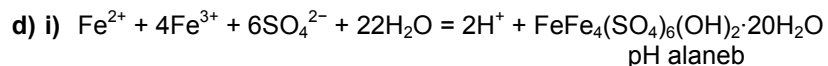
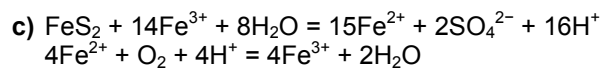
Oletame, et mineraali valem on $\text{Fe}_k(\text{H}_3\text{O})_l(\text{SO}_4)_m \cdot n\text{H}_2\text{O}$, siis

$$M_r(\text{romboklaas}) = 55,85 \cdot k + 19,03 \cdot l + 96,07 \cdot m + 18 \cdot n$$

$$(\text{laengubilanss: } 3 \cdot k + l = 2 \cdot m)$$

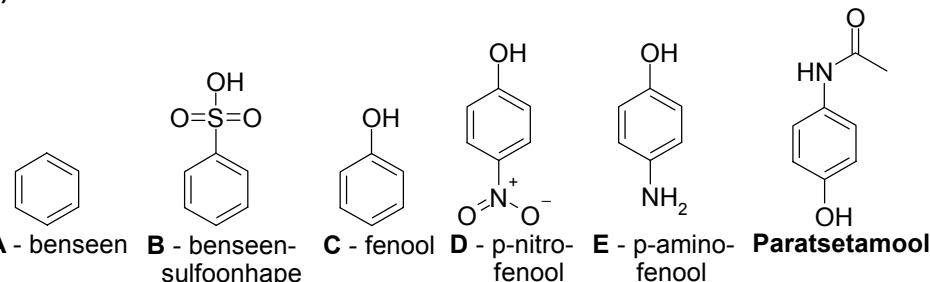
$$M_r(\text{romboklaas}) = \frac{55,85 \cdot k}{0,1739} = 321k \quad (\text{H}_3\text{O})\text{Fe}(\text{SO}_4)_2 \cdot 3\text{H}_2\text{O}$$

$$(k = l = 1, m = 2, n = 3)$$

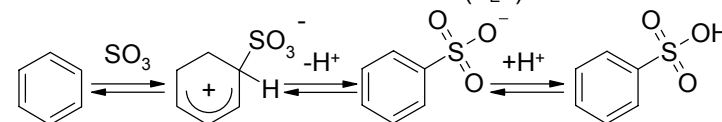


e) 90WA109 – melanteriit või szomolnokiit
 90WA110A – römeriit

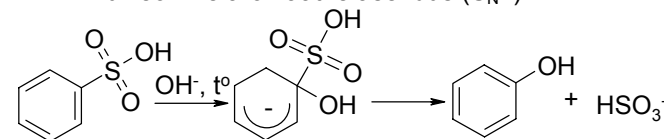
2. a)



b) A → B elektrofiilne aromaadne asendus (S_E2)

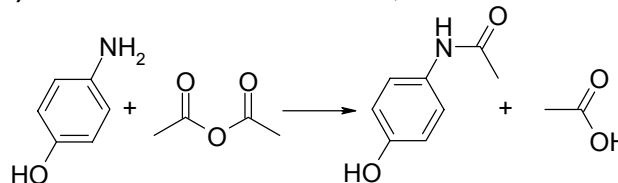


B → C nukleofiilne aromaadne asendus (S_N2)

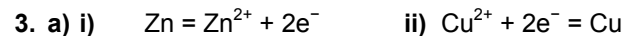


c) o-nitrofenool

d) i) Aineks F sobib atsetanhüdriid,



ii) Kuna tegemist on bimolekulaarse reaktsiooniga kulaks reaktsiooni lõpuni kulgemiseks reagentide stöhhiomeetriliste koguste korral lõpmatu aeg, sellepärast kasutatakse atsüülimisreaktsioonides ca 10% atsüüliiva reagendi ülehulka.



b) (-) Zn | ZnSO₄ || CuSO₄ | Cu (+)

$$\text{c) EMJ} = E(\text{Cu}^{2+}/\text{Cu}) - E(\text{Zn}^{2+}/\text{Zn}) = E^0(\text{Cu}^{2+}/\text{Cu}) - E^0(\text{Zn}^{2+}/\text{Zn}) - \frac{RT}{zF} \ln \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

$$\text{EMJ} = 0,340 \text{ V} - (-0,763 \text{ V}) - RT/2F \ln 1 = 1,103 \text{ V}$$

d) Galvaanielement töötab kuni kogu Cu^{2+} on redutseerunud.

$$q = \frac{2}{1} \cdot 1 \text{ dm}^3 \cdot 0,1 \frac{\text{mol}}{\text{dm}^3} \cdot 96485 \frac{\text{A} \cdot \text{s}}{\text{mol}} = 19\,300 \text{ C}$$

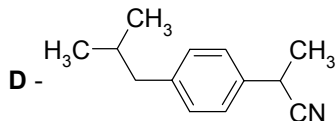
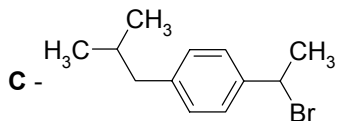
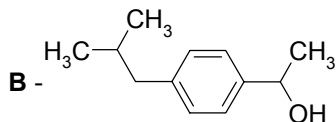
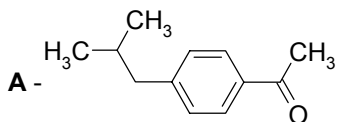
e) Tartu Ülikool

4. a) i) $\text{C} : \text{H} : \text{O} \Leftrightarrow \frac{75,68}{12,0} : \frac{8,81}{1,01} : \frac{15,51}{16,0} \Leftrightarrow 6,31 : 8,72 : 0,97 \Leftrightarrow 13:18:2$

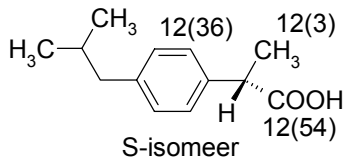
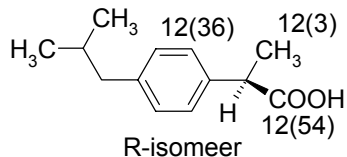
ibuprofeeni brutovalem $\text{C}_{13}\text{H}_{18}\text{O}_2$

ii) 1-isobutüülenseen

b)



c)



5. a) i) $7,4 = 6,86 - \log \frac{[\text{H}_2\text{PO}_4^-]}{[\text{HPO}_4^{2-}]} \quad \frac{[\text{H}_2\text{PO}_4^-]}{[\text{HPO}_4^{2-}]} = 0,288$

$$\%(\text{H}_2\text{PO}_4^-) = \frac{0,288}{1+0,288} \cdot 100 = 22,4 \approx 22$$

$$\%(\text{HPO}_4^{2-}) = \frac{1}{1+0,288} \cdot 100 = 77,6 \approx 78$$

ii) $[\text{H}_2\text{PO}_4^-] = 0,224 \cdot 1,2 \text{ mmol/l} = 0,269 \text{ mmol/l} \approx 0,27 \text{ mmol/l}$

$$[\text{HPO}_4^{2-}] = 0,776 \cdot 1,2 \text{ mmol/l} = 0,931 \text{ mmol/l} \approx 0,93 \text{ mmol/l}$$

b) $6,4 = 6,86 - \log \frac{[\text{H}_2\text{PO}_4^-] + \beta_{\text{H}^+}}{[\text{HPO}_4^{2-}] - \beta_{\text{H}^+}} \quad \frac{0,269 + \beta_{\text{H}^+}}{0,931 - \beta_{\text{H}^+}} = 2,88$

$$\beta_{\text{H}^+} = 0,65 \text{ mmol/l}$$

$$8,4 = 6,86 - \log \frac{[\text{H}_2\text{PO}_4^-] - \beta_{\text{OH}^-}}{[\text{HPO}_4^{2-}] + \beta_{\text{OH}^-}} \quad \frac{0,269 - \beta_{\text{OH}^-}}{0,931 + \beta_{\text{OH}^-}} = 0,0288$$

$$\beta_{\text{OH}^-} = 0,24 \text{ mmol/l}$$

c) Piimhapest, sest fosfaatpuhvri puhvermahtuvus on suurem happe järgi ($\beta_{\text{H}^+} > \beta_{\text{OH}^-}$).

6. a) i) $\text{Cu}_2\text{SO}_4(\text{OH})_2$ – divask(II)dihüdroksiidsulfaat

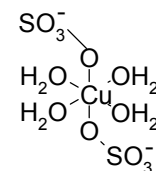
ii) $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ – tetraammiinvask(II)sulfaat

b) $2\text{CuSO}_4 + 2\text{NH}_3 + 2\text{H}_2\text{O} = \text{Cu}_2\text{SO}_4(\text{OH})_2 \downarrow + (\text{NH}_4)_2\text{SO}_4$ (reakts. 1)

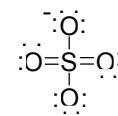
$\text{Cu}_2\text{SO}_4(\text{OH})_2 + (\text{NH}_4)_2\text{SO}_4 + 6\text{NH}_3 = 2[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 + 2\text{H}_2\text{O}$ (reakts. 2)

$[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 + 2\text{H}_2\text{SO}_4 = \text{CuSO}_4 + 2(\text{NH}_4)_2\text{SO}_4$ (reakts. 3)

c)

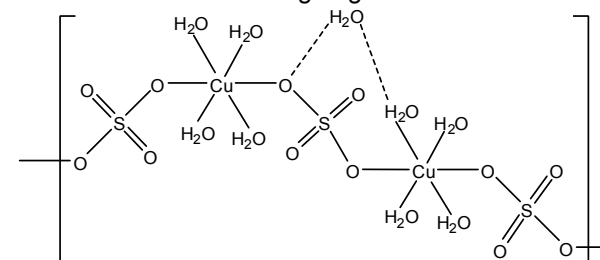


d)



e) kokku on 10 vesiniku aatomit, järelkult on kristallis 10 vesiniksidet

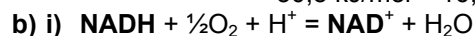
f) Vase aatomiga koordineerunud 4 vee molekuli saavad anda 8 vesiniksidet: kaks nendest lähevad sideme andmiseks vaba vee molekuliga ja ülejäänud kuus seostuvad sulfaatioonidega. Iga sulfaatioon võib vastavalt anda 8 vesiniksidet.



2006/2007 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a) i) $Q = \frac{[ADP] \cdot [P_i]}{[ATP]} = \frac{4,8 \cdot 10^{-3} \cdot 1,3 \cdot 10^{-3}}{3,4 \cdot 10^{-3}} = 1,8 \cdot 10^{-3}$

ii) $\Delta G = \Delta G^0 + RT \ln Q = -30,5 \frac{\text{kJ}}{\text{mol}} + 8,314 \frac{\text{J}}{\text{mol} \cdot \text{K}} \cdot \frac{1 \text{kJ}}{10^3 \text{J}} \cdot 310 \text{K} \ln 1,8 \cdot 10^{-3} =$
 $= -30,5 \text{ kJ/mol} - 16,2 \text{ kJ/mol} = -46,8 \text{ kJ/mol}$

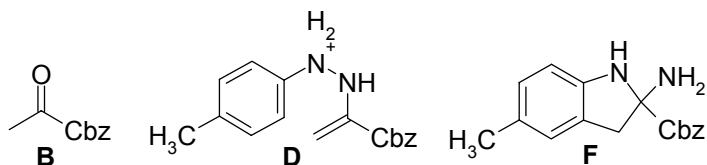


ii) $E^0 = E_2^0 + (-E_1^0) = 0,82 \text{ V} + 0,32 \text{ V} = 1,14 \text{ V}$

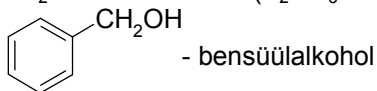
iii) $\Delta G^0 = -zFE^0 = 2 \cdot 96485 \frac{\text{J}}{\text{C} \cdot \text{V}} \cdot \frac{1 \text{kJ}}{10^3 \text{J}} \cdot 1,14 \text{ V} = 220 \text{ kJ/mol}$

c) $N = \frac{-220 \text{ kJ/mol} \cdot 0,63}{-46,8 \text{ kJ/mol}} = 3$

2. a)



b) CO_2 – süsinikdioksiid (K_2CO_3 – kaaliumkarbonaat KOH lahuses) ja



3. a) I kiht koosneb (borosilikaat)klaasist koostisega SiO_2 (60 %), Al_2O_3 (15 %), B_2O_3 (10 %), CaO (5,0 %), BaO (5,0 %), SrO (5,0 %).

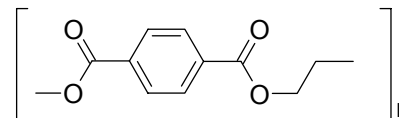
Oksiidi protsendiline sisaldus on leitav järgmiselt:

$$\%(\text{SiO}_2) = \frac{(28 + 2 \cdot 16) \cdot 280 / 28}{280 + 79 + 31 + 36 + 45 + 42 + 486} \cdot 100 = \frac{600}{999} \cdot 100 = 60$$

$$\%(\text{CaO}) = \frac{(40 + 16) \cdot 36 / 40}{280 + 79 + 31 + 36 + 45 + 42 + 486} \cdot 100 = \frac{50,4}{999} \cdot 100 = 5,0 \text{ jne.}$$

b) Hõbe, mis on teatavasti parim elektrijuht ja seepärast seda kasutatigi, et saaks teha nii peene juhtme, et see paistaks läbi.

c) polüetüleentereftalaat



d) Antud materjalil (koostisega In_2O_3 ja SnO_2) on pooljuhi omadused ja sellel baseerub mahtuvuse muutumine, kui elektrit juhtiva sõrmega kuskilt ekraanilt laengut vähendatakse.

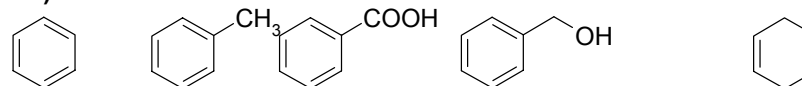
Oletame, et SnO_2 (151 g/mol) on 1 mool. In_2O_3 (278 g/mol) on seega 9/2 mooli.

$$\%(\text{In}_2\text{O}_3) = \frac{278 \cdot 9/2}{278 \cdot 9/2 + 151} \cdot 100 = 89,2\% = 89 \%$$

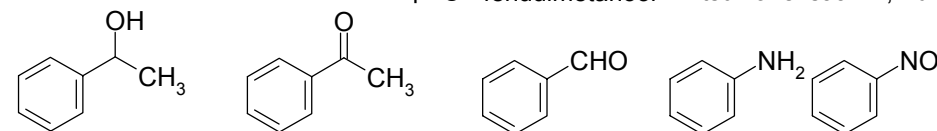
$$\%(\text{SnO}_2) = \frac{151}{151 + 278 \cdot 9/2} \cdot 100 = 10,8\% = 11 \%$$

4. a) Areenid

b)



X - benseen A - toluen B - bensoehape C - fenüülmetanool D - tsükloheksaan-1,4-dieen



E - 1-fenüületanool F - 1-fenüületanoon G - bensaldehüüd H - aniliin I - nitrobenseen

c) i) $\text{CH}_3\text{Cl}/\text{AlCl}_3$

ii) algul NaOH, CO_2 (rõhu all), siis H^+

iii) KMnO_4 , OH^- , t°

iv) LiAlH_4

v) Na/NH_3

vi) $\text{CH}_3\text{COBr}/\text{FeBr}_3$

vii) H_2 (kat.)

viii) CO , HCl , AlCl_3

ix) HNO_3 , H_2SO_4

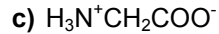
x) Sn , HCl

5. a) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH} + \text{OH}^- = \text{H}_3\text{N}^+\text{CH}_2\text{COO}^- + \text{H}_2\text{O}$

$\text{H}_3\text{N}^+\text{CH}_2\text{COO}^- + \text{OH}^- = \text{H}_2\text{NCH}_2\text{COO}^- + \text{H}_2\text{O}$

b) i) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH}$

ii) $\text{H}_2\text{NCH}_2\text{COO}^-$



d) i) $\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = 100$

ii) $2,817 = 2,34 + \log \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]} \quad \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]} = 3$

$$[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 3[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]$$

$$c(\text{glütsiin}) = [\text{H}_3\text{N}^+\text{CH}_2\text{COOH}] + [\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{c(\text{glütsiin})} \cdot 100 =$$

$$= \frac{3[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} \cdot 100 = \frac{3}{4} \cdot 100 = 75$$

iii) $10,057 = 9,58 + \log \frac{[\text{H}_2\text{NCH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} \quad \frac{[\text{H}_2\text{NCH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} = 3$

$$[\text{H}_2\text{NCH}_2\text{COO}^-] = 3[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$c(\text{glütsiin}) = [\text{H}_2\text{NCH}_2\text{COO}^-] + [\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{c(\text{glütsiin})} \cdot 100 = \frac{1}{4} \cdot 100 = 25$$

6. a) **A** – NO_3^- , nitraatioon

B – HNO_3 , lämmastikhape

C – NO_2^- , nitritioon

D – HNO_2 , lämmastikushape

E – NH_4^+ , ammooniumioon

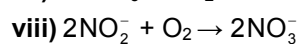
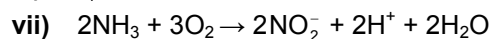
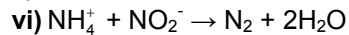
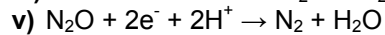
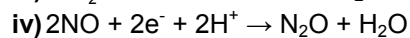
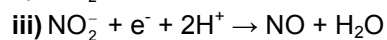
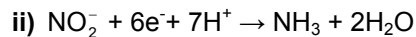
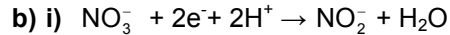
F – NH_3 , ammoniaak

G – NO , lämmastikmonooksiid

I – N_2O , dilämmastikoksiid

K – N_2 , lämmastik

X – N , atomaarne lämmastik



c) *Brocardia anammoxidans* elektronide aktseptoriks on **C** – NO_2^- , nitritioon ja doonoriks on **F** – NH_3 , ammoniaak.