VIIE KOOLI

(Nõo RG, Tartu HTG, Tartu MHG, Tartu Tamme G, Viljandi CRJG)

KOHTUMISE KEEMIAÜLESANNETE LAHENDUSED

Tartu Miina Härma G., 11.–12.jaanuar 2007

1. a) $S + Zn = ZnS$ — S – väävel — *redoks*
$ZnS + H_2SO_4 = ZnSO_4 + H_2S\uparrow$ — H_2S – divesiniksulfiidhape
$2H_2S + 3O_2 = 2H_2O + 2SO_2$ — SO_2 – vääveldioksiid *redoks*
$SO_2 + H_2O = H_2SO_3$ — H_2SO_3 – väävlishape
$2H_2SO_3 + O_2 = 2H_2SO_4$ — H_2SO_4 – väävelhape *redoks*
$H_2SO_4 + 2NaOH = Na_2SO_4 + 2H_2O$ — Na_2SO_4 – naatriumsulfaat
$Na_2SO_4 + BaCl_2 = BaSO_4\downarrow + 2NaCl$ — $BaSO_4$ – baariumsulfaat
(iga reakts. v. 0,25, iga nimetus 0,25; õiged reakts. tüübid 1)
(1,75 + 1,75 + 1) **4,5**

b) $H_2S < H_2SO_3 < H_2SO_4$ (3 õigesti 1, 2 õigesti 0,5) **1**

c) $H_2S^{IV}O_4 > H_2S^{VI}O_3 > S^0 > H_2S^{-II}$ (iga o.a. 0,25, õige järjestus 1,5) **2,5**
8 p

2. a) Oletame, et küllastunud lahust on täpselt 100 g.

i) **s($FeSO_4$) =** $\frac{100\text{ g}\cdot 0{,}208\cdot 100\text{ g}}{100\text{ g}\cdot(1-0{,}208)} = 26{,}26\text{ g} \approx$ **26,3 g (/ 100 g vees)** (0,5)

ii) **c($FeSO_4$) =** $\frac{100\text{ g}\cdot 0{,}208/(151{,}9\text{ g/mol})}{100\text{ g}/(1{,}22\text{ g/cm}^3)}\cdot\frac{1000\text{ cm}^3}{1\text{ dm}^3} = 1{,}67\ \frac{\text{mol}}{\text{dm}^3} =$
= 1,67 M (1)

iii) **c_m($FeSO_4$) =** $\frac{100\text{ g}\cdot 0{,}208/(151{,}9\text{ g/mol})}{100\text{ g}\cdot(1-0{,}208)}\cdot\frac{1000\text{ g}}{1\text{ kg}} = 1{,}73\ \frac{\text{mol}}{\text{kg}} =$
= 1,73 m (1) **2,5**

b) i) %($FeSO_4$) = $\frac{23\text{ g}}{(23+45)\text{ g}}\cdot 100 =$ **34 > 20,8**
ületab küllastunud lahuse protsendilise sisalduse (0,5)

ii) **V(H_2O) =** $(\frac{23\text{ g}\cdot 100\text{ g}}{26{,}3\text{ g}} - 45\text{ g})\cdot\frac{1\text{ cm}^3}{1\text{ g}} = 42{,}5\text{ cm}^3 \approx$ **43 cm³** (1,5)

iii) s($FeSO_4$) = $\frac{45\text{ g}\cdot 43{,}7\text{ g}}{100\text{ g}} =$ 20 g (/45 g vees) < 23 g
80°C juures on lahus küllastunud ja $FeSO_4$ protsendilise sisalduse saab leida lahustuvusest. (1,5)

%($FeSO_4$) = $\frac{43{,}7\text{ g}}{100\text{ g}+43{,}7\text{ g}}\cdot 100 =$ **30,4** (0,5) **4**

c) i) m(10 % lahus) = 100 cm³ · $1{,}1\frac{\text{g}}{\text{cm}^3}$ = 110 g
m($FeSO_4$) = 110 g · 0,1 = 11,0 g
6 % lahuse mass: m_1 küllastunud lahuse mass: m_2 = 110 g – m_1
$m_1\cdot 0{,}06 + (110\text{ g} - m_1)\cdot 0{,}208 = 11\text{ g}$
$0{,}148\cdot m_1 = -11{,}88$ g $m_1 = 80{,}3$ g m_2 = 110 g – 80,3 g = 29,7 g

V(6 % lahus) = 80,3 g · $\frac{1\text{ cm}^3}{1{,}06\text{ g}}$ = **75,8 cm³**

V(küllastunud lahus) = 29,7 g · $\frac{1\text{ cm}^3}{1{,}22\text{ g}}$ = 24,3 cm³ ≈ **24 cm³** (4)

ii) **ΔV =** (75,8 + 24,3)cm³ – 100 cm³ = (100,1 – 100) cm³ = 0,1 cm³ ≈ **≈ 0 cm³**
Kontraktsiooni ei toimu! (0,5) **4,5**
11 p

3. a) i) Pt katood (-): $4Ag^+ + 4e^- = 4Ag\downarrow$ (iga õige võrrand 0,5)
Pt anood (+): $2H_2O - 4e^- = 4H^+ + O_2\uparrow$
$4AgNO_3 + 2H_2O = 4Ag\downarrow + 4HNO_3 + O_2\uparrow$ (1,5)

ii) Ag katood (-): $Ag^+ + 1e^- = Ag\downarrow$
Ag anood (+): $Ag - 1e^- = Ag^+$
$AgNO_3 + Ag = Ag\downarrow + AgNO_3$ (1,5) **3**

b) Pt katood (-): $2Ag^+ + 2e^- = 2Ag$
Pt anood (+): $2Cl^- - 2e^- = Cl_2\uparrow$
$2AgCl = 2Ag + Cl_2\uparrow$ **1,5**

c) i) **n($AgNO_3$) =** n(e^-) = $\frac{1}{1}\cdot\frac{100\text{ cm}^3}{10\text{ cm}^3}\cdot 12{,}1\text{ cm}^3\cdot\frac{1\text{ dm}^3}{1000\text{ cm}^3}\cdot\frac{0{,}1321\text{ mol}}{\text{dm}^3} =$
= 0,0160 mol (2)

ii) **t =** $0{,}0160\text{ mol}\cdot\frac{96485\text{ A}\cdot\text{s}}{1\text{ mol}}\cdot\frac{1}{20\text{ mA}}\cdot\frac{1000\text{ mA}}{1\text{ A}} =$
$= 77190\text{ s}\cdot\frac{1\text{ h}}{3600\text{ s}} \approx$ **21 h** (2) **4**

d) Ei muutu. **0,5**
9 p

4. a) i) $HCl + NH_3 \cdot H_2O = NH_4Cl + H_2O$ (0,5)

ii) **n(HCl) =** $203{,}1\ cm^3 \cdot 1{,}02\frac{g}{cm^3} \cdot 0{,}044 \cdot \frac{1\,mol}{36{,}5\ g}$ **= 0,25 mol** (1)

n($NH_3 \cdot H_2O$) = $315\ g \cdot 0{,}05 \cdot \frac{1\,mol}{35\ g}$ **= 0,45 mol** (0,5)

iii) **n($NH_3 \cdot H_2O$) =** (0,45 – 0,25) mol = **0,20 mol** (0,5)

n(NH_4Cl) = 0,25 mol (0,5) **3**

b) $NH_4Cl \rightarrow NH_4^+ + Cl^-$ $NH_3 \cdot H_2O \leftrightarrow NH_4^+ + OH^-$ (2 · 0,5) **1**

c) i) **pH** = $9{,}25 - \log\frac{0{,}25\ mol}{0{,}2\ mol}$ **= 9,15** **v) pH > 7, aluseline** (1+0,5)

ii) $n(HCl) = 17{,}4\ cm^3 \cdot 1{,}05\frac{g}{cm^3} \cdot 0{,}1 \cdot \frac{1\,mol}{36{,}5\ g} = 0{,}0500\ mol$

$n(NH_3 \cdot H_2O)$ = (0,20 – 0,05) mol = 0,15 mol

$n(NH_4Cl)$ = (0,25 + 0,05) mol = 0,30 mol

pH = $9{,}25 - \log\frac{0{,}3\ mol}{0{,}15\ mol} = 8{,}95$ **v) pH > 7, aluseline** (0,5)

ΔpH = 9,15 -8.95 = **0,20** (2,5)

iii) **pH(dest. vesi) = 7** **v) neutraalne** (0,5+0,5)

iv) $pH = -\log\left[\frac{0{,}05\ mol}{(525+17{,}4)\ cm^3} \cdot \frac{1000\ cm^3}{1\,dm^3}\right] = 1{,}04$

v) pH < 7, happeline (0,5)

ΔpH = 7 - 1,04 = **5,96** (1) **7**

11 p

5. a) i) Süsiniku hulk ületab $\frac{1}{1} \cdot 7{,}99\ dm^3 \cdot \frac{1\,mol}{22{,}4\ dm^3}$

süsivesiku hulka $2\ dm^3 \cdot \frac{1\,mol}{22{,}4\ dm^3}$

7,99/2 ≈ 4 korda

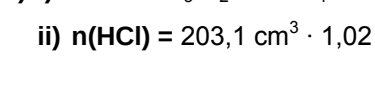
Vesiniku hulk ületab $\frac{2}{1} \cdot 6{,}42\ g \cdot \frac{1\,mol}{18{,}0\ g} = 0{,}713\ mol$

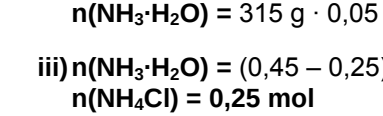
süsivesiku hulka $2\ dm^3 \cdot \frac{1\,mol}{22{,}4\ dm^3} = 0.0893\ mol$

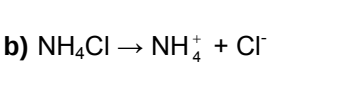
0.713/0,0893 = 8 korda

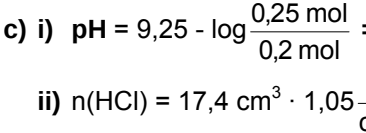
Süsivesiku brutovalem on **C_4H_8** (2)

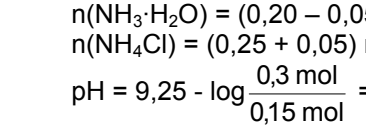
ii) (valem 0,5, nimetus 0,5)

B  , 2-buteen (1)

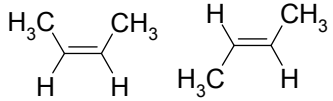
C  , 1-buteen (1)

D  , metüülpropeen (1)

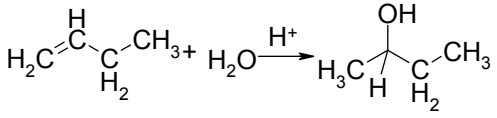
E  , tsüklobutaan (1)

F  , metüültsüklopropaan (1)

iii) cis-isomeer trans-isomeer

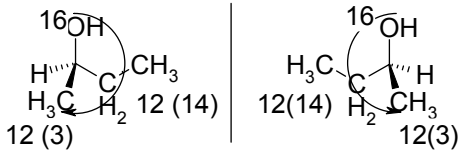
 (1) **8**

b) (valem 0,5, nimetus 0,5)



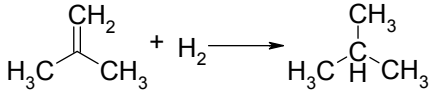
2-butanool (1)

R isomeer S isomeer



(0,5 + 0,5) **2**

c) (valem 0,5, nimetus 0,5)



$CH_3C(CH_3)CH_3$ – metüülpropaan **1**

11 p