2002/2003 õa keemiaolümpiaadi piirkonnavooru
ülesannete lahendused
10. klass

1. a) gaasilise

b) kristallvõre lõhkumine ja hüdraatide (solvaatide) moodustumine.

-III V
c) $\mathbf{NH_4NO_3}$

d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

e) i) $2H_2 + O_2 = 2H_2O$ $\Delta H < 0$, eksotermiline

ii) $2H_2O = 2H_2 + O_2$ $\Delta H > 0$, endotermiline

f) i) Na, pH>7, moodustub alus
Cl_2, pH<7, moodustub (kaks) hapet
S_8, pH=7, ei lahustu vees

ii) SiO_2, pH=7, ei lahustu vees
CaO, pH>7, moodustub alus
SO_2; pH<7, moodustub hape

iii)

$Fe(OH)_3$,	pH=7,	ei lahustu vees
HCl,	pH<7,	vees lahustuv hape
NaOH,	pH>7,	vees lahustuv alus
CH_3COOH,	pH<7,	vees lahustuv hape

iv)

NH_4Cl,	pH<7,	tugeva happe ja nõrga aluse sool
NaCl,	pH=7,	tugeva happe ja tugeva aluse sool
Na_2CO_3,	pH>7,	tugeva aluse ja nõrga happe sool

2. a) i) $Ca(OH)_2 + 2HCl = CaCl_2 + 2H_2O$
$CaCO_3 + 2HCl = CaCl_2 + CO_2\uparrow + H_2O$

ii) SiO_2

b) $Ca^{2+} \Leftrightarrow$ EDTA

$$c(Ca^{2+}) = \frac{1}{1} \cdot 0{,}0250\ \text{mol/dm}^3 \cdot 20{,}0\ \text{cm}^3 \cdot \frac{1}{5{,}00\ \text{cm}^3} = 0{,}100\ \text{mol/dm}^3$$

$$n(Ca^{2+}) = 100\ \text{ml} \cdot \frac{1\ \text{dm}^3}{1000\ \text{ml}} \cdot 0{,}100\ \text{mol/dm}^3 = 0{,}0100\ \text{mol}$$

i) $Ca^{2+} \Leftrightarrow CaO$

$m(CaO) = 0{,}0100\ mol \cdot 56{,}1\ g/mol = 0{,}561\ g$

%(CaO) = $\frac{0{,}561\ g}{3{,}00\ g} \cdot 100$ = **18,7**

ii) $Ca^{2+} \Leftrightarrow CaCO_3$

$m(CaCO_3) = 0{,}0100\ mol \cdot 100\ g/mol = 1{,}00\ g$

%($CaCO_3$) = $\frac{1{,}00\ g}{3{,}00\ g} \cdot 100$ = **33,3**

c) i) $C + O_2 = CO_2$

ii) $Ca(OH)_2 + CO_2 = CaCO_3\downarrow + H_2O$

3. a) A – $K_2Cr_2O_7$, kaaliumdikromaat
B – $Cr_2(SO_4)_3$, kroom(III)sulfaat
C – $Cr(OH)_3$, kroom(III)hüdroksiid
D – K_2CrO_4, kaaliumkromaat

b) i) $K_2Cr_2O_7 + 2KOH = 2K_2CrO_4 + H_2O$

ii) $2Cr(OH)_3 + 3H_2SO_4 = Cr_2(SO_4)_3 + 6H_2O$

c)

$$\overset{VI}{2K_2Cr_2O_7} + 3\overset{-II}{C_2H_5OH} + 8H_2SO_4 = \overset{III}{2Cr_2(SO_4)_3} + 2K_2SO_4 + 3\overset{0}{CH_3COOH} + 11H_2O$$

$2 \cdot VI \ (-) \ 2 \cdot III$
$Cr_2 + 6e^- \rightarrow 2Cr$ | 2
$2 \cdot (-II) \ (-) \ 2 \cdot 0$
$C_2 - 4e^- \rightarrow C_2$ | 3

4. a) Ühendi **A** valem on $\mathbf{X}_2O_2$

M(**X**) = $32\ g/mol \cdot \frac{1}{41\%} \cdot 59\% \cdot \frac{1}{2} =$ 23 g/mol

X – Na, naatrium

Ühendi **B** valem on $Y\mathbf{O_2}$

M(**Y**) = $32\ g/mol \cdot \frac{1}{45\%} \cdot 55\%$ = 39 g/mol

Y – K, kaalium

b) **A** – Na_2O_2, naatriumperoksiid
B – KO_2, kaaliumhüperoksiid

c) i) $2\ Na_2O_2 + 2CO_2 = 2Na_2CO_3 + \ O_2$

ii) $4KO_2 + 2CO_2 = \ 2K_2CO_3 \ + 3O_2$

d) i) $2Na_2O_2 \Leftrightarrow 2CO_2$ $\qquad$ $4KO_2 \Leftrightarrow 2CO_2$
$M(Na_2O_2) = 78{,}0$ g/mol $\qquad$ $M(KO_2) = 71{,}1$ g/mol

$n(CO_2) = \frac{2}{2} \cdot \frac{1000\ \text{g}}{78{,}0\ \text{g/mol}} = 12{,}8$ mol

$\mathbf{m(KO_2)} = \frac{4}{2} \cdot 12{,}8\ \text{mol} \cdot 71{,}1\ \text{g/mol} = 1820$ g = **1,82 kg**

ii) $2Na_2O_2 \Leftrightarrow O_2$ $\qquad$ $4KO_2 \Leftrightarrow 3O_2$

$\mathbf{m(KO_2)} = \frac{4}{3} \cdot \frac{1}{2} \cdot \frac{1000\ \text{g}}{78{,}0\ \text{g/mol}} \cdot 71{,}1\ \text{g/mol} = 607{,}6$ g $\approx$ **0,608 kg**

5. a) **A** – HCOOH, sipelghape
B – CO, süsinikmonooksiid
C – H_2O, vesi

b) $(COOH)_2$

i) $HCOOH \xrightarrow{^0t} CO + H_2O$

ii) $2NaOH + (COOH)_2 = (COONa)_2 + 2H_2O$

6. a) Metalli **X** oksüdatsiooniaste soolas **D** on I ja soolas **E** on III. Seda tõestavad järgmised andmed: 1**B** $\Leftrightarrow$ 2**D**; 1**E** $\Leftrightarrow$ $3AgNO_3$. Sama vooluga sama koguse metalli saamiseks soolast **E** kulub aega kolm korda rohkem kui soolast **D**.

b) i) $2\mathbf{X} + H_2SO_4 = \mathbf{X}_2SO_4 + H_2$

ii) $\mathbf{X}_2SO_4 + BaCl_2 = 2\mathbf{X}Cl + BaSO_4\downarrow$

iii) $\mathbf{X}Cl_3 + 3AgNO_3 = 3AgCl + \mathbf{X}(NO_3)_3$

c) i) **G** – X_2O_3

$$\mathbf{M(X)} = 16\ \text{g/mol} \cdot 3 \cdot \frac{1}{10{,}53\%} \cdot 89{,}47\% \cdot \frac{1}{2} = 203{,}9\ \text{g/mol} \approx \mathbf{204\ g/mol}$$

ii) 9,11 g 0,50$\underline{0}$ dm^3

2**X** $\Leftrightarrow$ H_2

M 22,4 dm^3/mol

$$9{,}11\ \text{g} = \frac{2}{1} \cdot 0{,}50\underline{0}\ \text{dm}^3 \cdot \frac{1\ \text{mol}}{22{,}4\ \text{dm}^3} \cdot \text{M}(\mathbf{X})$$

M(**X**) = **204 g/mol**

iii) 10,0 g 10,0 A·473 s

X $\Leftrightarrow$ e^-

M 96500 A·s/mol

$$10{,}0\ \text{g} = \frac{1}{1} \cdot \frac{10{,}0\ \text{A} \cdot 473\ \text{s}}{96500\ \text{A} \cdot \text{s/mol}} \cdot \text{M}(\mathbf{X})$$

M(**X**) = **204 g/mol**

d) X– Tl, tallium

A – H_2SO_4, väävelhape

B – Tl_2SO_4, tallium(I)sulfaat

C – $BaCl_2$, baariumkloriid

D – TlCl, tallium(I)kloriid

E – $TlCl_3$, tallium(III)kloriid

F - AgCl, hõbekloriid

G – Tl_2O_3, tallium(III)oksiid