1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused
8. klass

1. a) $M_r[KAl(SO_4)_2 \cdot 12H_2O]$ =1·39,1+1·27,0+2·32,1+8·16,0+24·1,01+12·16,0 =
=474,5 » **474** 3(á 0,5)+3* = 6

Märkus: Õige on 474, sest vesiniku aatommass on ümardatud suuremaks. Vastus 475 lugeda ka õigeks.

b) $2[KAl(SO_4)_2 \cdot 12H_2O] = K_2SO_4 + Al_2(SO_4)_3 + 24H_2O$ 2(á 0,5)+2*= 4

c) K_2SO_4 Y $Al_2(SO_4)_3$ 0,5

N[$Al_2(SO_4)_3$] = $\frac{1}{1} \cdot 2$ molekuli= **2 molekuli** 1

K_2SO_4 Y $24H_2O$ 0,5

N(H_2O) = $\frac{24}{1} \cdot 2$ molekuli = **48 molekuli** 1 .

13 p

2. a) $2SO_2 + O_2 = 2SO_3$ 2*

b) $P_4 + 5O_2 = P_4O_{10}$ 2*

c) $4H_3BO_3 + 2NaOH = Na_2B_4O_7 + 7H_2O$ 3*

d) $2H_3PO_4 + 3Ca(OH)_2 = Ca_3(PO_4)_2 + 6H_2O$ 3*

e) $2C_2H_2 + 5O_2 = 4CO_2 + 2H_2O$ 4* .

14 p

3. a) ρ(kett) = 35,9 g: 13,3 cm^3 = 2,70 g/cm^3 1,5

Kett oli valmistatud alumiiniumist. 0,5

b) i) 13,3 cm^3 1

ii) $35{,}9\ g \cdot \frac{1\ cm^3}{10{,}5\ g} = 3{,}42\ cm^3$ 2

iii) $35{,}9\ g \cdot \frac{1\ cm^3}{19{,}3\ g} = 1{,}86\ cm^3$ 2 .

7 p

4. a) $72{,}72\% = \frac{2 \cdot A_r(Y)}{44{,}0} \cdot 100\%$, millest $A_r(Y) = \frac{72{,}72}{100} \cdot 44{,}0 \cdot \frac{1}{2} = 16{,}0$ 1,5+1= 2,5

100% - 72,72% = $\frac{A_r(X)}{44{,}0} \cdot 100\%$, millest $A_r(X) = \frac{27{,}28}{100} \cdot 44{,}0 = 12{,}0$ 1,5+1= 2,5

100% - 88,80% = $\frac{2 \cdot A_r(Z)}{18{,}0} \cdot 100\%$, millest $A_r(Z) = \frac{11{,}20}{100} \cdot 18{,}0 \cdot \frac{1}{2} = 1{,}01$ 2,5

Y – O, hapnik; **X** – C, süsinik; **Z** – H, vesinik (á 0,5*) 1,5

Märkus: 100% on üks tervik, mis on alati lõpmatult täpne.

b) $\mathbf{XY_2}$ – CO_2 1*

$\mathbf{Z_2Y}$ – H_2O 1*

$\mathbf{XZ_4}$ - CH_4 1*

c) %(C) = $\frac{12,0}{16,0} \cdot 100$ = **75,0** 1

%(H) = $\frac{4 \cdot 1,01}{16,0} \cdot 100$ = **25,3** 2 .

Märkus: Lahendus %(H) = 100–75,0 ei vasta ülesandes püstitatud tingimustele. **15 p**

5. a) järjenumber = prootonite arv = elektronide arv 2*

b) X – O, hapnik, 8, VI, 16; **Y** – Na, naatrium, 11, I, 23;

Z – C, süsinik, 6, IV, 12; **Q** – H, vesinik, 1, I, 1 (á1*) 4

c) 8+11+6+1 = 26 1*

VI+I+IV+I = XII 1*

1) 26 - 16 = 10 1*

2) 11 - 1 = 10 1*

3) 16 - 6 = 10 1* .

11 p

6. a) b = a + 2,00 amü 1*

2b = 2a + 2·2,00 amü 1*

2b = 2a·1,0571 1*

2a·1,0571 = 2a + 2·2,00 amü 1*

a = $\frac{2,00\,\text{amü}}{0,0571}$ = **35,0 amü** 1

b = 35,0 amü + 2,00 amü = **37,0 amü** 1

b) $\mathbf{M_r(X)}$ = 35,0 + 0,5 = **35,5** 1

Element **X** on **Cl**, kloor. 1*

c) Kergem isotoop koosneb 17 prootonist, 17 elektronist ja 18 neutronist. 1,5*

Raskemal isotoobil on prootonite ja elektronide arv sama (17), kuid neutroneid on 20. 1,5* .

11 p

1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused

9. klass

1. a) Mg – magneesium –
MgO – magneesiumoksiid 0,5
$MgSO_4$ – magneesiumsulfaat 0,5
$Mg(OH)_2$ – magneesiumhüdroksiid 0,5
$MgCl_2$ – magneesiumkloriid 0,5
$MgCO_3$ – magneesiumkarbonaat 0,5
$Mg(HCO_3)_2$ – magneesiumvesinikkarbonaat 0,5

b) 1) $2Mg + O_2 = 2MgO$ 1
metall mittemetall aluseline oksiid

2) $MgO + H_2SO_4 = MgSO_4 + H_2O$ 1
hape sool

3) $MgSO_4 + 2NaOH = Mg(OH)_2\downarrow + Na_2SO_4$ 1
alus alus sool

4) $Mg(OH)_2 + 2HCl = MgCl_2 + 2H_2O$ 1
hape sool

5) $MgCl_2 + Na_2CO_3 = MgCO_3\downarrow + 2NaCl$ 1
sool sool sool

6) $MgCO_3 + H_2O + CO_2 = Mg(HCO_3)_2$ 1
happeline oksiid vesiniksool

7) $Mg(HCO_3)_2 \xrightarrow{t^o} MgO + 2CO_2\uparrow + H_2O$ 1 .

10 p

2. a) Molekulide alljärgneva vastavuse korral on mõlemas aines võrdne mass lämmastikku:

$V \cdot 0{,}958\ g/cm^3 \cdot 0{,}100$ 5000 g
$2NH_3 \Leftrightarrow (NH_2)_2CO$ 1*
17 g/mol 60,1 g/mol

V(NH₃) $= \frac{2}{1} \cdot \frac{5000\ g}{60{,}1\ g/mol} \cdot 17\ g/mol \cdot \frac{1}{0{,}100} \cdot \frac{1\ cm^3}{0{,}958\ g} = 29530\ cm^3 \approx$ **29,5 l** 3

b) $m \cdot 0{,}850$ 5,00 kg
$2NaNO_3 \Leftrightarrow (NH_2)_2CO$ 1*
85,0 kg/kmol 60,1 kg/mol

m(NaNO₃) $= \frac{2}{1} \cdot 5{,}00\ kg \cdot \frac{1\ kmol}{60{,}1\ kg} \cdot \frac{85{,}0\ kg}{1\ kmol} \cdot \frac{1}{0{,}850} =$ **16,6 kg** 3 .

8 p

3. a) 1) $P_4O_{10} + 6H_2O = 4H_3PO_4$ 1*
2) $3CrO_3 + Al_2O_3 = Al_2(CrO_4)_3$ 1*
3) $FeSO_4 + 6KCN = K_4[Fe(CN)_6] + K_2SO_4$ 1*
4) $3Cr_2O_3 + Fe_2O_3 = 2Fe(CrO_2)_3$ 1*

b) Antud reaktsioonides on happelisteks oksiidideks:
P_4O_{10} – tetrafosfordekaoksiid ehk fosfor(V)oksiid; 1
CrO_3 – (mono)kroomtrioksiid ehk kroom(VI)oksiid; 1
Cr_2O_3 – dikroomtrioksiid ehk kroom(III)oksiid 1

c) $6H_2O \Leftrightarrow 4H_3PO_4$ 0,5

n(H₂O) $= \frac{6}{4} \cdot 20 =$ **30 mol** 1

d) $6KCN \Leftrightarrow K_4[Fe(CN)_6]$ 0,5

n{K₄[Fe(CN)₆]} $= \frac{1}{6} \cdot 1{,}5 =$ **0,25 mol** 1 .

10 p

4. a) i) $MgCO_3 + 2HCl = MgCl_2 + H_2O + CO_2$ 1*

ii) $Al(OH)_3 + 3HCl = AlCl_3 + 3H_2O$ 1*

b) $M(MgCO_3) = 84{,}0$ g/mol 1

$M[Al(OH)_3] = 78{,}0$ g/mol 1

c) Olgu $m(MgCO_3) = x$, siis $m[Al(OH)_3] = 0{,}700\text{ g} - x$

$MgCO_3 \Leftrightarrow 2HCl$ $\quad n'(HCl) = \frac{2}{1} x \cdot \frac{1\text{ mol}}{84{,}0\text{ g}}$ 1*

$Al(OH)_3 \Leftrightarrow 3HCl$ $\quad n''(HCl) = \frac{3}{1}(0{,}700\text{ g} - x) \cdot \frac{1\text{ mol}}{78{,}0\text{ g}}$ 1*

d) $n' + n'' = 0{,}0200$ mol 0,5

$$2x \cdot \frac{1\text{ mol}}{84{,}0\text{ g}} + 3(0{,}700\text{ g} - x) \cdot \frac{1\text{ mol}}{78{,}0\text{ g}} = 0{,}0200\text{ mol}$$

Ühik mol taandub 3,5

$$0{,}0238x \cdot \frac{1}{g} + 0{,}0269 - 0{,}0385x \cdot \frac{1}{g} = 0{,}0200$$

$0{,}0147x = 0{,}0069$ g

$m(MgCO_3) = 0{,}47$ g 0,5

$m[Al(OH)_3] = 0{,}23$ g 0,5

Märkus: Vastused on kahe tüvenumbri täpsusega, sest vahe 0,0269 - 0,0200 annab täpsuseks kaks tüvenumbrit.

11 p

5. 1) a) $2H_3PO_4 + 3Ca(OH)_2 = Ca_3PO_4 + 6H_2O$ 1*

b) $Ca(OH)_2 + 2HCl = CaCl_2 + 2H_2O$ 1*

c) $H_3PO_4 + 3NaOH = Na_3PO_4 + 3H_2O$ 1*

d) $Ca(OH)_2 + H_2CO_3 = CaCO_3 + 2H_2O$ 1*

2) Esimest lähteainet peaks täielikuks neutraliseerimiseks olema

a) $n_1 = \frac{2}{3} \cdot 12 = 8$ mol; on ekvivalentselt 1

b) $n_1 = \frac{1}{2} \cdot 6 = 3$ mol; liias on HCl 1

c) $n_1 = \frac{1}{3} \cdot 3 = 1$ mol; liias on H_3PO_4 1

d) $n_1 = \frac{1}{1} \cdot 5 = 5$ mol; liias on H_2CO_3 1

3) a) sama, mis **1)a)** 0,5

b) sama, mis **1)b)** 0,5

c) $H_3PO_4 + NaOH = NaH_2PO_4 + 3H_2O$ 1*

d) $Ca(OH)_2 + 2H_2CO_3 = Ca(HCO_3)_2 + 2H_2O$ 1*

4) a) ei jäänud 0,5

b) 2 mol HCl $\quad n(HCl) = 6\text{ mol} - \frac{2}{1} \cdot 2\text{ mol} = 2\text{ mol}$ 0,5

c) ei jäänud 0,5

d) ei jäänud. 0,5

13 p

6. $m(HCl, \text{alguses}) = 125{,}0\text{ cm}^3 \cdot 1{,}198\text{ g/cm}^3 \cdot 0{,}400 = 59{,}9$ g 2

$m(H_2O, \text{alguses}) = 125{,}0\text{ cm}^3 \cdot 1{,}198\text{ g/cm}^3 \cdot 0{,}600 = 89{,}9$ g 1

$V(\text{lahus, lõpus}) = 125{,}0\text{ cm}^3 - 25{,}0\text{ cm}^3 = 100{,}0\text{ cm}^3$ 1

$m(HCl, \text{lõpus}) = 100{,}0\text{ cm}^3 \cdot 1{,}147\text{ g/cm}^3 \cdot 0{,}305 = 35{,}0$ g 1

$m(H_2O, \text{lõpus}) = 100{,}0\text{ cm}^3 \cdot 1{,}147\text{ g/cm}^3 \cdot 0{,}695 = 79{,}7$ g 1

$\Delta m(HCl) = 59{,}9\text{ g} - 35{,}0\text{ g} = 24{,}9$ g 1

$\Delta m(H_2O) = 89{,}9\text{ g} - 79{,}7\text{ g} = 10{,}2$ g 1

8 p

1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused
10. klass

1. a) **i)** $Cu + 4HNO_3 = Cu(NO_3)_2 + 2NO_2 + 2H_2O$ 1,5*

ii) $(CuOH)_2CO_3 + 4HNO_3 = 2Cu(NO_3)_2 + 3H_2O + CO_2$ 1,5*

iii) $CuO + 2HNO_3 = Cu(NO_3)_2 + H_2O$ 1*

b)

$0{,}20\ cm \cdot 1{,}0\ cm^2 \cdot 8{,}96\ g/cm^3$		$V \cdot 1{,}39\ g/cm^3 \cdot 0{,}65 \cdot 0{,}50$
Cu	Y	$4HNO_3$
63,5 g/mol		63 g/mol

1*

$$\textbf{V(HNO}_3\textbf{ lahus)} = \frac{4}{1} \cdot 0{,}20\ cm \cdot 1{,}0\ cm^2 \cdot 8{,}96\ g/cm^3 \cdot \frac{1\ mol}{63{,}5\ g} \cdot 63\frac{g}{mol} \cdot$$

$$\cdot \frac{1}{0{,}50} \cdot \frac{1}{0{,}65} \cdot \frac{1\ cm^3}{1{,}39\ g} = 15{,}7\ cm^3 \approx \textbf{16 cm}^3$$ 3

c) ei ole, sest kuld reageerib ainult kuningveega. 1 .

9 p

2. a) **A** – Fe_3O_4; 1*

B – NH_4Cl 1*

b) **i)** $FeCl_2 + 2FeCl_3 + 8NH_3 \cdot H_2O \xrightarrow{^ot} Fe_3O_4 + 8NH_4Cl + 4H_2O$ 3*

ii) $NH_4Cl = NH_3\uparrow + HCl\uparrow$ 1*

$NH_3 + HCl = NH_4Cl$ (valge suits) 1*

c) $n(Fe_3O_4) = 0{,}696 \cdot \frac{1\ mol}{232\ g} = 0{,}00300\ mol$ 1

$n(FeCl_2) = \frac{1}{1} \cdot 0{,}00300\ mol$ 1

$n(FeCl_3) = \frac{2}{1} \cdot 0{,}00300\ mol$ 1

$\textbf{c(FeCl}_2\textbf{ lahus)} = \frac{0{,}00300\ mol}{0{,}0100\ dm^3} = \textbf{0,300 mol/dm}^3$ 1

$\textbf{c(FeCl}_3\textbf{ lahus)} = \frac{0{,}00600\ mol}{0{,}0100\ dm^3} = \textbf{0,600 mol/dm}^3$ 1 .

12 p

3. a) $CaCO_3$, kaltsiumkarbonaat; 0,5*

$MgCO_3$, magneesiumkarbonaat; 0,5*

D – CO_2, süsinikdioksiid; 0,5*

E – CaO, kaltsiumoksiid; 0,5*

F – MgO, magneesiumoksiid 0,5*

b) $MgO + 2HCl = MgCl_2 + H_2O$ 1*

$CaO + 2HCl = CaCl_2 + H_2O$ 1*

$MgO + H_2SO_4 = MgSO_4 + H_2O$ 1,5*

$CaSO_4$ lahustub väga vähe.

c) $CaCO_3 \cdot MgCO_3 \xrightarrow{^{o}t} CaO + MgO + 2CO_2$ 1*

$CaCO_3 \cdot 3MgCO_3 \xrightarrow{^{o}t} CaO + 3MgO + 4CO_2$ 1*

$MgCO_3 \cdot 3CaCO_3 \xrightarrow{^{o}t} MgO + 3CaO + 4CO_2$ 1*

d) $M(CaCO_3 \cdot MgCO_3)$=184,4 g/mol; 0,5

$M(CaO)$=56,1 g/mol; 0,5

$M(MgO)$=40,3 g/mol 0,5

%(jääk, mineraalist **A**) = $\frac{56{,}1 + 40{,}3}{184{,}4} \cdot 100 = 52{,}27$ **$CaCO_3$ˠ$MgCO_3$** 1

$M(CaCO_3 \cdot 3MgCO_3)$ = 353,0 g/mol 0,5

%(jääk, mineraalist **B)** = $\frac{56{,}1 + 3 \cdot 40{,}3}{353{,}0} \cdot 100 = 50{,}14\%$ **$CaCO_3$ˠ$3MgCO_3$** 1

$MgCO_3 \cdot 3CaCO_3$ ei sobi, sest suurema Ca sisalduse tõttu annab ta suurema põletusjäägi protsendi, kui see oli dolomiidil. 1 .

13 p

4. a) A – NH_4HCO_3, ammooniumvesinikkarbonaat 1

B – NH_4NO_2, ammooniumnitrit 1

b) $NH_4HCO_3 \xrightarrow{^{o}t} NH_3\uparrow + CO_2\uparrow + H_2O$ 2*

$NH_4NO_2 \xrightarrow{^{o}t} N_2\uparrow + 2H_2O$ 2* .

6 p

5. a) $m(H_2SO_4)$ = 0,05448 dm^3·17,97 mol/dm^3·98,06 g/mol = **96,00 g** 2

b) $m(H_2SO_4$, lahus) = 54,48 cm^3·1,8355 g/cm^3 = 100,0 g 1

$0{,}660 = \frac{96{,}0\ g}{100{,}0\ g + m'(H_2O)}$ 1

66,0 g + 0,660 m'(H_2O) = 96,0 g

m'(H_2O) = **45,5 g** 2

c) m'(H_2SO_4, lahus) = 100,0 g + 45,5 g = 145,5 g 1

V'(H_2SO_4, lahus) = 145,5 g · $\frac{1\ cm^3}{1{,}571\ g}$ = **92,62 cm^3** 1

d) Ei või, sest vett ei tohi kontsentreeritud väävelhappe lahusesse valada. 1 .

9 p

6. a) M – O_2, dihapnik; (0,5*) **N** – O_3, osoon; (0,5*) **B** – C, süsinik; (0,5*) 1,5

E–H_2, vesinik (0,5*); **G**–Na, naatrium(0,5*); **X**–CO_2, süsinikdioksiid(0,5*); 1,5

Y – H_2O, vesi(0,5*); **Z** – Na_2O, naatriumoksiid(0,5*); 1

K – H_2CO_3, süsihape; 1*

L – NaOH, naatriumhüdroksiid; 1*

R – $NaHCO_3$, naatriumvesinikkarbonaat. 1*

b) i) $CO_2 + H_2O = H_2CO_3$ 1*

ii) $Na_2O + H_2O = 2NaOH$ 1*

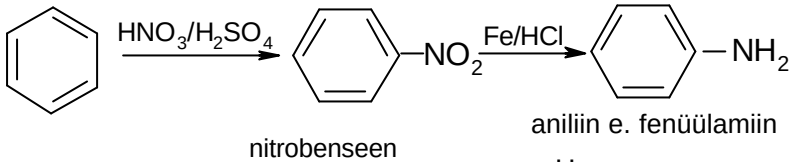
c) $2NaOH + CO_2 \xrightarrow{H_2O} Na_2CO_3 + H_2O$ 1*

$Na_2CO_3 + CO_2 + H_2O = 2NaHCO_3$ 1* .

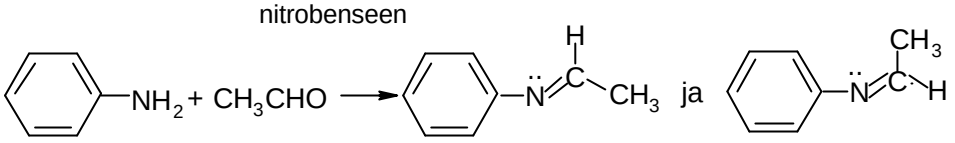
11 p

1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused
11. klass

1. a) Näiteks: Aniliini sünteesiks nitreeris keemiateaduskonna **dekaan benseeni lämmastik-** ja **väävelhappe** seguga ning redutseeris moodustunud nitrobenseeni **rauaga soolhappe** keskkonnas. 0,5

b) 

nitrobenseen — aniliin e. fenüülamiin (á 1*) 4

c) 

(1,5;1*;1*) 3,5 .

8 p

2. a) $4C_6H_2(NO_2)_3CH_3 = 26C + 10H_2O + 2CO + 6NO_2 + 3N_2$ 2*

b) 1000 g

4(TNT) Y (10+2+6+3) (gaase) 1

227 g/mol

n(gaas) = $\frac{21}{4} \cdot 1000\ \text{g} \cdot \frac{1\ \text{mol}}{227\ \text{g}} = \mathbf{23{,}1\ mol}$ 2

c) $p \cdot V = n \cdot R \cdot T$; 2*

V(gaas) = $23{,}13\ \text{mol} \cdot 8{,}314 \frac{\text{N} \cdot \text{m}}{\text{K} \cdot \text{mol}} \cdot 1773\ \text{K} \cdot \frac{1}{1{,}013 \cdot 10^5} \frac{\text{m}^2}{\text{N}} = \mathbf{3{,}37\ m^3}$ 2 .

9 p

3. a) i) 1–butanool; (0,5*) **ii)** 2–pentanool; (1*) **iii)** 3–metüül–3–heksanool; (1,5*) 3

b) i) $C_4H_9OH \xrightarrow{O} C_3H_7CHO \xrightarrow{O} C_3H_7COOH$ 2

butanaal butaanhape

ii) $C_3H_7CH(OH)CH_3 \xrightarrow{O} C_3H_7COCH_3$ 2

2–pentanoon

iii) $C_3H_7C(CH_3)(OH)C_2H_5 \xrightarrow{O}$ ei oksüdeeru 1* .

8 p

4. a) i) %(CH_4) = $\frac{49{,}1}{100 - 32} \cdot 100 = \mathbf{72{,}2}$ 1

ii) %(O_2) = $\frac{7{,}5}{100 - 32} \cdot 100 = \mathbf{11}$ 2

b) $CH_4 + 2O_2 = CO_2 + 2H_2O$ 0,5

Olgu puhastatud prügilagaasi ruumala V

$V(\Sigma O_2) = \frac{2}{1} \cdot 0{,}722V = 1{,}44V$ 1

$V(O_2, \text{õhust}) = 1{,}44V - 0{,}11V = 1{,}33V$ 1

$V(\text{õhk}) = \frac{1{,}33V}{0{,}21} = 6{,}3V$ **V(prügilagaas) : V(õhk)** = **1 : 6,3** 1,5

c) $CH_4 + 2O_2 = CO_2 + 2H_2O$ 0,5

Reaktsioonientalpia tekkeentalpiate järgi võrdub saadusainete tekkeentalpiate (summa) ja lähteainete tekkeentalpiate (summa) vahega

ΔH = 1 mol·(-393 kJ/mol)+2 mol·(-286 kJ/mol)-[2·0+1 mol·(-75 kJ/mol)] = -890 kJ 2

$\Delta H = \frac{1000\ \text{dm}^3 \cdot 0{,}722}{22{,}4\ \text{dm}^3/\text{mol}} \cdot (-890\ \text{kJ/mol}) =$ **-28,7 MJ** 1,5 .

11 p

5. a) Moodustunud soolade sinine värvus viitab, et katiooniks on vask. Et aine **A** reageerimisel hapetega happed redutseeruvad, siis on ühendiks **A** vask(I)ühend. Kui mittemetalliks on element **X**, siis

2,72 g 0,851 dm^3

CuX → NO_2

M 22,4 dm^3/mol

$$2{,}72\ \text{g} = \frac{1}{1} \cdot 0{,}851\ \text{dm}^3 \cdot \frac{1\ \text{mol}}{22{,}4\ \text{dm}^3} \cdot M(CuX)$$

M(CuX) = 71,5 g/mol; M(X*) = 71,5 g/mol - 63,5 g/mol = 8 g/mol

* - sellise molaarmassiga mittemetalli ei ole.

$Cu_2X = 2NO_2$, mis arvutades annab $M(Cu_2X) = 2 \cdot M(CuX^*)$ 0,5

$M(Cu_2X) = 2 \cdot 71{,}5$ g/mol = 143 g/mol 1,5

M(X) = 143 g/mol - 127 g/mol = 16 g/mol 1

A → Cu_2O 1

b) i) $Cu_2O + 6HNO_3 = 2Cu(NO_3)_2 + 2NO_2 + 3H_2O$ 1*

ii) $Cu_2O + 3H_2SO_4 = 2CuSO_4 + H_2SO_3 + 2H_2O$ 1,5*

c) Cu_2O reageerimisel lämmastikhappega moodustub $Cu(NO_3)_2$ ja väävelhappega – $CuSO_4$.

i) $M[Cu(NO_3)_2] = 187{,}6$ g/mol 0,5

$$0{,}596 = \frac{6 \cdot 16 + n \cdot 16}{187{,}6 + n \cdot 18}; \qquad 5{,}27n = 15{,}8$$ 1

$n(H_2O)$ = 3 0,5

ii) $M(CuSO_4) = 159{,}6$ g/mol 0,5

$$0{,}577 = \frac{4 \cdot 16 + n \cdot 16}{159{,}6 + n \cdot 18}; \qquad 5{,}61n = 28{,}1$$ 1

$n(H_2O)$ = 5 0,5

d) A - Cu_2O, vask(I)oksiid; **B** – NO_2, lämmastikdioksiid; **C** – $Cu(NO_3)_2$, vask(II)nitraat; **D**–$Cu(NO_3)_2 \cdot 3H_2O$, vask(II)nitraat-3-vesi; **E**–$CuSO_4$, vasksulfaat; **F** – H_2SO_3, väävlishape; **G** – $CuSO_4 \cdot 5H_2O$, vasksulfaat-5-vesi. (á 0,5*) 3,5 .

14 p

6. a) i) 2 NaOH → H_2SO_4

$$\textbf{m(NaOH)} = \frac{2}{1} \cdot 20{,}0\ \text{g} \cdot 0{,}200 \cdot \frac{1\ \text{mol}}{98{,}1\ \text{g}} \cdot 40{,}0\ \text{g/mol} =$$ **3,26 g** 1

ii) m(NaOH) = 16,04 g - 3,26 g = **12,78 g** 1

b) H_2SO_4 → 2NaOH SO_3 → 2NaOH

$n(H_2SO_4, SO_3) = \frac{2}{1} n(NaOH)$ 2*

$$\frac{m(SO_3)}{80{,}1\ \text{g/mol}} + \frac{15{,}0\ \text{g} - m(SO_3)}{98{,}1\ \text{g/mol}} = \frac{1}{2} \cdot \frac{12{,}78}{40{,}00\ \text{g/mol}}$$ 4

$0{,}01248m(SO_2) + 0{,}1529\ \text{g} - 0{,}01019m(SO_3) = 0{,}15975\ \text{g}$

$0{,}00229m(SO_3) = 0{,}00685\ \text{g}$ $m(SO_3) = 3{,}0\ \text{g}$

$$\textbf{\%(SO}_3\textbf{)} = \frac{3{,}0\ \text{g}}{15{,}0\ \text{g}} \cdot 100 =$$ **20** 2 .

8 p

1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused

12. klass

1. a) i) Suhkrud **ii)** Happed — 1

b) Suhkrutes on alati hüdroksüülrühmi; — 0,5

kindlasti peab olema ka –COOR ehk estersideme grupp — 1

c) Hüdrolüüs — 1

d) A–COO–B + H_2O = A–COOH + B–OH — 2*

e) m(uneliiv) = $1{,}5 \cdot 10^6$ inimest·65 kg/inimene·$1{,}0 \cdot 10^{-6}$ g/kg= **98 g** — 1

f) 100 kg mees vajab 100 kg·$1{,}0 \cdot 10^{-6}$ g/kg = $1{,}0 \cdot 10^{-4}$g — 0,5

$\frac{1{,}0 \cdot 10^{-4}\ \text{g}}{60\ \text{kg}}$ = $1{,}7 \cdot 10^{-6}$ g/kg, mis ilmselt pole ohtlik. — 1 .

8 p

2. a) $[H^+] = 10^{-1{,}92} = 1{,}20 \cdot 10^{-2}$ mol/dm^3 — 1

b) $K_{dis} = \frac{[H^+]^2}{c}$ — 2*

c) c(hape) = $\frac{(1{,}20 \cdot 10^{-2})^2}{1{,}75 \cdot 10^{-5}} = \frac{1{,}44 \cdot 10^{-4}}{1{,}75 \cdot 10^{-5}}$ = **8,23 mol/dm^3** — 3

d) 0,533 = $\frac{32{,}0\ \text{g/mol}}{\text{M(hape)}}$

M(hape) = 32,0 g/mol·$\frac{1}{0{,}533}$ = **60,0 g/mol** — 1

CH_3COOH, etaanhape

e) i) $CH_3COOH + C_2H_5OH = CH_3COOC_2H_5$ — 1*

ii) etüületanaat — 0,5

iii) m($CH_3COOC_2H_5$) = $\frac{1}{1} \cdot 8{,}23\ \text{mol} \cdot 0{,}80 \cdot 88{,}1\ \text{g/mol}$ = **580 g** — 1,5* .

10 p

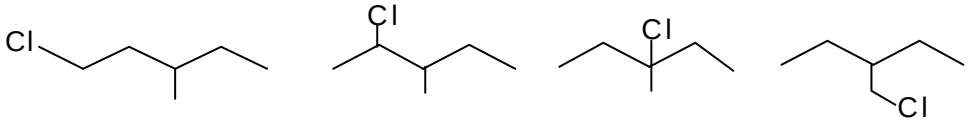
3. a) Küllastatud süsivesiniku valem: C_nH_{2n+2}

i) $\frac{1 \cdot (2n+2)}{12n + 1(2n+2)} = 0{,}163$

2n+2 = 2,282n+0,326 0,282n = 1,674 **n = 6** — 2

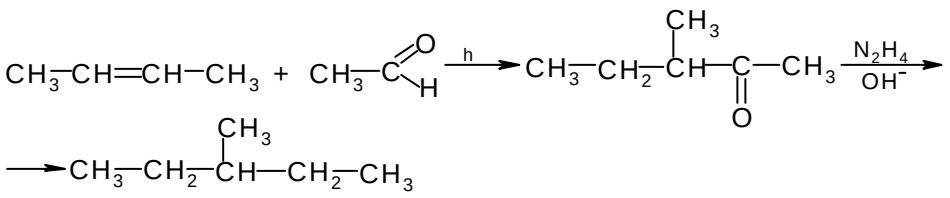
ii) C_6H_{14} — 1*

b) Et 6 süsinikuga oleks võimalik neli monokloroisomeeri, peab kolmanda süsiniku kõrvalahelas olema metüülradikaal



(á 0,5) — 2

c)



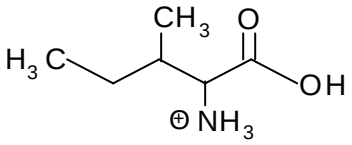
(1*;1,5*;1,5*) 4 .

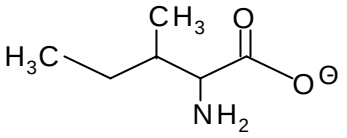
9 p

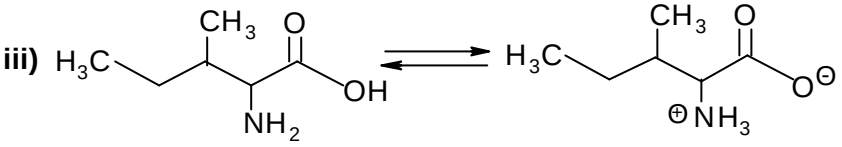
4. a) i) $C_2H_5CH(CH_3)CH(NH_2)COOH$ — 1*

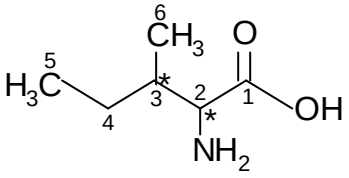
ii) 2-amino-3-metüülpentaanhape — 1

b) 2–aminohape (või α–aminohape) — 1

c) i)  (2*)

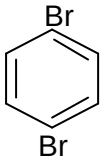
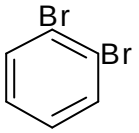
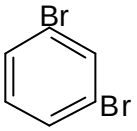
ii)  (2*) 4

iii)  2*

d)  (0,5; 0,5; 1*) 2

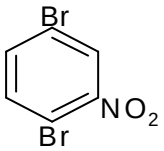
e) 2, 3, 4, 5, 6 1* .

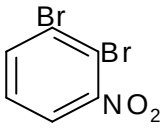
12 p

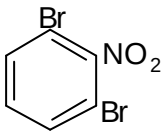
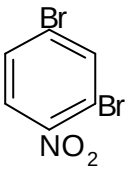
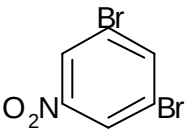
5. a)  para-  orto-  meta-

A **B** **C** (á 1*) 3

b)

A 

B  

C   

(á 1*) 6 .

9 p

6. a) **X** – Hg, elavhõbe; **Y** – HgO, elavhõbe(II)oksiid; **Z**– Hg_2Cl_2, elavhõbe(I)kloriid, kalomel; **A** – $HgCl_2$, elavhõbe(II)kloriid, sublimaat; **B**– $Hg(NO_3)_2$; elavhõbe(II)nitraat; **D** – $Hg_2(NO_3)_2$, elavhõbe(I)nitraat. (á 0,5*) 3

b) 1) $2Hg + O_2 \overset{^{o}t}{=} 2HgO$ 1*

2) $2HgO \overset{^{o}t}{=} 2Hg + O_2$ 1*

3) $2Hg + Cl_2 = Hg_2Cl_2$ 1*

4) $Hg_2Cl_2 = Hg + HgCl_2$ 1*

5) $KMnO_4 + 8HCl = 5Cl^* + MnCl_2 + KCl + 4H_2O$ 1*

Märkus: Hg oksüdeerijaks on kloor tekkimise momendil. Cl_2 moodustumine lugeda ka õigeks.

6) $2Cl^* + 2Hg = Hg_2Cl_2$ 1*

7) $3Hg + 8HNO_3 = 3Hg(NO_3)_2 + 2NO + 4H_2O$ 1*

8) $6Hg + 8HNO_3 = 3Hg_2(NO_3)_2 + 2NO + 4H_2O$ 1*

c) Metallide lahuseid elavhõbedas nimetatakse amalgaamideks. 1* .

12 p