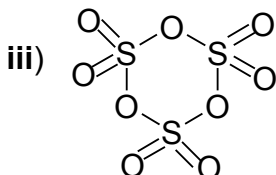
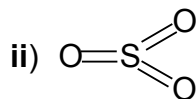
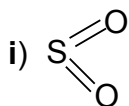


1998/99 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
9. klass

1. a)



b) i) S_3O_9

ii) $M(S_3O_9) = 3 \cdot 32 \text{ g/mol} + 9 \cdot 16 \text{ g/mol} = 240 \text{ g/mol}$

c) i) $m(S_3O_3) = 3 \cdot 32 \text{ amü} + 3 \cdot 16 \text{ amü} = 144 \text{ amü}$

ii) $\frac{9 \cdot 16}{3 \cdot 32} = 1,5$

iii) $\frac{80}{240} = \frac{1}{3}$

d) $m(S_3O_9) = 240 \text{ g/mol} \cdot \frac{1 \text{ mol}}{6,02 \cdot 10^{23} \text{ molekul}} = 3,99 \cdot 10^{22} \text{ g/molekul}$

e) i) $S_3O_9 + 3H_2O = 3H_2SO_4$

$n(H_2O) = 270 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 15 \text{ mol}$

Vett on suure ülehulgas

ii) $\% (H_2SO_4) = \frac{\frac{3}{1} \cdot 1 \text{ mol} \cdot 98,1 \text{ g/mol}}{1 \text{ mol} \cdot 240 \text{ g/mol} + 270 \text{ g}} \cdot 100 = 57,7$

2. a) i) $\Sigma(n) = 5,1 \text{ m}^3 \cdot \frac{1000 \text{ dm}^3}{1 \text{ m}^3} \cdot \frac{1 \text{ mol}}{15 \text{ dm}^3} = 340 \text{ mol}$

ii) $n(O_2) = 340 \text{ mol} \cdot 0,15 = 51 \text{ mol}$

b) i) $2H_2 + O_2 = 2H_2O$

ii) $CH_4 + 2O_2 = CO_2 + 2H_2O$

iii) $2H_2S + 3O_2 = 2H_2O + 2SO_2$

c) i) $n'(O_2) = \frac{1}{2} \cdot 340 \text{ mol} \cdot 0,25 - 51 \text{ mol} = -9 \text{ mol}$

$$\text{ii) } n'(\text{O}_2) = \frac{2}{1} \cdot 340 \text{ mol} \cdot 0,30 - 51 \text{ mol} = 153 \text{ mol}$$

$$\text{iii) } n'(\text{O}_2) = \frac{3}{2} \cdot 340 \text{ mol} \cdot 0,20 - 51 \text{ mol} = 51 \text{ mol}$$

$$\text{d) i) } \Delta H = 340 \text{ mol} \cdot 0,25 \cdot (-240 \text{ kJ/mol}) = -2,0 \cdot 10^4 \text{ kJ}$$

$$\text{ii) } \Delta H = 340 \cdot 0,30 \cdot (-800 \text{ kJ/mol}) = -8,2 \cdot 10^4 \text{ kJ}$$

$$\text{iii) } \Delta H = 340 \text{ mol} \cdot 0,20 \cdot (-520 \text{ kJ/mol}) = -3,5 \cdot 10^4 \text{ kJ}$$

3. a) t°



$$\text{b) } m(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot 0,500 \text{ mol} \cdot 106 \text{ g/mol} = 26,5 \text{ g}$$

$$m(\text{H}_2\text{O}) = 250 \text{ cm}^3 \cdot 0,958 \text{ g/cm}^3 = 239,5 \text{ g}$$

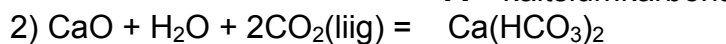
$$m(\text{H}_2\text{O}') = \frac{1}{2} \cdot 0,500 \text{ mol} \cdot 18,0 \text{ g/mol} = 4,5 \text{ g}$$

$$m(\Sigma\text{H}_2\text{O}) = 239,5 \text{ g} + 4,5 \text{ g} = 244 \text{ g}$$

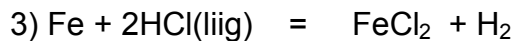
$$\%(\text{Na}_2\text{CO}_3) = \frac{26,5 \text{ g}}{244 \text{ g} + 26,5 \text{ g}} \cdot 100 = \mathbf{9,80}$$

$$\text{c) } V(\text{H}_2\text{O}) = 244 \text{ g} \cdot \frac{1 \text{ cm}^3}{1 \text{ g}} = \mathbf{244 \text{ cm}^3}$$

4. a) 1) $\text{CaO} + (\text{H}_2\text{O}) + \text{CO}_2 = (\text{H}_2\text{O}) + \text{CaCO}_3$
A – kaltsiumkarbonaat



B – kaltsiumvesinikkarbonaat



C – raud(II)kloriid



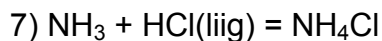
D – raud(II)kloriid



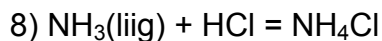
E – naatriumkarbonaat



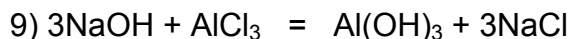
F – naatriumvesinikkarbonaat



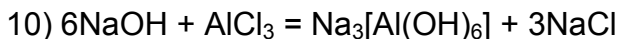
G – ammooniumkloriid



H – ammooniumkloriid



I – alumiiniumhüdrosiid

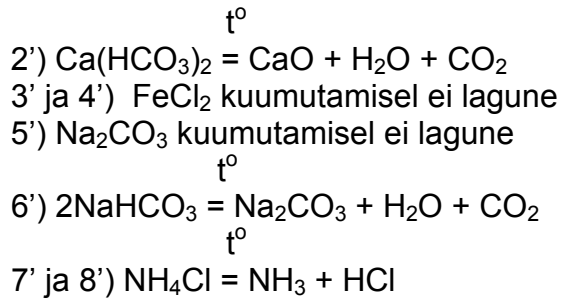


J – naatriumaluminaat e

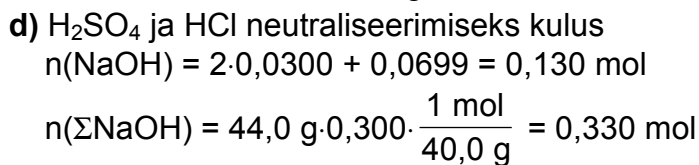
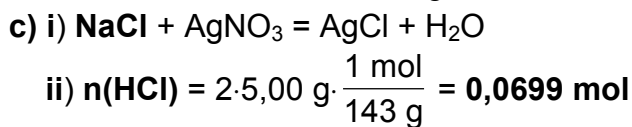
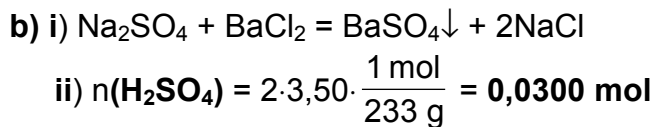
naatriumheksahüdrosüaluminaat

b) 1') t°





5. a) i) $\text{HCl} + \text{NaOH} = \text{NaCl} + \text{H}_2\text{O}$
 ii) $\text{HNO}_3 + \text{NaOH} = \text{NaNO}_3 + \text{H}_2\text{O}$
 iii) $\text{H}_2\text{SO}_4 + 2\text{NaOH} = \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$



$$n(\text{HNO}_3) = \frac{1}{1} \cdot (0,330 \text{ mol} - 0,130 \text{ mol}) = \mathbf{0,200 \text{ mol}}$$

6. a) i) $n(\text{HCl}) = \frac{4}{5} V_a \cdot \frac{1 \text{ mol}}{4,55 \text{ dm}^3} = 0,1762 V_a \cdot \frac{\text{mol}}{\text{dm}^3}$

Märkus: $V_a = \text{arvväärtus} \cdot \text{dm}^3$

ii) $m(\text{HCl}) = 0,1758 V_a \cdot \frac{\text{mol}}{\text{dm}^3} \cdot 36,5 \text{ g/mol} = 6,42 V_a \cdot \frac{\text{g}}{\text{dm}^3}$

b) $m(\text{lahus}) = m(\text{H}_2\text{O}) + m(\text{HCl})$

$$m(\text{H}_2\text{O}) = V_a \cdot 1000 \frac{\text{g}}{\text{dm}^3} = 1000 V_a \cdot \frac{\text{g}}{\text{dm}^3}$$

$$m(\text{lahus}) = 1000 V_a \cdot \frac{\text{g}}{\text{dm}^3} + 6,42 V_a \cdot \frac{\text{g}}{\text{dm}^3} = 1006,42 V_a \cdot \frac{\text{g}}{\text{dm}^3}$$

c) $\%(\text{HCl}) = \frac{6,42 V_a \text{ g/dm}^3}{1006,42 V_a \text{ g/dm}^3} \cdot 100 = \mathbf{0,638}$

Märkus: 4 °C juures ei ole vee tihedus neljast tüvenumbrist täpsem. Kui lahuse massi tüvenumbrite arv on ümardatud neljani, siis lugeda see õigeks. lahenduskäik lihtsustub, kui võtta anumate ruumalaks täpselt 1 dm³.

**1998/99 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
10. klass**

1. a) Element **X** on Li

b) I II IV
X₂O, YO ja ZO₂

c) A_r(Li) = 6,94; M_r(Li₂O) = 29,88

$$\%(\text{Li}) = \frac{13,88}{29,88} \cdot 100 = 46,45$$

$$\%(\text{O}) = 100 - 46,45 = 53,55$$

i) $A_r(\text{Y}) = 16,0 \cdot \frac{46,45\%}{53,55\%} = 13,9 \approx 14$

Y on lämmastik – **N**

ii) $A_r(\text{Z}) = 2 \cdot 16 \cdot \frac{46,45\%}{53,55\%} = 27,8 \approx 28$

Z on räni – **Si**

d) i) $\%(\text{O}) = \frac{16,0}{29,9} \cdot 100 = 53,5$

ii) $\%(\text{O}) = \frac{16,0}{30,0} \cdot 100 = 53,3$

iii) $\%(\text{O}) = \frac{32,0}{60,1} \cdot 100 = 53,2$

2. a) i) $\text{S} + \text{O}_2 = \text{SO}_2$

A B

ii) $2\text{SO}_2 + \text{Ca}(\text{OH})_2 = \text{Ca}(\text{HSO}_3)_2$

B

C

b) i) $M(\text{D}) = \frac{1}{1} \cdot 6,00 \text{ g} \cdot \frac{1}{1,12 \text{ dm}^3} \cdot \frac{22,4 \text{ dm}^3}{1 \text{ mol}} = 120 \text{ g/mol}$

ii) CaSO₃; iii) kaltsiumsulfit

c) i) $\text{CaSO}_3 \xrightarrow{\text{H}_2\text{SO}_4} \text{CaSO}_4 \downarrow$

ii) $\text{CaSO}_3 \xrightarrow{\text{HNO}_3} \text{CaSO}_4 \downarrow$

d) $\text{Ca}(\text{HSO}_3)_2 + 2\text{Na}_2\text{S} = \text{CaSO}_3 \downarrow + \text{Na}_2\text{SO}_3 + 2\text{NaHS}$

Sulfiidioon on happelises keskkonnas ebapüsiv.

3. a) i) $\text{Na}_2\text{S}_2\text{O}_3 + \text{HCl} = \text{H}_2\text{S}_2\text{O}_3 + 2\text{NaCl}$

ebapüsiv

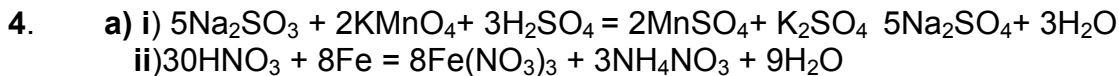
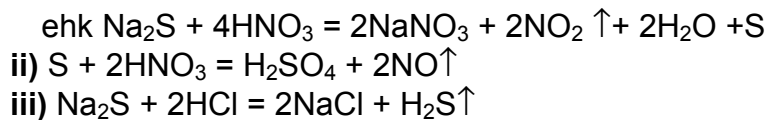
$\text{H}_2\text{S}_2\text{O}_3 = \text{S} \downarrow + \text{SO}_2 + \text{H}_2\text{O}$

ii) $\text{Na}_2\text{S}_2\text{O}_3 + \text{HNO}_3 = \text{H}_2\text{S}_2\text{O}_3 + 2\text{NaNO}_3$

$\text{H}_2\text{S}_2\text{O}_3 = \text{S} \downarrow + \text{SO}_2 + \text{H}_2\text{O}$

b) $[\text{Ag}(\text{NH}_3)_2]\text{Cl} + 2\text{HNO}_3 = \text{AgCl} \downarrow + 2\text{NH}_4\text{NO}_3$

c) i) $3\text{Na}_2\text{S} + 8\text{HNO}_3 = 6\text{NaNO}_3 + 3\text{S} + 2\text{NO} \uparrow + 4\text{H}_2\text{O}$



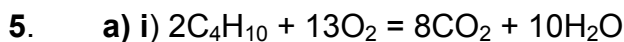
$$\text{b) } N(\text{rüütel}) = \frac{5}{2} \cdot 5,00 \text{ cm} \cdot 5,00 \text{ cm}^2 \cdot \frac{0,0127 \text{ mol}}{\text{cm}^3} \cdot \frac{1}{0,70} \cdot \frac{1 \text{ löök}}{0,00150 \text{ mol}} = 760 \text{ lööki}$$

$$\text{c) } n(\text{Fe}) = 0,300 \text{ cm} \cdot 10 \text{ cm}^3 \cdot 7,8 \text{ g/cm}^3 \cdot \frac{1 \text{ mol}}{55,9 \text{ g}} = 0,419 \text{ mol}$$

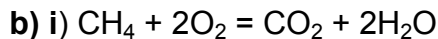
$$n(\text{Fe, üks rünnak}) = \frac{8}{30} \cdot 3 \cdot 0,050 \frac{\text{dm}^3}{\text{rünnak}} \cdot 0,02 \text{ mol/dm}^3 \cdot 0,60 = 0,00048 \text{ mol/rünnak}$$

$$N(\text{hüdra}) = 0,419 \text{ mol} \cdot \frac{1 \text{ rünnak}}{0,00048 \text{ mol}} = 870 \text{ rünnakut}$$

d) Lahingu võitis rüütel. Hüdral jäi võitmiseks 110 vasturünnakut sooritamata



$$\text{ii) } \Delta H(\text{butaan}) = 21,0 \text{ kg} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} \cdot \frac{1 \text{ mol}}{58,1 \text{ g}} \cdot (-2655 \text{ kJ/mol}) = 9,60 \cdot 10^5 \text{ kJ}$$



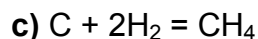
$$\text{ii) } n(\text{CH}_4) = 9,60 \cdot 10^5 \text{ kJ} \cdot \frac{1 \text{ mol}}{8,02 \cdot 10^2 \text{ kJ}} = 1,20 \cdot 10^3 \text{ mol}$$

$$V_M(\text{talvel}) = 22,4 \frac{\text{dm}^3}{\text{mol}} \cdot \frac{253}{273} = 20,8 \text{ dm}^3/\text{mol}$$

$$V(\text{CH}_4) = 1,20 \cdot 10^3 \text{ mol} \cdot \frac{1}{0,990} \cdot 20,8 \text{ dm}^3/\text{mol} = 25,2 \cdot 10^3 \text{ dm}^3$$

$$\text{iii) } V_M(\text{suvel}) = 22,4 \frac{\text{dm}^3}{\text{mol}} \cdot \frac{293}{273} = 24,0 \text{ dm}^3/\text{mol}$$

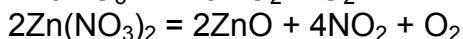
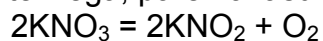
$$V(\text{CH}_4) = 1,20 \cdot 10^3 \text{ mol} \cdot \frac{1}{0,990} \cdot 24,0 \text{ dm}^3/\text{mol} = 29,1 \cdot 10^3 \text{ dm}^3$$



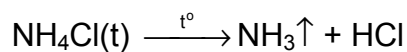
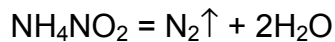
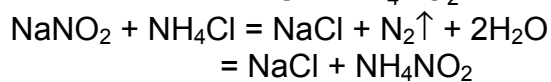
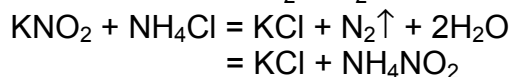
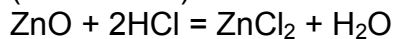
$$1 \text{ mol} \cdot \Delta H(\text{CH}_4, \text{teke}) = 1 \text{ mol} \cdot (-394 \text{ kJ/mol}) + 2 \text{ mol} \cdot (-242 \text{ kJ/mol}) - 1 \text{ mol} \cdot (-802 \text{ kJ/mol}) = -76 \text{ kJ}$$

$$\Delta H(\text{CH}_4, \text{teke}) = -76 \text{ kJ/mol}$$

6. a) Pingereas magneesiumist vasakul asuvate metallide nitraadid lagunevad nitritite tekkega, paremal asuvate metallide nitraadid lagunevadoksiidideks.



b) Töötlemisel NH_4Cl ja HCl lahuste liiaga ja järgneval kuivaksaurutamisel tekivad metallide kloriidid, eralduvad N_2 , H_2O ; NH_4Cl laguneb; NH_3 , HCl ja H_2O lenduvad (aurustuvad).



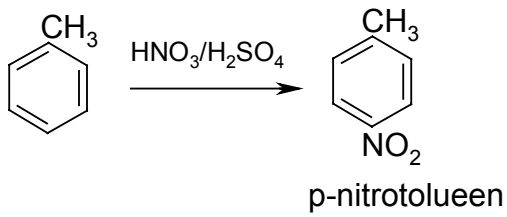
c) $x + y + z = 1,0000 \text{ g}$

$$\frac{x}{M(\text{KNO}_3)} \cdot M(\text{KNO}_2) + \frac{y}{M(\text{NaNO}_3)} \cdot M(\text{NaNO}_2) + \frac{z}{M[\text{Zn}(\text{NO}_3)_2]} \cdot M(\text{ZnO}) = 0,7106 \text{ g}$$

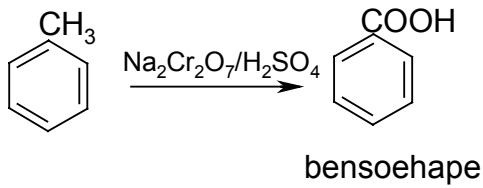
$$\frac{x}{M(\text{KNO}_3)} \cdot M(\text{KCl}) + \frac{y}{M(\text{NaNO}_3)} \cdot M(\text{NaCl}) + \frac{z}{M[\text{Zn}(\text{NO}_3)_2]} \cdot M(\text{ZnCl}_2) = 0,7195$$

1998/99 õa keemiaolümpiaadi lõppvoorü ülesannete lahendused
11. klass

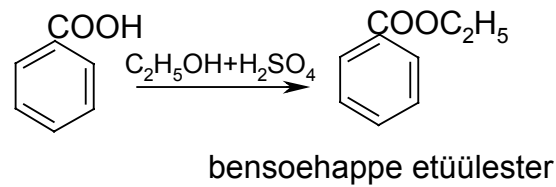
1. a) i)



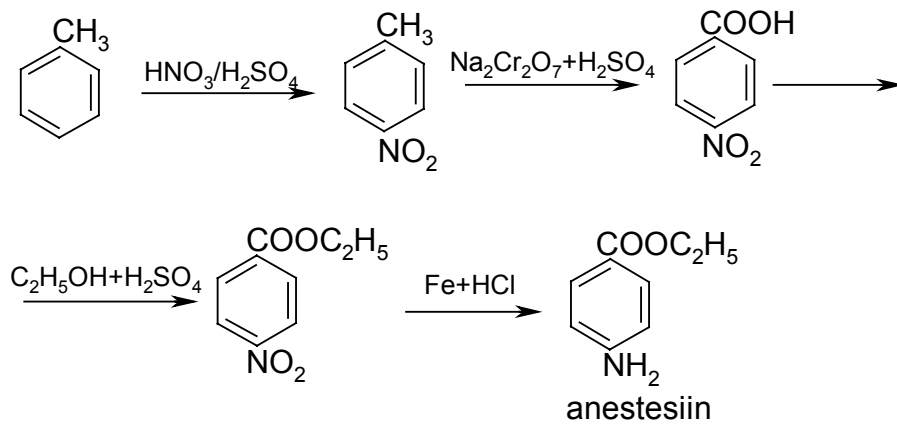
ii)



iii)



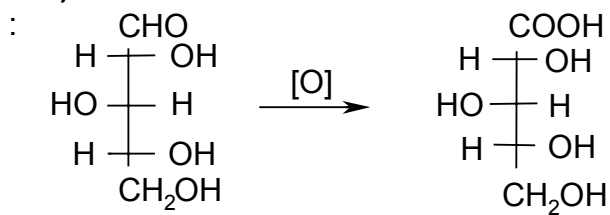
b)

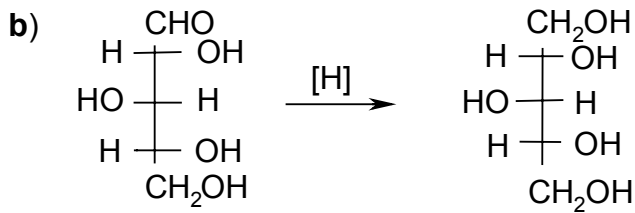


2. a) i) D-ksüloos on tüüpiline redutseerija

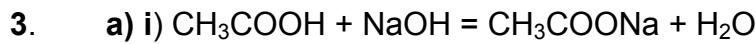
ii) Seda põhjustab aldehüüdrühm

iii)



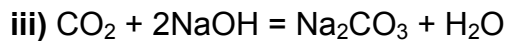
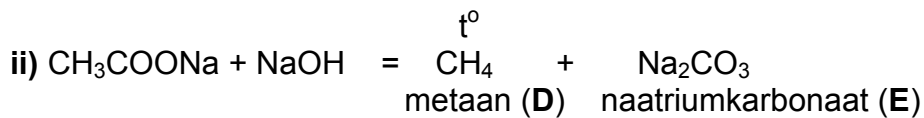


c) 1,2,3,4,5-pentaoolpentaan

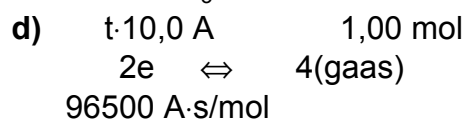
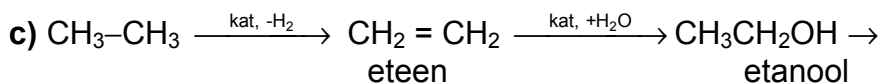
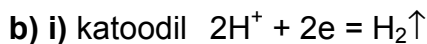
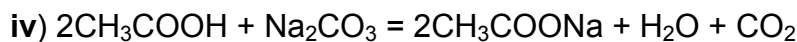


etaanhape (A)

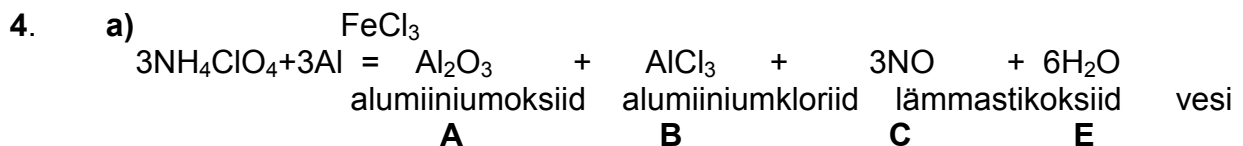
naatriummetaat (B)



G



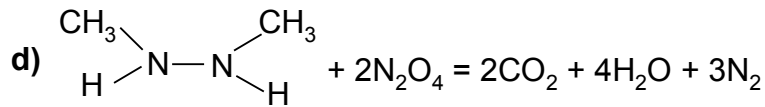
$$t = \frac{2}{4} \cdot 1,00 \text{ mol} \cdot 96500 \frac{\text{A} \cdot \text{s}}{\text{mol}} \cdot \frac{1}{10,0 \text{ A}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = 1,34 \text{ h}$$



b) $\Delta H(\text{H}_2) = 1,4 \cdot 10^3 \text{ m}^3 \cdot \frac{1000 \text{ dm}^3}{1 \text{ m}^3} \cdot 70 \text{ g/dm}^3 \cdot \frac{1 \text{ mol}}{2,0 \text{ g}} \cdot (-241 \text{ kJ/mol}) =$
 $= -1,18 \cdot 10^7 \cdot 10^3 \text{ J} \approx -1,2 \cdot 10^{10} \text{ kJ}$

c) $\Delta H(\text{butaan}) = 21,0 \frac{\text{kg}}{\text{balloon}} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} \cdot \frac{1 \text{ mol}}{58,1 \text{ g}} \cdot (-2,88 \cdot 10^3 \text{ kJ/mol}) =$
 $= -1,04 \cdot 10^6 \text{ kJ/balloon}$

$$N(\text{butaan}) = \frac{-1,18 \cdot 10^{10} \text{ kJ}}{-1,04 \cdot 10^6 \text{ kJ/balloon}} = \mathbf{11000 \text{ ballooni}}$$



e) $n(\text{DMH}) = \frac{1}{3} \cdot 18 \text{ mol} = \mathbf{6 \text{ mol}}$

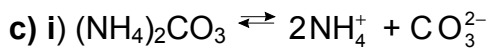
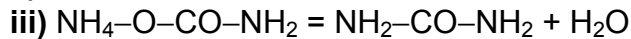
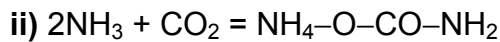
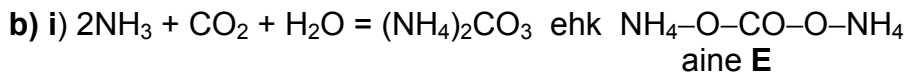
5. a) i) $\Delta T = m(\text{G}) \cdot K_{\text{kr}}$

$$m(\text{G}) = \frac{6,00 \text{ g}}{M(\text{G})} \cdot \frac{1}{0,100 \text{ kg}}$$

$$\frac{1,86\text{K}}{1,86\text{K} \cdot \text{kg/mol}} = \frac{6,00 \text{ g}}{M(\text{G}) \cdot 0,100 \text{ kg}}$$

$$M(\text{G}) = \frac{6,00 \text{ g}}{0,100 \text{ kg}} \cdot 1 \frac{\text{kg}}{\text{mol}} = \mathbf{60,0 \text{ g/mol}}$$

ii) **G** on $\text{NH}_2\text{--CO--NH}_2$, karbamiid

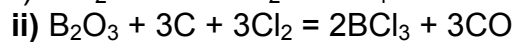
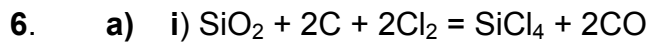


d) **A** – NH_3 , ammoniaak

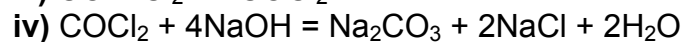
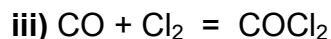
B – CO_2 , süsinikdioksiid

C – H_2O , vesi

D – $(\text{NH}_4)_2\text{CO}_3$, ammooniumkarbonaat



h·v



b) $n(\text{HCl}) = n(\text{NaOH}) - 4n(\text{COCl}_2) + 2n(\text{COCl}_2)$

$$\underbrace{\hspace{10em}}_{n(\text{NaOH, reageerimata})} \quad \underbrace{\hspace{10em}}_{n(\text{Na}_2\text{CO}_3)}$$

$$0,02200 \text{ mol} = 0,03000 \text{ mol} - 2n(\text{COCl}_2)$$

c) i) $2n(\text{CoCl}_2) = 0,03000 \text{ mol} - 0,02200 \text{ mol}$
 $n(\text{CoCl}_2) = \mathbf{0,00400 \text{ mol}}$

ii) $n(\text{Cl}_2) = 0,03500 \text{ mol} - 0,00400 \text{ mol} = \mathbf{0,03100 \text{ mol}}$

iii) $0,7878 \text{ g} \times \quad 0,7878 \text{ g} (100\% - x)$
 $2\text{SiO}_2 + 3\text{B}_2\text{O}_3 = 0,03100 \text{ mol} \cdot 100\%$
 $60,09 \text{ g/mol} \quad 69,62 \text{ g/mol}$

$$0,02622x + 3,3947\% - 0,03395x = 3,1000\%$$

$$0,007727x = 0,2947\%$$

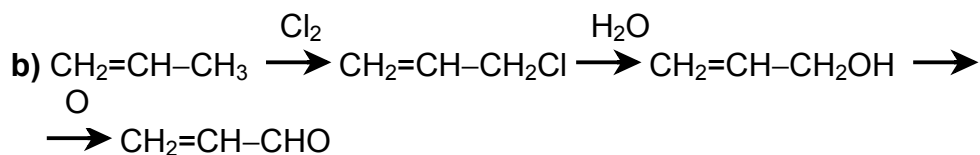
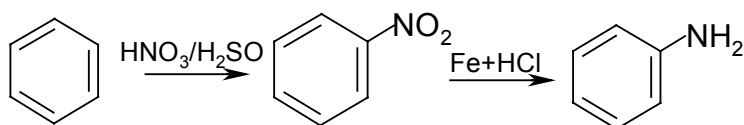
$$x = 38,14\%$$

$$\%(\text{SiO}_2) = \mathbf{38,14}$$

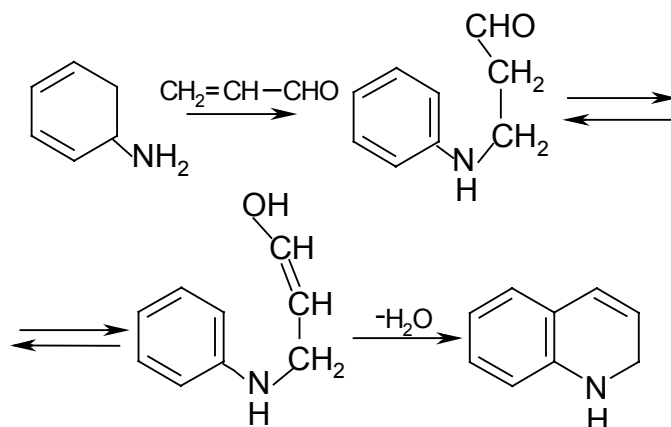
$$\%(\text{B}_2\text{O}_3) = 100 - 38,14 = \mathbf{61,86}$$

1998/99 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a)



c)



2. a) $K = \frac{2 \cdot 0,6}{0,1 \cdot 0,3} = 40$

b) $\Sigma_c = 3,000 \text{ cmol/dm}^3$;
 $V_{\text{alg}} = 1 \text{ dm}^3$

$$V_{\text{lõpp}} = 1 \text{ dm}^3 + \frac{0,500 \text{ cmol}}{3,000 \text{ cmol}} \cdot 1 \text{ dm}^3 = \frac{7}{6} \text{ dm}^3$$

c) $40 = \frac{(2+x) \cdot (0,6+x)}{(0,3+0,5-x) \cdot (0,1-x)}$

d) $[\text{NO}] = \frac{(2+x) \cdot 6}{7}$; $[\text{SO}_3] = \frac{(0,6+x) \cdot 6}{7}$;
 $[\text{NO}_2] = \frac{(0,1-x) \cdot 6}{7}$; $[\text{SO}_2] = \frac{(0,3+0,5-x) \cdot 6}{7}$

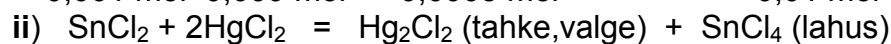
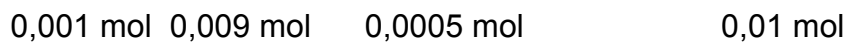
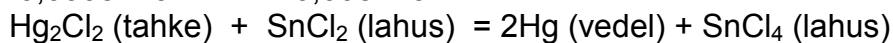
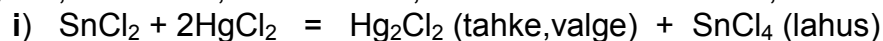
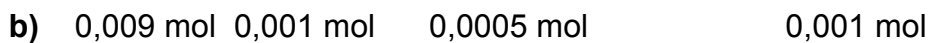
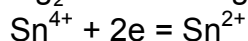
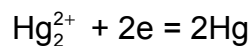
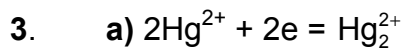
e) $39x^2 - 38,6x + 2 = 0$, mille positiivse väärtusega lahend on 0,055.

$$[\text{NO}] = \frac{2,055 \cdot 6}{7} = 1,761 \text{ cmol/dm}^3;$$

$$[\text{SO}_3] = \frac{0,655 \cdot 6}{7} = 0,561 \text{ cmol/dm}^3;$$

$$[\text{NO}_2] = \frac{0,045 \cdot 6}{7} = 0,039 \text{ cmol/dm}^3;$$

$$[\text{SO}_2] = \frac{0,745 \cdot 6}{7} = 0,633 \text{ cmol/dm}^3$$

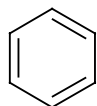


Heterogeenne reaktsioon, mis toimub tahke aine pinnal. Moodustunud elavhõbe värvib sademe tumedaks.

c) Punktis ii) jätkub redutseerijat ainult osa Hg_2^{2+} redutseerimiseks Hg_2^{2+} -ks, mis annab kloriidioonidega mittelahustuva valge kalomeli. Punktis i) redutseeritakse kogu sublimaat kalomeliks ja tina(II)kloriidi jätkub veel kalomeli redutseerimiseks elavhõbedani, mis värvib sademe tumedaks.

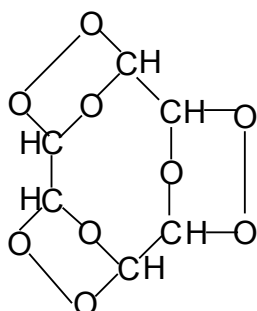
d) Standardpotentsiaalide erinevus on väike. Heterogeense reaktsioonina toimub elavhõbeda moodustumine ainult sademe pinnal.

4. a) i)



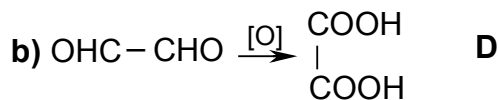
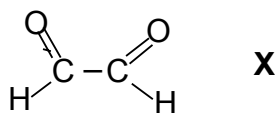
A

ii)

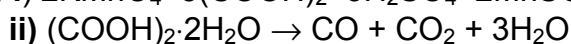
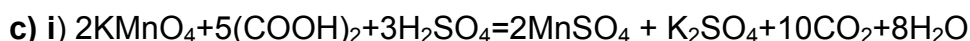


B

iii)



etaandihape e oblikhape

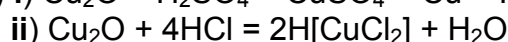
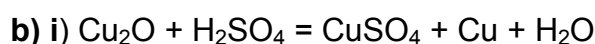
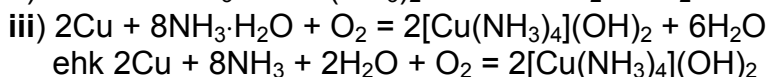


$$\text{d) i) } n(\text{COOH})_2 = \frac{5}{2} \cdot 0,01320 \text{ dm}^3 \cdot 0,02000 \text{ mol/dm}^3 \cdot 10 = 0,006600 \text{ mol}$$

$$c(\text{COOH})_2 = \frac{0,006600 \text{ mol}}{0,01000 \text{ dm}^3} = \mathbf{0,6600 \text{ mol/dm}^3}$$

$$\text{ii) } V(\text{gaasid}) = \frac{5}{1} \cdot 12,6 \text{ g} \cdot \frac{1 \text{ mol}}{126 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} \cdot \frac{373\text{K}}{273\text{K}} = \mathbf{15,3 \text{ dm}^3}$$

5.



$$\text{c) i) } n(\text{HCl}) = 22,60 \text{ cm}^3 \cdot 1,19 \text{ g/cm}^3 \cdot 0,380 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} = 0,280 \text{ mol}$$

$$n(\text{Cu}_2\text{O}) = n(\text{Cu}) = 1,27 \text{ g} \cdot \frac{1 \text{ mol}}{63,5 \text{ g}} = \mathbf{0,0200 \text{ mol}}$$

$$m(\text{Cu}_2\text{O}) = 0,0200 \text{ mol} \cdot 143 \text{ g/mol} = 2,86 \text{ g}$$

HCl hulk, mis kulus Cu_2O reageerimiseks, on

$$n'(\text{HCl}) = \frac{4}{1} \cdot 0,0200 \text{ mol}$$

ii) HCl hulk, mis kulus XO reageerimiseks, on

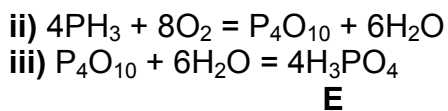
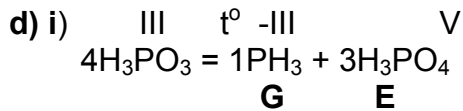
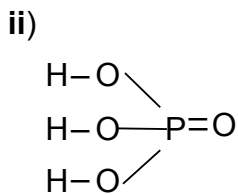
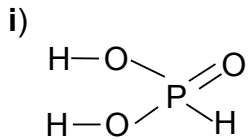
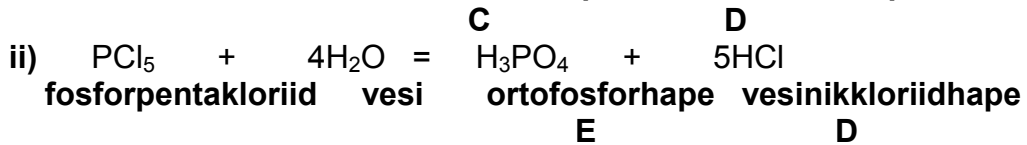
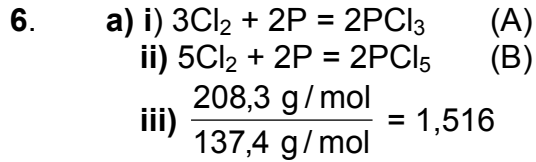
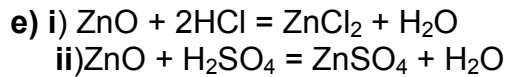
$$n''(\text{HCl}) = 0,280 \text{ mol} - 0,080 \text{ mol} = 0,200 \text{ mol}$$

$$m(\text{XO}) = 11,00 \text{ g} - 2,86 \text{ g} = 8,14 \text{ g}$$

$$n(\text{XO}) = \frac{1}{2} \cdot 0,200 \text{ mol} = \mathbf{0,100 \text{ mol}}$$

$$\text{d) } M(\text{XO}) = 8,14 \text{ g} \cdot \frac{1}{0,100} \text{ mol} = 81,4 \text{ g/mol}$$

$$M(X) = 81,4 \text{ g/mol} - 16 \text{ g/mol} = 65,4 \text{ g/mol (Zn)}$$



**1998/99 õa keemiaolümpiaadi piirkondliku vooru
ülesannete lahendused
8. klass**

1. a) a – ettevaatust; b – tuleohtlik; c – mürgine; d – mürgine gaas
b) e – pipett; f – tilgapipett; g – porselankauss; h – porselantiigel; i – tiigitangid;
j – uhmer; k – uhmri nui

2. a) $M_r(\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}) = 2 \cdot 23,0 + 4 \cdot 10,8 + 7 \cdot 16,0 + 10(2 \cdot 1,01 + 1 \cdot 16,0) = 381$

b) 1(booraks) \Leftrightarrow 10 molekuli (H_2O)

$$N(\text{H}_2\text{O}) = 5(\text{booraks}) \cdot \frac{10 \text{ molekuli}}{1(\text{booraks})} = \mathbf{50 \text{ molekuli}}$$

c) 4(B) \Leftrightarrow 1 molekul (booraks)

$$N(\text{booraks}) = 12(\text{B}) \cdot \frac{1 \text{ molekul}}{4(\text{B})} = \mathbf{3 \text{ molekuli}}$$

d) 17(O) \Leftrightarrow 1 molekul (booraks)

$$N(\text{booraks}) = 34(\text{O}) \cdot \frac{1 \text{ molekul}}{17(\text{O})} = \mathbf{2 \text{ molekuli}}$$

e) **$\text{Na}_2\text{B}_4\text{O}_7$**

Sula naatriumtetraboraat eemaldab metallidelt oksiidikihi, muutes nad hästi kokkujoodetavaks. Seetõttu joodetakse pitsiliste metalljuveelide (filigraanide) valmistamisel metallindikesed kokku sulandi all, mis tekib booraksi kuumutamisel.

3. a) Aatomis on elektronide arv prootonite arvuga võrdne. Prootoni ja neutroni mass on võrdne – 1 amü. Elektroni mass on tühine ja nende massi võib jätta arvestamata.

$$A_r(\mathbf{X}) = 18 + (18 + 4) = 40$$

$$A_r(\mathbf{Y}) = 19 + (19 + 1) = 39$$

b) **X** +18)2)8)8

Y +19)2)8)8)1

Z +17)2)8)7

- c) Element **X** on inertne, sest tema viimane kiht on täidetud. Element **Z** eelistatult liidab elektrone, sest tal jääb viimase kihi täitmiseks üks elektron puudu. Element **Y** loovutab oma viimase kihi ainsa elektroni.

- d) **Z**₂-halogeen; **X**-vääriskaas; **Y**-leelismetall
Cl₂ Ar K

4. a) Os(VIII); P(V); Al(III); H(I); S(VI); Cl(VII); N(IV); Ca(II); O(-II)

- b) P-fosfor, Al-alumiinium; H₂-vesinik; S-väävel; Cl₂-kloor; N₂-lämmastik; Ca-kaltsium; O₂-hapnik. Ka P₄ ja S₈ lugeda õigeks.

- c) 1) oksüdeerunud olekus on: Os, P, Al, H, S, Cl, N ja Ca
2) redutseerunud olekus on: O

5. a) $V_{(\text{mesi})} = 1 \cdot \frac{1000 \text{ cm}^3}{1} = 1000 \text{ cm}^3$

$$m_{(\text{mesi})} = 1000 \text{ cm}^3 \cdot 1,45 \text{ g/cm}^3 = \mathbf{1450 \text{ g}}$$

b) Proov A

$$m(\text{ensüümid}) = 45\text{mg} \cdot \frac{1\text{g}}{1000\text{mg}} = 0,045\text{g}$$

Tähistame ensüümide protsendilise sisalduse tähega **X**.

$$x = \frac{0,045\text{g}}{1450\text{g}} \cdot 100\% \Rightarrow 0,0031\% \text{ ehk}$$

$$\%(\text{ensüümid}) = \mathbf{0,0031}$$

Proov B

$$\%(\text{ensüümid}) = \frac{0,160\text{g}}{1450\text{g}} \cdot 100 = \mathbf{0,011}$$

Proov C

$$\%(\text{ensüümid}) = \frac{0,0075\text{g}}{1450\text{g}} \cdot 100 = \mathbf{0,00052}$$

c) Proovid A ja B on ehtne mesi, **proov C** on rikunud mesi.

- 6. a)** **A** – H₂O, vesi – oksiid, vedelik
B – SiO₂, ränidioksiid, liiv – oksiid, tahke
C – J₂, jood – lihtaine, tahke
D – Hg, elavhõbe – lihtaine, vedelik

$$\mathbf{b)} \quad \rho(\text{A}) = \frac{\rho(\text{D})}{13,5} = \frac{13,5\text{g/cm}^3}{13,5} = \mathbf{1,00\text{g/cm}^3}$$

$$\rho(\text{B}) = \rho(\text{A}) \cdot 2,65 = 1,00\text{g/cm}^3 \cdot 2,65 = \mathbf{2,65\text{g/cm}^3}$$

$$\rho(\text{C}) = \rho(\text{B}) \cdot 1,86 = 2,65\text{g/cm}^3 \cdot 1,86 = \mathbf{4,93\text{g/cm}^3}$$

c) $t_{\text{sul}}(\text{H}_2\text{O}) = 0^\circ\text{C}$

$t_{\text{sul}}(\text{Hg}) = \approx -40^\circ\text{C}$ (+40°C ei saa olla, sest siis ei ole ta toatemperatuuril vedelik.)

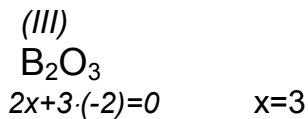
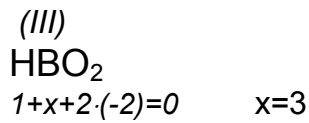
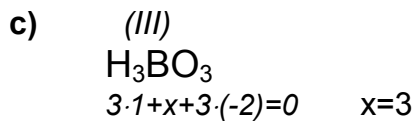
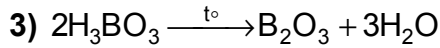
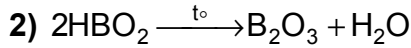
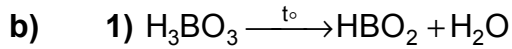
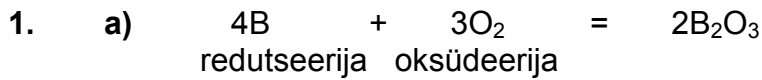
$t_{\text{keem}}(\text{H}_2\text{O}) = 100^\circ\text{C}$

$t_{\text{keem}}(\text{Hg}) = 100^\circ\text{C} + 240^\circ\text{C} \approx 340^\circ\text{C}$

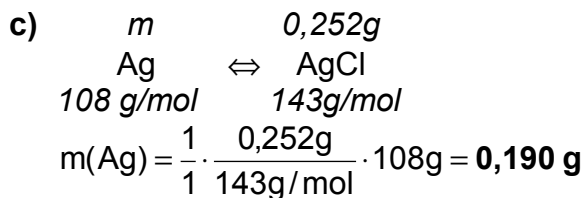
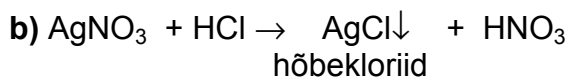
- d)** 1) Jaotuslehtriiga eraldame Hg;
2) filtreerimisega eraldame H₂O;
3) sublimeerime J₂, jäägiks on SiO₂;
J₂ võib eraldada liivast ka etanooli abil, sest J₂ lahustub ja lahuse eraldamise järel võib etanool aurustuda.

**1998/99 õa keemiaolümpiaadi piirkondliku vooru
ülesannete lahendused**

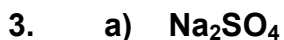
9. klass



d) Diboortrioksiid, sest boor on mittemetall. Diboortrioksiid on happeline oksiid.



d) $\%(Ag) = \frac{0,190g}{0,328g} \cdot 100 = 57,9$



- b) 1) kollane leek – naatrium
2) vesilahuse neutraalne reaktsioon – normaalsool
3) sade $Ba(NO_3)_2$ lahusega – karbonaat või sulfaat
4) happe toimel gaasi mitteeraldumine välistab karbonaadi



d) $M(Na_2SO_4) = 142 \text{ g/mol}$
 $M(X) = 142 \text{ g/mol} \cdot \frac{1}{0,441} = 322 \text{ g/mol}$



$N(H_2O) = \frac{322 - 142}{18} = 10 \text{ molekuli}$ Märkus: arvutamisel kasutasime molekulmasse.



4. a) Ca-kaltsium, metall; CaO-kaltsiumoksiid, aluseline oksiid;
Ca(OH)₂-kaltsiumhüdrosiid, alus; CaCO₃-kaltsiumkarbonaat, normaalsool;
Ca(HCO₃)₂-kaltsiumvesinikkarbonaat, happeline ehk vesiniksool;
CO₂-süsinikdioksiid, happeline oksiid; C-süsinik, mittemetall

- b)
1. $2\text{Ca} + \text{O}_2 = 2\text{CaO}$
 2. $\text{Ca} + 2\text{H}_2\text{O} = \text{Ca(OH)}_2 + \text{H}_2\uparrow$
 3. $\text{CaO} + \text{H}_2\text{O} = \text{Ca(OH)}_2$
 4. $\text{Ca(OH)}_2 \xrightarrow{t^\circ} \text{CaO} + \text{H}_2\text{O}$
 5. $\text{CaO} + \text{CO}_2 = \text{CaCO}_3$
 6. $\text{Ca(OH)}_2 + \text{CO}_2 = \text{CaCO}_3 + \text{H}_2\text{O}$
 7. $\text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O} = \text{Ca(HCO}_3)_2$
 8. $\text{CO}_2 + \text{Ca(OH)}_2 = \text{CaCO}_3 + \text{H}_2\text{O}$
 9. $\text{Ca(HCO}_3)_2 \xrightarrow{t^\circ} \text{CaO} + 2\text{CO}_2 + \text{H}_2\text{O}$
 10. $\text{CO}_2 + \text{H}_2\text{O} + \text{CaCO}_3 = \text{Ca(HCO}_3)_2$
 11. $\text{C} + \text{O}_2 = \text{CO}_2$

c) H₂CO₃ – süsihape

5. a) Kuna välises elektronihis on maksimaalselt kaheksa elektroni, siis sobiksid elemendid, mille järjenumber on 2, 4, 6 ja 8. Need oleksid esimese ja teise perioodi elemendid. Element järjenumbriga 2 on He, kuid ta ei anna keemilisi ühendeid ja seetõttu ta ei sobi.

b) Sobiksid elemendid **Be, C ja O**

c, d) Elementide **Be, C ja O** aatommasside ja ühendi **XY₂** järgi leiame elemendi **Y** võimaliku aatommassi

$$A_r(\text{Be})=9,01 \qquad A_r(\text{Y}) = 9,01 \cdot \frac{1}{15,8} \% \cdot 84,2\% \cdot \frac{1}{2} = \mathbf{24,0}$$

Sel juhul oleks elemendiks **Y** magneesium, kuid Mg on välises kihis ainult 2 elektroni ja see **ei sobi**.

$$A_r(\text{C})=12,0 \qquad A_r(\text{Y}) = 12,0 \cdot \frac{1}{15,8} \% \cdot 84,2\% \cdot \frac{1}{2} = \mathbf{32,0}$$

Elemendiks **Y** on **S**. Väävel sobib, sest ta välises kihis on 6 elektroni, mis võrdub süsiniku kõikide elektronide arvuga.

$$A_r(\text{O})=16 \qquad A_r(\text{Y}) = 16,0 \cdot \frac{1}{15,8} \% \cdot 84,2\% \cdot \frac{1}{2} = \mathbf{42,6}$$

Sellise aatommassiga elementi pole.

Seega ühend **XY₂** on **CS₂** ja elemendid **X ja Y** on vastavalt **süsinik ja väävel**.

6. a) Hapnik – O₂; osoon – O₃

b) S+O₂=SO₂; 2Ca+O₂=2CaO

Osoon on ebastabiilne ja laguneb hapnikuks ning monohapnikuks, mis on väga tugev oksüdeerija O₃→O₂+O

c) O₃ kontsentratsiooni vähenemine laseb elusorganismidele ebasoodsa ultraviolettkiirguse maapinnale.

- d)
1. $\text{H}_2\text{O} \xrightarrow{\text{elektrolüüs}} \text{H}_2 + \text{O}_2$
 2. $2\text{KClO}_3 \xrightarrow{\text{MnO}_2; t^\circ} 2\text{KCl} + 3\text{O}_2$
 3. $2\text{H}_2\text{O}_2 \xrightarrow{\text{MnO}_2} 2\text{H}_2\text{O} + \text{O}_2$

**1998/99 õa keemiaolümpiaadi piirkondliku vooru
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1. $3,600 \text{ M} = 3,600 \text{ mol/dm}^3$

$$\rho(\text{H}_2\text{SO}_4 \text{ lahus}) = \frac{\text{lahuse mass (grammides)}}{\text{lahuse ruumala (kuupsentimeetrites)}}$$

Täpselt ühes kuupdetsimeetris lahuses on 3,600 mol H_2SO_4 .
Seega lahuse ruumala on täpselt 1000 kuupsentimeetrit.

$$m(\text{H}_2\text{SO}_4) = 3,600 \text{ mol} \cdot 98,08 \text{ g/mol} = 353,09 \text{ g}$$

$$m(\text{H}_2\text{SO}_4 \text{ lahus}) = 353,09 \text{ g} \cdot \frac{1}{0,2900} = 1218 \text{ g}$$

$$\rho(\text{H}_2\text{SO}_4 \text{ lahus}) = \frac{1218 \text{ g}}{1000 \text{ cm}^3} = \mathbf{1,218 \text{ g/cm}^3}$$

2. a) $n(\text{H}_3\text{PO}_4) = 0,50 \text{ dm}^3 \cdot 0,10 \text{ mol/dm}^3 = 0,050 \text{ mol}$

$$n(\text{NaOH}) = 3,0 \text{ g} \cdot \frac{1 \text{ mol}}{40 \text{ g}} = \mathbf{0,075 \text{ mol}}$$

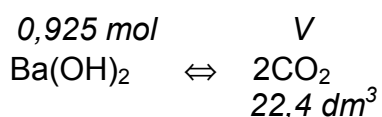
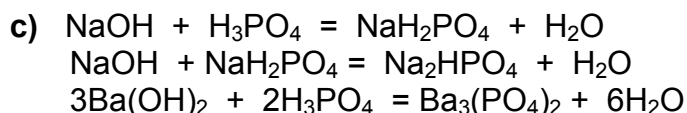
b) H_3PO_4 esimese prootoni neutraliseerimiseks kulub $\frac{1}{1} \cdot 0,050 \text{ mol NaOH}$.

Järelejäänud NaOH hulgast piisab moodustunud NaH_2PO_4 poole koguse üleviimiseks Na_2HPO_4 -ks. Peale lahuse kuivaksaurutamist on tahkete ainete segus **0,025 mol NaH_2PO_4** ja **0,025 mol Na_2HPO_4** .

$$\text{Ba}_3(\text{PO}_4)_2 \text{ moodustumiseks kulub } \frac{3}{2} \cdot 0,050 \text{ mol Ba(OH)}_2 \text{ ja järele jääb}$$

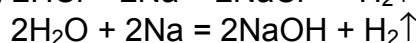
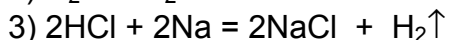
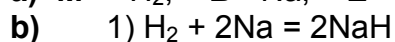
$$1,000 \text{ mol} - 0,075 \text{ mol} = 0,925 \text{ mol Ba(OH)}_2.$$

Peale lahuse kuivaksaurutamist on tahkete ainete segus **0,025 mol $\text{Ba}_3(\text{PO}_4)_2$** ja **0,925 mol Ba(OH)_2** .



$$V(\text{CO}_2) = \frac{2}{1} \cdot 0,925 \text{ mol} \cdot 22,4 \text{ dm}^3 = \mathbf{41,4 \text{ dm}^3}$$

3. a) **M** - H_2 ; **B** - Na; **E** - Cl_2 ; **G** - HCl; **L** - NaH.



c) Na asemel võiks olla **Li** või **K**.

Cl_2 asemel võiks olla **Br_2** või **I_2** (gaasilises olekus).

d) oksüdeerub: $\text{H}_2 + \text{Cl}_2 = 2\text{HCl}$ - vesinikkloriid

redutseerub: $\text{H}_2 + 2\text{Na} = 2\text{NaH}$ - naatriumhüdriid.

4. a) $\%(\text{Na}_2\text{SO}_4) = \frac{4,40}{220 \text{ g}} \cdot 100 = \mathbf{2,00}$

$$\text{b) } V(\text{Na}_2\text{SO}_4 \text{ lahus}) = 220\text{g} \cdot \frac{1\text{cm}^3}{1,016\text{g}} = \mathbf{216,5 \text{ cm}^3}$$

$$n(\text{Na}_2\text{SO}_4) = 4,40\text{g} \cdot \frac{1\text{mol}}{142\text{g}} = 0,03099 \text{ mol}$$

$$c(\text{Na}_2\text{SO}_4) = \frac{0,03099\text{mol}}{0,2165\text{dm}^3} = \mathbf{0,143 \text{ mol/dm}^3}$$

Märkus: vahetehete vastustes on üks lisanumber.

$$\text{c) } m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}) = 4,40\text{g} \cdot \frac{322\text{g/mol}}{142\text{g/mol}} = \mathbf{9,98 \text{ g}}$$

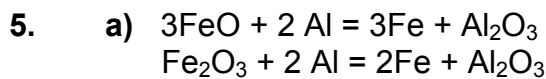
d) Tähistame $m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O})$ sümboliga $m(\text{kr.s})$

$$\frac{10,0\%}{100\%} = \frac{4,40\text{g} + m(\text{kr.s}) \cdot \frac{142}{322}}{220 + m(\text{kr.s})}$$

$$22,0 + 0,100 m(\text{kr.s}) = 4,40 + 0,441 m(\text{kr.s})$$

$$0,341m(\text{kr.s}) = 17,6 \text{ g};$$

$$m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}) = \mathbf{51,6 \text{ g}}$$



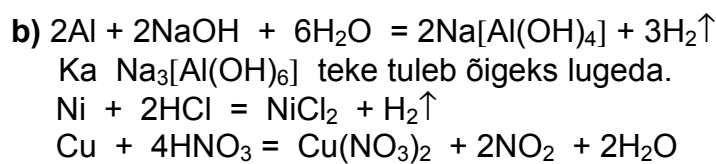
b) $\Delta H_{\text{red}}(\text{FeO}) \cdot 3\text{mol} = 1\text{mol} \cdot (-1675\text{kJ/mol}) - 3\text{mol} \cdot (-264\text{kJ/mol}) = -883 \text{ kJ/mol}$
 $\Delta H_{\text{red}}(\text{FeO}) = -883 \text{ kJ/mol} \cdot (1/3\text{mol}) = \mathbf{-294 \text{ kJ/mol}}$

$$\Delta H_{\text{red}}(\text{Fe}_2\text{O}_3) \cdot 1\text{mol} = 1\text{mol} \cdot (-1675\text{kJ/mol}) - 1\text{mol} \cdot (-821\text{kJ/mol}) = -854 \text{ kJ/mol}$$

$$\Delta H_{\text{red}}(\text{Fe}_2\text{O}_3) = -854 \text{ kJ/mol} \cdot (1/1\text{mol}) = \mathbf{-854 \text{ kJ/mol}}$$

c) 1) $\Delta H_{\text{saamine}}(\text{Fe}) \cdot 3\text{mol} = -883 \text{ kJ}$
 $\Delta H_{\text{saamine}}(\text{Fe}) = -883 \text{ kJ/mol} \cdot (1/3\text{mol}) = \mathbf{-294 \text{ kJ/mol}}$
2) $\Delta H_{\text{saamine}}(\text{Fe}) \cdot 2\text{mol} = -854 \text{ kJ}$
 $\Delta H_{\text{saamine}}(\text{Fe}) = -854 \text{ kJ/mol} \cdot (1/2\text{mol}) = \mathbf{-427 \text{ kJ/mol}}$

6. a) Tundmatu aine on **vask**.



c)

$$\begin{array}{ccc} m & & 1,87 \text{ dm}^3 \\ 2\text{Al} & \Leftrightarrow & 3\text{H}_2 \\ 27,0 \text{ g/mol} & & 22,4 \text{ dm}^3/\text{mol} \end{array}$$

$$m(\text{Al}) = \frac{2}{3} \cdot 1,87\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot 27,0\text{g/mol} = \mathbf{1,50 \text{ g}}$$

$$\begin{array}{ccc} m & & 1,50 \text{ dm}^3 \\ \text{Ni} & \Leftrightarrow & \text{H}_2 \\ 58,7 \text{ g/mol} & & 22,4 \text{ dm}^3/\text{mol} \end{array}$$

$$m(\text{Ni}) = \frac{1}{1} \cdot 1,50\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot 58,7\text{g/mol} = \mathbf{3,93 \text{ g}}$$

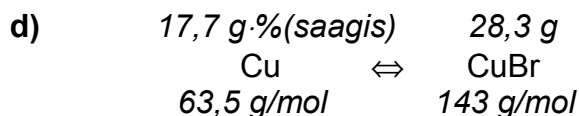
$$m(\text{Cu}) = 30,00 - 1,50 \text{ g} - 3,93 \text{ g} = \mathbf{24,57 \text{ g}}$$

**1998/99 õa keemiaolümpiaadi piirkondliku vooru
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11. klass**

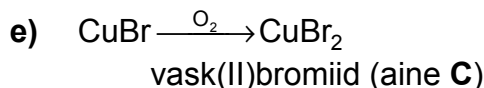
1. a) $2\text{Ca}_3(\text{PO}_4)_2 + 3\text{SiO}_2 + 10\text{C} = 3\text{Ca}_2\text{SiO}_4 + 10\text{CO} + \text{P}_4$
- b) $\text{Ca}_3(\text{PO}_4)_2$ - kaltsiumfosfaat
 SiO_2 - ränidioksiid
 C - süsinik
 aine **A** - fosfor
 aine **B** - kaltsiumortosilikaat Ca_2SiO_4 või kaltsiummetasilikaat CaSiO_3
 aine **C** - süsinikmonooksiid
- c) $100\text{ g} \cdot 0,25 \quad m$
 $2\text{Ca}_3(\text{PO}_4)_2 \Leftrightarrow \text{P}_4$
 $310\text{ g/mol} \quad 124\text{ g/mol}$
 $m(\text{P}_4) = \frac{1}{2} \cdot 100\text{g} \cdot 0,25 \cdot \frac{1\text{mol}}{310\text{g}} \cdot 124\text{g/mol} = 5,0\text{ g}$
2. a) $3\text{I}_2 + \text{NH}_3 = \text{NI}_3 + 3\text{HI}$
 jood ammoniaak joodnitriid vesinikjodiid
 (aine **A**) (aine **B**)
- b) $n(\text{NI}_3) = 20 \cdot 0,003\text{mol} = 0,06\text{ mol}$
 lahus **A**: $m(\text{I}_2\text{lahus}) = \frac{3}{1} \cdot 0,06\text{mol} \cdot 254\text{g/mol} \cdot \frac{1}{0,05} \cdot \frac{1}{0,76} = 1,2\text{ kg}$
 lahus **B**: $m(\text{NH}_3\text{lahus}) = \frac{1}{1} \cdot 0,06\text{mol} \cdot 17\text{g/mol} \cdot \frac{1}{0,1} = 10,2\text{ g}$
- c) $m(\text{NI}_3) = 0,003\text{mol} \cdot 395\text{ g/mol} = 1,2\text{ g}$
3. a) 1) $2\text{KI} + \text{Cl}_2 = 2\text{KCl} + \text{I}_2$
 2) $3\text{I}_2 + 2\text{Al} \xrightarrow{\text{H}_2\text{O}} 2\text{AlI}_3$
- b) Kaaliumi ühendid annavad leegile lillakas-violetse värvi. Kloor oksüdeerib ühendis oleva passiivsema halogeeni lihtaineks. Tahke halogeeninäe esineb ainult jood.
- c) $m(\text{I}_2) = 13,5\text{g} \cdot \frac{1}{6,617\%} \cdot 93,383\% = 191\text{g}$
- $18,1\text{ dm}^3 \quad m$
 $\text{Cl}_2 \Leftrightarrow \text{I}_2$
 $22,4\text{dm}^3/\text{mol} \cdot \frac{293}{273} \quad 254\text{ g/mol}$
 $m(\text{I}_2) = \frac{1}{1} \cdot 18,1\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot \frac{273}{293} \cdot 254\text{g/mol} = 191\text{ g}$
4. a) $\text{Cu} + 2\text{H}_2\text{SO}_4 = \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$ Metall **A** on vask.
 $\text{Cu} + 4\text{HNO}_3(\text{konts.}) = \text{Cu}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$
 $3\text{Cu} + 8\text{HNO}_3(\text{lahj.}) = 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$
- b) $2\text{CuSO}_4 + 2\text{KBr} + \text{SO}_2 + 2\text{H}_2\text{O} = 2\text{CuBr} \downarrow + \text{K}_2\text{SO}_4 + 2\text{H}_2\text{SO}_4$
 vask(I)bromiid
 (aine **B**)
- c) $2\text{Cu} \Leftrightarrow 2\text{CuBr} \Leftrightarrow \text{SO}_2$
 $n(\text{Cu}) = 17,7\text{g} \cdot \frac{1\text{mol}}{63,5\text{g}} = 0,279\text{mol}$

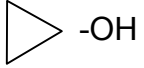
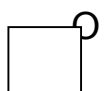
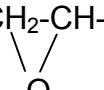
$$n(\text{SO}_2) = 7,35\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} = 0,328\text{mol}$$

SO₂ on rohkem kui kahekordses ülehulgas.



$$\%(\text{saagis}) = \frac{1}{1} \cdot 28,3\text{g} \cdot \frac{1\text{mol}}{143\text{g}} \cdot 63,5\text{g/mol} \cdot \frac{1}{17,7\text{g}} \cdot 100 = \mathbf{71,0\%}$$



5. a) Alkoholid: $\text{CH}_2=\text{CH}-\text{CH}_2\text{OH}$ – propeen-3-ool
 – tsüklopropanool
 $\text{CH}_2=\text{C}-\text{CH}_3$ – propeen-2-ool
 $\begin{array}{c} | \\ \text{OH} \end{array}$
 $\text{CH}_3-\text{CH}=\text{CH}-\text{OH}$ – propenool
 Ketoon: $\text{CH}_3-\text{C}-\text{CH}_3$ – propanoon
 $\begin{array}{c} || \\ \text{O} \end{array}$
 Aldehüüd: $\text{CH}_3-\text{CH}_2-\text{C}$
 $\begin{array}{l} // \text{O} \\ \backslash \text{H} \end{array}$ – propanaal
 Eetrid: $\text{CH}_2=\text{CH}-\text{O}-\text{CH}_3$ –(metoksüeteen)
 –(1,3-epoksüpropan)
 $\text{CH}_2-\text{CH}-\text{CH}_3$ –(1,2-epoksüpropan)


6. a) $n(\text{NaOH}) = 3,54\text{dm}^3 \cdot 1000\text{g/dm}^3 \cdot 0,00026 \cdot \frac{1\text{mol}}{40\text{g}} = 0,023\text{mol}$
 $n(\text{H}_3\text{PO}_4) = 1,46\text{dm}^3 \cdot 1000\text{g/dm}^3 \cdot 0,000403 \cdot \frac{1\text{mol}}{98,0\text{g}} = 0,00600\text{mol}$
 $C(\text{NaOH}) = \frac{0,023\text{mol}}{3,54\text{dm}^3} = \mathbf{0,0065\text{mol/dm}^3}$
 $c(\text{H}_3\text{PO}_4) = \frac{0,00600\text{mol}}{1,46\text{dm}^3} = \mathbf{0,00411\text{mol/dm}^3}$



c) H₃PO₄ täielikuks neutraliseerimiseks kulub (3/1)·0,006 mol = 0,018 mol.
Lahuses on **0,00600 mol Na₃PO₄** ja 0,023 - 0,018 = **0,005 mol NaOH**.

d) $C(\text{NaOH}) = \frac{0,005\text{mol}}{5,00\text{dm}^3} = 0,001\text{mol/dm}^3$
 $C(\text{H}^+) = \frac{10^{-14}}{10^{-3}} = 10^{-11}$ $\text{pH} = -\log 10^{-11} = \mathbf{11}$

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1. a) m $\quad 15,0A \cdot 0,600 \cdot 3600s$
 $Ni \quad \Leftrightarrow \quad 2e^-$
 $58,7g/mol \quad 96500 A \cdot s/mol$
 $m(Ni) = \frac{1}{2} \cdot 15,0A \cdot 0,600 \cdot 3600s \cdot \frac{1mol}{96500A \cdot s} \cdot 58,7g/mol = \mathbf{9,85 g}$

b) V $\quad 15,0A \cdot 0,400 \cdot 3600s$
 $H_2 \quad \Leftrightarrow \quad 2e^-$
 $V_M \quad 96500 A \cdot s/mol$
 $V_M = 22,4 \frac{dm^3}{mol} \cdot \frac{293}{273} \cdot \frac{760}{780} = 23,4 \frac{dm^3}{mol}$

$$V(H_2) = \frac{1}{2} \cdot 15,0A \cdot 0,400 \cdot 3600s \cdot \frac{1mol}{96500A \cdot s} \cdot 23,4 \frac{dm^3}{mol} = \mathbf{2,62 dm^3}$$

c) Lahusesse tekib Ni^{2+} ioone rohkem kui neid metallesemel redutseerub. Vesiniku eraldumisega jääb lahusesse hüdroksiidioonide liig.

d) $l(Ni) = 9,85g \cdot \frac{1cm^3}{8,9g} \cdot \frac{1}{32cm^2} = \mathbf{0,035 cm}$

2. a) $820 \text{ ööpäeva} \cdot \frac{1aasta}{365 \text{ ööpäeva}} = 2,25 \text{ aastat}$

$$K = \frac{\ln 2}{2,25 \text{ aastat}} = \mathbf{0,308 \text{ aasta}^{-1}}$$

b) $t = \frac{1aasta}{0,308} \cdot \ln \frac{1,0 \cdot 10^{-2}}{7,3 \cdot 10^{-3}} = \mathbf{1,0 \text{ aastat}}$

c) $e^{k \cdot t} = \frac{c_0}{c_t}$

$$c_t = c_0 \cdot e^{-k \cdot t} \Rightarrow 1,0 \cdot 10^{-2}\% \cdot e^{-0,308 \text{ aasta}^{-1} \cdot 1,5 \text{ aastat}} = \mathbf{2,1 \cdot 10^{-3}\%}$$

3. a) **A** – HCl; **B** – Cl₂; **D** – NaBr; **E** – Br₂ (ka I₂ on õige); **G** sisaldab NaCl, NaBr ja H₂SO₄

- b)
- 1) $MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$
 - 2) $Cl_2 + 2NaBr = 2NaCl + Br_2$
 - 3) $Br_2 + NaHSO_3 + H_2O = NaBr + H_2SO_4 + HBr$
 Õige on ka $Br_2 + NaHSO_3 + H_2O = NaHSO_4 + 2HBr$
 - 4) $H_2SO_4 + Ba(NO_3)_2 = BaSO_4 \downarrow + 2HNO_3$
 - 5) $NaCl + NaBr + H_2SO_4 + 4AgNO_3 = AgCl \downarrow + AgBr \downarrow + Ag_2SO_4 \downarrow + 2NaNO_3 + 2HNO_3$

c) Ba(NO₃)₂ lisamisel: lahuses H⁺, Na⁺, Cl⁻; Br⁻; sademes BaSO₄
 AgNO₃ lisamisel: lahuses H⁺, Na⁺, NO₃⁻; sademes AgCl, AgBr, Ag₂SO₄

4. a) $[SnSO_4] = [Sn^{2+}] = [SO_4^{2-}] = \sqrt{L(SnSO_4)}$

