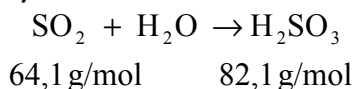


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9. klass

1. a)



$$\text{b) } 0,0500 = \frac{m(\text{H}_2\text{SO}_3)}{m(\text{H}_2\text{O}) + m(\text{SO}_2)} \Rightarrow \frac{\frac{1}{1} m(\text{SO}_2) \cdot \frac{1 \text{ mol}}{64,1 \text{ g}} \cdot 82,1 \text{ g/mol}}{1,00 \text{ dm}^3 \cdot 997 \text{ g/dm}^3 + m(\text{SO}_2)}$$

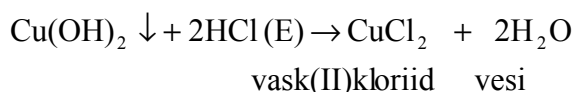
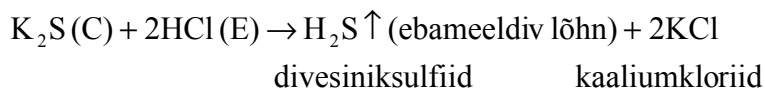
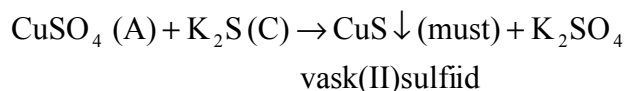
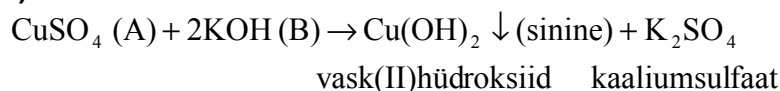
$m(\text{SO}_2) = 40,5 \text{ g}$

$$\text{c) } V_M = 1 \text{ mol} \cdot 0,08206 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 298 \text{ K} \cdot \frac{1}{1,01 \text{ atm}} = 24,2 \text{ dm}^3 / \text{mol}$$

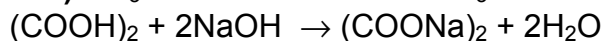
$$\text{d) } V = 40,5 \text{ g} \cdot \frac{1 \text{ mol}}{64,1 \text{ g}} \cdot 24,2 \text{ dm}^3 / \text{mol} = 15,3 \text{ dm}^3$$

2. a) A - CuSO₄; B - KOH; C - K₂S; D - NaNO₃; E - HCl

b)



3. a) CH₃COOH + NaOH → CH₃COONa + H₂O



b) Tiitrimiseks kulunud naatriumhüdrosiidi hulk on:

$$n(\text{NaOH}) = 0,300 \text{ dm}^3 \cdot 1,00 \text{ mol/dm}^3 = 0,300 \text{ mol.}$$

Sellest kulus etaanhappe (mida oli x g) neutraliseerimiseks

$$n'(\text{NaOH}) = \frac{1}{1} \cdot x \text{ g} \cdot \frac{1 \text{ mol}}{60,0 \text{ g}}$$

ja oblikhappe [mida oli (16,0-x) g] neutraliseerimiseks

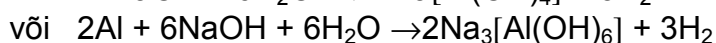
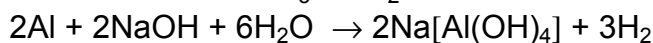
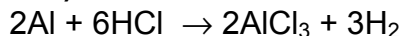
$$n''(\text{NaOH}) = \frac{2}{1} (16,0 - x) \text{ g} \cdot \frac{1 \text{ mol}}{90,0 \text{ g}}$$

Need seosed võimaldavad koostada võrrandi

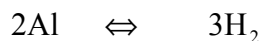
$$\frac{x}{60,0} + \frac{2 \cdot (16,0 - x)}{90,0} = 0,300$$

$$x = 10,0 \text{ g}; \quad m(\text{CH}_3\text{COOH}) = 10,0 \text{ g}; \quad m[(\text{COOH})_2] = 16,0 - 10,0 = 6,0 \text{ g}$$

4. a) Nii HCl-i kui ka NaOH lahus reageerib ainult alumiiniumiga



b)



$$27,0 \text{ g/mol} \quad 22,4 \text{ dm}^3/\text{mol}$$

$$m'(Al) = \frac{2}{3} \cdot 6,72 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} \cdot 27,0 \text{ g/mol} = 5,40 \text{ g}$$

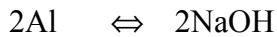
$$m'(Cu) = 10,0 - 5,4 = 4,6 \text{ g}$$

$$m''(Al) = 500 \text{ g (segu)} \cdot \frac{5,40 \text{ g}}{10,0 \text{ g (segu)}} = 270 \text{ g}$$

$$m''(Cu) = 500 \text{ g} - 270 \text{ g} = 230 \text{ g}$$

c)

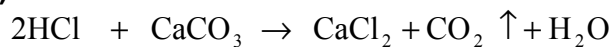
$$270 \text{ g} \quad V(\text{cm}^3) \quad 1,22 \text{ g/cm}^3 \cdot 0,200$$



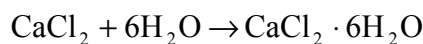
$$27,0 \text{ g/mol} \quad 40,0 \text{ g/mol}$$

$$V(\text{NaOH}) = \frac{2}{2} \cdot \frac{270 \text{ g}}{27,0 \text{ g/mol}} \cdot 40,0 \text{ g/mol} \cdot \frac{1}{0,200} \cdot \frac{1 \text{ cm}^3}{1,22 \text{ g}} = 1639 \text{ cm}^3$$

5. a)



$$36,5 \text{ g/mol} \quad 100,1 \text{ g/mol} \quad 111 \text{ g/mol}$$



$$219 \text{ g/mol}$$

b)

$$V \text{ cm}^3 \cdot 1,05 \text{ g/cm}^3 \cdot 0,100 \quad 100 \text{ g}$$



$$V(\text{HCl}) = \frac{2}{1} \cdot \frac{100 \text{ g}}{1} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 36,5 \text{ g/mol} \cdot \frac{1}{0,100} \cdot \frac{1 \text{ cm}^3}{1,05 \text{ g}} = 317 \text{ cm}^3$$

$$c) m(\text{CaCO}_3) = \frac{1}{1} \cdot \frac{100 \text{ g}}{1} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 100,1 \text{ g/mol} = 45,7 \text{ g}$$

d)

$$m(\text{lahus}) = 317 \text{ cm}^3 \cdot 1,05 \text{ g/cm}^3 + 45,7 \text{ g} - \frac{1}{1} \cdot 100 \text{ g} \cdot \frac{1 \text{ mol}}{219 \text{ g}} \cdot 44 \text{ g/mol} = 333 + 46 - 20 = 359 \text{ g}$$

$$V(\text{lahus}) = 359 \cdot \frac{1 \text{ cm}^3}{1,12 \text{ g}} = 321 \text{ cm}^3$$

$$e) m(\text{H}_2\text{O}) = 359 - 100 = 259 \text{ g}$$

6. a) X - aluseline, Y - happeline, Z - aluseline

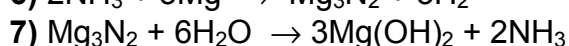
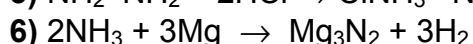
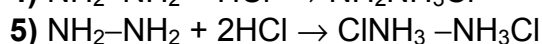
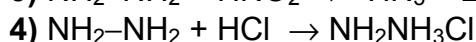
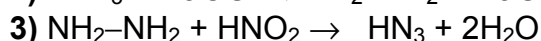
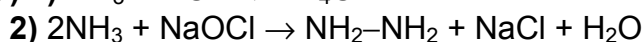
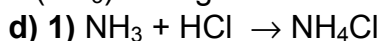
b) X - NH₃ (ammoniaak); M - NH₄Cl (ammooniumkloriid)

c) Gaaside molaarmass ja tihedus on võrdelises sõltuvuses.

$$\text{Seetõttu } M(Y) = \sim 0,98 \cdot 44 \text{ g/mol} = \sim 43 \text{ g/mol}$$

Et ühendi Y molekulis on sama arv aatomeid kui ammoniaagis, siis arvutusel saadud ligilähedasele molaarmassile vastab ühend HN₃.

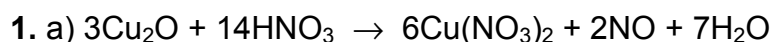
$$M(\text{HN}_3) = 43 \text{ g/mol}$$



e) Y - HN₃; Z - NH₂-NH₂; Q - Mg₃N₂ (magneesiumnitriid); R - Pb(N₃)₂

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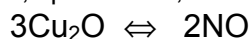
10. klass



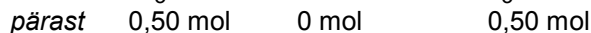
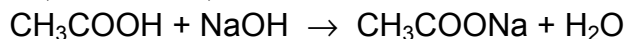
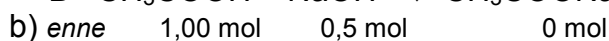
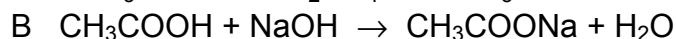
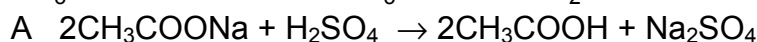
$$m[\text{Cu}(\text{NO}_3)_2] = \frac{6}{3} \cdot 10,0 \text{ g} \cdot \frac{1 \text{ mol}}{143 \text{ g}} \cdot 188 \text{ g/mol} = 26,3 \text{ g}$$

c) Võib lähtuda põhimõttest, et lähteainest reageeris murdosa, mis vastab saagise protsendile (p/100)

$$10,0 \cdot p/100 \quad 0,900 \text{ dm}^3$$



$$p = \frac{3}{2} \cdot 0,900 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} \cdot 143 \text{ g/mol} \cdot \frac{100}{10,0} = 86,18 \sim 86,2 \%$$



Nii lahuses A kui B on ainete hulgad järgmised:

$$n(\text{CH}_3\text{COOH}) = \frac{0,50 \text{ mol}}{2} = 0,25 \text{ mol}$$

$$n(\text{CH}_3\text{COONa}) = \frac{0,50 \text{ mol}}{2} = 0,25 \text{ mol}$$

A $n(\text{CH}_3\text{COOH}) = 0,25 + 2 \cdot 0,200 \text{ dm}^3 \cdot 0,500 \text{ mol/dm}^3 = 0,45 \text{ mol}$

$n(\text{CH}_3\text{COONa}) = 0,25 - 2 \cdot 0,200 \text{ dm}^3 \cdot 0,500 \text{ mol/dm}^3 = 0,05 \text{ mol}$

B $n(\text{CH}_3\text{COOH}) = 0,25 - 0,10 = 0,15 \text{ mol}$

$n(\text{CH}_3\text{COONa}) = 0,25 + 0,10 = 0,35 \text{ mol}$

c) $\text{pH} = -\lg\sqrt{k \cdot c} = -\lg\sqrt{1,75 \cdot 10^{-5} \cdot 1,00} = -\lg 4,18 \cdot 10^{-3} = 2,37 \approx 2,4$

Enne lahuse pooleksjagamist on puhverlahus.

$$\text{pH} = -\lg K_{\text{diss}} \cdot \frac{n(\text{hape})}{n(\text{sool})} = -\lg 1,75 \cdot 10^{-5} \cdot \frac{0,50}{0,50} = 4,76 \approx 4,8$$

d) A $\text{pH} = -\lg 1,75 \cdot 10^{-5} \cdot \frac{0,45}{0,05} = 3,80 \approx 3,8$

B $\text{pH} = -\lg 1,75 \cdot 10^{-5} \cdot \frac{0,15}{0,35} = 5,12 \approx 5,1$

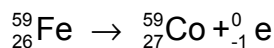
e) $K_{\text{diss}} = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]}$ Puhverlahuses $[\text{CH}_3\text{COO}^-] \sim c_{\text{sool}} ; [\text{CH}_3\text{COOH}] \sim$

c_{hape}

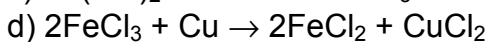
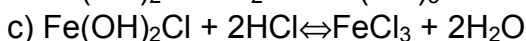
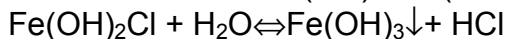
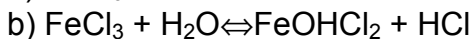
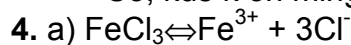
$$[\text{H}^+] = K_{\text{diss}} \cdot \frac{[\text{CH}_3\text{COOH}]}{[\text{CH}_3\text{COO}^-]} = K_{\text{diss}} \cdot \frac{c_{\text{sool}}}{c_{\text{hape}}}$$

3. a) Kui aatomi eelviimases kihis on d-elektrone vähem kui 10, siis on ta nn. d-element. Et kokku on 8 s-elektroni, siis peab see element kuuluma 4. perioodi, kus 4s orbitaal on täidetud ja 3d-orbitaal, mis 4. perioodis järgneb 4s-orbitaalile, on täidetud 6 elektroniga. Järelikult element A kuulub lühikeses tabelis 8. rühma ja tema järjenumbr on 2+8+8+8=26. Ta on rauatriaadi esimene element - ${}_{26}\text{Fe}$.

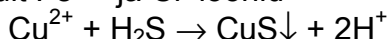
b) Isotoobis A' on 26+7=33 neutronit ja tema massiarv on 59



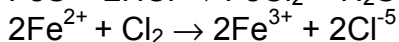
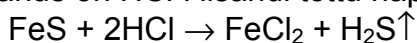
c) Tabelis antakse looduslike isotoopide keskmised aatommassid. $M(\text{Co})=58,93$ g/mol. On igati õigustatud arvamus, et looduslik Co koosneb peamiselt isotoobist ${}_{27}^{59}\text{Co}$. On vähetõenäone, et looduses on 50 % isotoopi ${}^{(59+k)}\text{Co}$ ja 50 % isotoopi ${}^{(59-k)}\text{Co}$, kus k on mingi täisarv.



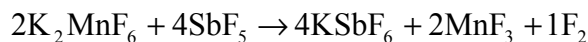
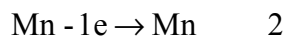
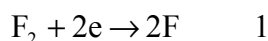
e) Cu^{2+} -ioonid tuleb selliselt välja sadestada, et lõpptulemusena jääksid lahusesse ainult Fe^{3+} - ja Cl^- -ioonid



Et lahus on HCl-i lisandi tõttu happeline, siis FeS ei sadene



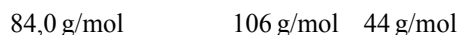
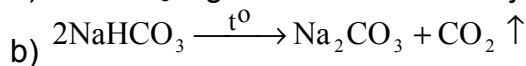
5. a)



$$\text{b) } m(\text{K}_2\text{MnF}_6) = \frac{2}{4} \cdot \frac{500\text{g}}{217\text{g/mol}} \cdot 247\text{g/mol} = 285\text{g}$$

$$\text{c) } V(\text{F}_2) = \frac{1}{4} \cdot \frac{500\text{g}}{217\text{g/mol}} \cdot 1\text{mol} \cdot 298\text{K} \cdot \frac{0,08206\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot \frac{760}{765} \cdot \frac{1}{\text{atm}} = 13,99 \sim 14,0\text{dm}^3$$

6. a) NaHCO_3 laguneb kuumutamisel ja tekib naatriumkarbonaat Na_2CO_3



$$m_1(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot 100 \cdot 0,09\text{g} \cdot \frac{1\text{mol}}{84\text{g}} \cdot 106\text{g/mol} = 5,678\text{g}$$

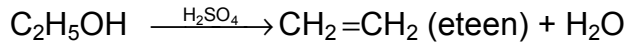
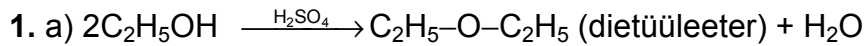
$$\text{c) } m_2(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot 5,51\text{g} \cdot \frac{1\text{mol}}{84\text{g}} \cdot 106\text{g/mol} = 3,476\text{g}$$

$$9,154 \sim 9,15\text{g}$$

$$m(\text{H}_2\text{O}) = 9,15\text{g} \cdot \frac{91}{9} = 92,52 \approx 92,5\text{g}$$

$$\text{d) } \omega = \frac{\frac{1}{2} \cdot \frac{100 \cdot \omega + 5,51}{84} \cdot 106}{100 + 5,51 - \frac{1}{2} \cdot \frac{100 \cdot \omega + 5,51}{84} \cdot 44}$$

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11. klass



b) $1,25 \text{ g/dm}^3 \cdot 22,4 \text{ dm}^3/\text{mol} = 28,0 \text{ g/mol}$ (eteen)

c) molaarruumala

$$V_M = 1 \text{ mol} \cdot 0,08206 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 323 \text{ K} \cdot \frac{1}{1 \text{ atm}} = 26,5 \text{ dm}^3 / \text{mol}$$

$$M(\text{gaasid}) = 1,49 \text{ g/dm}^3 \cdot 26,5 \text{ dm}^3/\text{mol} = 39,49 \sim 39,5 \text{ g/mol}$$

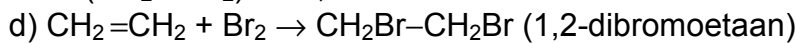
$$x \text{ mol } \underset{74,1 \text{ g/mol}}{\text{C}_2\text{H}_5\text{OC}_2\text{H}_5} + (1-x) \text{ mol } \underset{28,0 \text{ g/mol}}{\text{CH}_2=\text{CH}_2} = \underset{39,5 \text{ g/mol}}{1 \text{ mol gaase}}$$

$$74,1x + 28,0 - 28,0x = 39,5$$

$$x = 25,0 \%$$

$$\% (\text{C}_2\text{H}_5\text{OC}_2\text{H}_5) = 25,0$$

$$\% (\text{CH}_2=\text{CH}_2) = 75,0$$

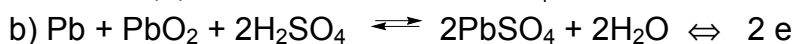
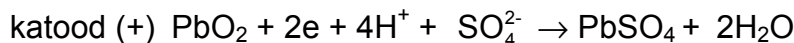
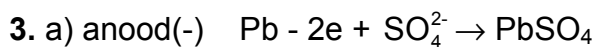
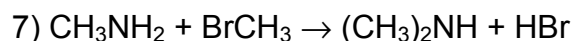
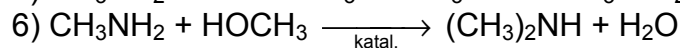
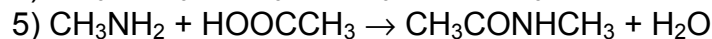
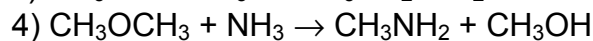
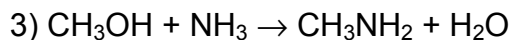


$$\underset{28 \text{ g/mol}}{\text{CH}_2=\text{CH}_2} + \underset{188 \text{ g/mol}}{\text{Br}_2} \rightarrow \underset{188 \text{ g/mol}}{\text{CH}_2\text{Br-CH}_2\text{Br}}$$

$$188 : 28 = 6,7$$



$$31,1 : 45,1 = 1 : 1,45$$



c) $n(\text{e}) = 250 \text{ A} \cdot 45 \text{ s} \cdot \frac{1 \text{ mol}}{96500 \text{ A} \cdot \text{s}} = 0,11658 \sim 0,117 \text{ mol}$

$$\Delta m(\text{anood}) = \frac{1}{2} \cdot 0,11658 \text{ mol} \cdot 96 \text{ g/mol} = 5,595 \sim 5,60 \text{ g}$$

$$\Delta m(\text{katood}) = -\frac{1}{2} \cdot 0,11658 \text{ mol} \cdot 32 \text{ g/mol} + 5,595 \text{ g} = 3,72 \text{ g}$$

d) $\Delta m(\text{H}_2\text{SO}_4) = 3,00 \text{ dm}^3 \cdot 1243 \text{ g/dm}^3 \cdot 0,33 - 3,00 \text{ dm}^3 \cdot 1194 \text{ g/dm}^3 \cdot 0,27 = 263 \text{ g}$

$$Q = \frac{2}{2} \cdot \frac{263 \text{ g}}{98,1 \text{ g/mol}} \cdot 96500 \frac{\text{A} \cdot \text{s}}{\text{mol}} \cdot \frac{1 \text{ tund}}{3600 \text{ s}} = 71,9 \text{ A} \cdot \text{tundi}$$

$$4. a) n(\text{H}_2\text{SO}_4) = \frac{10,0 \text{ cm}^3 \cdot 1,83 \text{ g / cm}^3 \cdot 0,95}{98,1 \text{ g / mol}} = 0,1772 \sim 0,117 \text{ mol}$$

$$n(\text{NaOH}) = 2 \cdot 0,1772 = 0,354 \text{ mol}$$

$$n(\text{H}_2\text{O}) = 10 \cdot 0,1772 = 1,772 \text{ mol}$$

$$n'(\text{H}_2\text{O}) = \frac{10,0 \text{ cm}^3 \cdot 1,83 \text{ g / cm}^3 \cdot 0,05}{18 \text{ g / mol}} = 0,0508 \text{ mol (H}_2\text{SO}_4)$$

$$n''(\text{H}_2\text{O}) = 0,354 \text{ mol (tekib reaktsiooni käigus)}$$

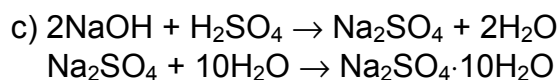
$$n''' \text{ lahuses (H}_2\text{O)} = 1,772 - 0,354 - 0,051 = 1,367 \text{ mol (NaOH lahuses)}$$

$$m(\text{NaOH lahus}) = 0,354 \text{ mol} \cdot 40 \text{ g/mol} + 1,367 \text{ mol} \cdot 18,0 \text{ g/mol} = 38,8 \text{ g}$$

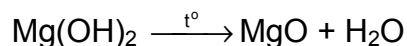
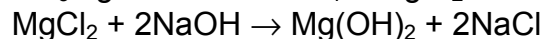
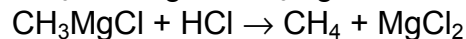
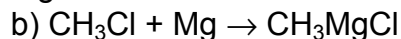
$$\%(\text{NaOH}) = \frac{0,354 \text{ mol} \cdot 40,0 \text{ g / mol}}{38,8 \text{ g}} = 36,5 \%$$

$$b) \%(\text{H}_2\text{O väävelhapest}) = \frac{0,0508}{1,772} \cdot 100 = 2,87$$

$$\%(\text{H}_2\text{O NaOH}) = \frac{1,367}{1,772} \cdot 100 = 77,1$$



5. a) A - CH₃Cl; B - Mg; C - CH₃ MgCl; D - CH₄; E - MgCl₂; F - Mg(OH)₂; G - MgO



c) Ühend E saab olla kloriid, millest NaOH lisamisel tekib hüdroksiid F. Viimane laguneb termilisel töötlemisel oksiidiks G.

$$\frac{M(E)}{M(G)} \Rightarrow \frac{5,96}{2,52} = \frac{M(B) + 35,5x}{M(B) + x \cdot \frac{16}{2}}; M(B) = 12,15x. \text{ Kui } x=2, \text{ siis } M(B)=24,3$$

g/mol

B on Mg.

$$M(G) = M(\text{MgO}) = 24,3 + 16,0 = 40,3 \text{ g/mol}$$

$$M(D) = \frac{40,3}{2,52} = 16 \text{ g / mol};$$

Ühend D on metaan CH₄.

6. a) M(seguga) = 17,0 · 2,02 g/mol = 34,3 g/mol

$$\%(I) = \frac{120}{200} \cdot 100 = 60$$

$$\%(II) = \frac{200 - 120}{200} \cdot 100 = 40$$

b) Gaas(I) ei reageeri broomiveega, järelikut on ta alkaan (C_xH_{2x+2})

$$n(\text{II}) = 0,080 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = 0,00357 \text{ mol}$$

$$n(\text{Br}_2) = 0,200 \text{ dm}^3 \cdot 0,100 \text{ mol/dm}^3 - 2,06 \text{ g} \cdot \frac{1 \text{ mol}}{160 \text{ g}} = 0,0200 - 0,0129 =$$

$$= 0,0071 \text{ mol}$$

Et broomi hulk on kaks korda suurem gaasi (II) hulgast [$n(\text{Br}_2) \sim 2n(\text{II})$].
siis gaas(II) peab olema kas dieen või alküün (C_yH_{2y-2}).

c) Gaasi(I) molaarmass on $(14x+2)$ ja gaasi(II) molaarmass on $(14y-2)$

$$0,6 \cdot (14x+2) + 0,4(14y-2) = 34,0, \text{ mis taandub kujule}$$

$$3x+2y = 12$$

Selle võrrandi täisarvuliseks lahendiks on $x=2$ ja $y=3$

Gaas(I) - C_2H_6

Gaas(II) - C_3H_4

d) Gaas(I) CH_3-CH_3 etaan

Gaas(II) $CH_2=C=CH_2$ propadieen

$CH\equiv C-CH_3$ propüün

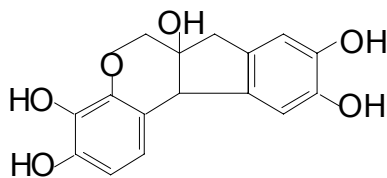
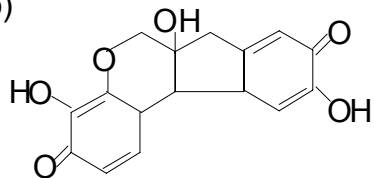
e) $CH_2=C=CH_2 + 2Br_2 \rightarrow CH_2BrCBr_2CH_2Br$ 1,2,2,3-tetrabromopropaan

$CH\equiv C-CH_3 + 2Br_2 \rightarrow CHBr_2CBr_2CH_3$ 1,1,2,2-tetrabromopropaan

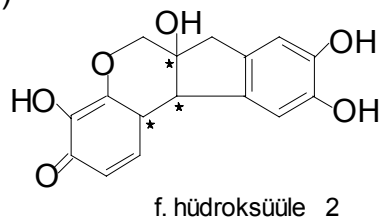
1996/97 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a) Fenoolseid hüdroksüüle on kaks.

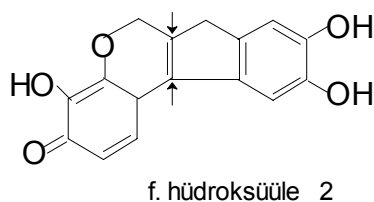
b)



c)

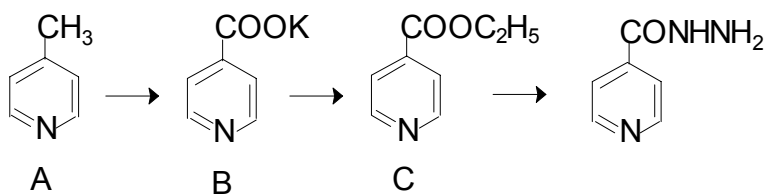


d)

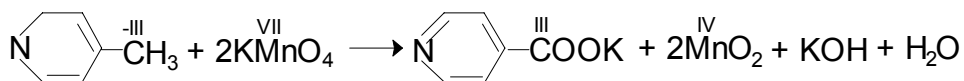


e) ühend on eetriks $\left(\begin{array}{c} \diagup \\ \text{O} \\ \diagdown \end{array} \right)$.

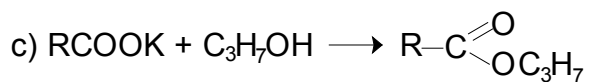
2. a)

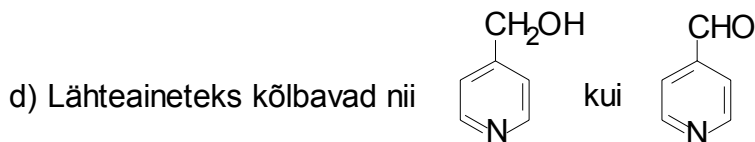


b)



$$m(\text{KMnO}_4) = \frac{2}{1} \cdot \frac{9,3 \text{ g}}{93 \text{ g/mol}} \cdot 158 \text{ g/mol} \cdot \frac{1}{0,75} = 42,1 \sim 42 \text{ g}$$



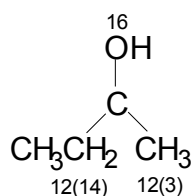
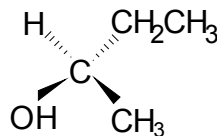
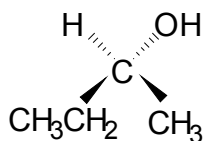


3. a) R₁ on etüülrühm ja R₂ on metüülrühm

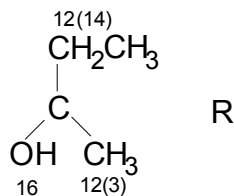
A - CH₃CH₂CH=CH₂ 1-buteen; B - CH₃CH₂COCH₃
 etüülmütüülketoon e. butanoon; C - CH₃CH₂CHClCH₃ 2-klorobutaan,
 D - CH₃CHO etanaal

b) CH₃CH₂CH(OH)CH₃ 2-butanool

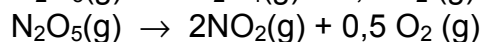
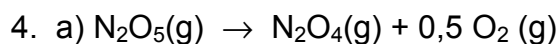
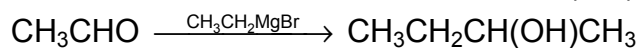
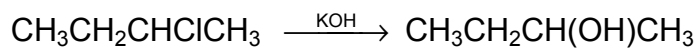
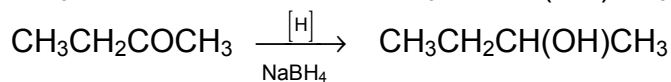
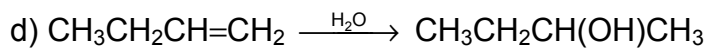
c)



S



R



$$\text{b) } \tau = \frac{\ln 2}{k} = \frac{0,693}{1,42 \cdot 10^{-3}} = 488 \text{ s} = 8,13 \text{ min} = 8 \text{ min } 8 \text{ s}$$

c) Osarõhk on võrdeline kontsentratsiooniga

$$t = \frac{1}{k} \ln \frac{p_0}{p} = \frac{1}{1,42 \cdot 10^{-3}} \ln \frac{2,84}{0,355} = 1464 \text{ s} \sim 24,4 \text{ min} \sim 24 \text{ min } 20 \text{ s}$$

Võib arvutada ka järgmiselt:

$$\frac{2,84}{0,355} = 8,00 \text{ (kontsentratsioon vähenes 8 korda, selleks kulus}$$

järelikult kolm poolestusaega) $t = 3 \cdot 488 = 1464 \text{ s} = 24,4 \text{ min}$

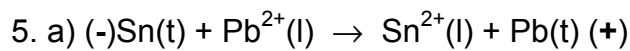
$$d) n^t(N_2O_5) = \frac{2,84 \text{ atm} \cdot 10,0 \text{ dm}^3}{0,08206 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 323 \text{ K}} = 1,071 \text{ mol}$$

$$n^t(N_2O_5) = \frac{0,355 \cdot 10,0}{0,08206 \cdot 323} = 0,1339 \sim 0,134 \text{ mol}$$

$$n^t(N_2O_5) - n^t(N_2O_5) = 1,071 - 0,134 = 0,937 \text{ mol}$$

$$n^t(NO_2) = \frac{2}{1} \cdot 0,937 + \frac{2}{1} \cdot 0,01 = 1,87 + 0,02 = 1,89 \text{ mol}$$

$$n^t(O_2) = \frac{0,5}{1} \cdot 0,937 + \frac{0,5}{1} \cdot 0,01 = 0,4685 + 0,005 = 0,474 \text{ mol}$$



$$E_{\text{Me}^{2+}/\text{Me}} = E_{\text{Me}^{2+}/\text{Me}}^{\circ} + \frac{RT}{zF} \ln[\text{Me}^{2+}]$$

b) Elektrodireaktsioonis $\text{Me}^{2+} + 2e \rightleftharpoons \text{Me}$ on Me redutseerijaks ja $[\text{Me}]=1$

$$\frac{RT}{zF} \ln[\text{Me}^{2+}] = \frac{2,3 \cdot 8,314 \frac{\text{A} \cdot \text{V} \cdot \text{s}}{\text{mol} \cdot \text{K}} \cdot 298 \text{ K}}{2 \cdot 96500 \text{ A} \cdot \text{s} / \text{mol}} \cdot \lg[\text{Me}^{2+}] = 0,0295 \lg[\text{Me}^{2+}]$$

$$E = E_{\text{Pb}^{2+}/\text{Pb}} - E_{\text{Sn}^{2+}/\text{Sn}} = -0,125 + 0,0295 \lg 0,550 - (-0,137 + 0,0295 \cdot \lg 0,150) =$$

$$= 0,012 + 0,0295 \lg \frac{0,550}{0,150} = 0,012 + 0,017 = 0,029 \text{ V}$$

c) Voolu tarbimisel Sn^{2+} ionide kontsentratsioon suureneb ja Pb^{2+} ionide kontsentratsioon väheneb. Et EMJ võrrandis kontsentratsioonide logaritmid on vastupidise märgiga, siis EMJ pidevalt väheneb.

d) Kui Pb^{2+} ionide kontsentratsioon vähenes $0,500 \text{ mol/dm}^3$ -ni, siis Sn^{2+} ionide kontsentratsioon suurenes $0,200 \text{ mol/dm}^3$ -ni.

$$E = 0,012 + 0,0295 \lg \frac{0,500}{0,200} = 0,012 + 0,012 = 0,024 \text{ V}$$

e) Elemendi töö lakkab, kui elektrodide vaheline elektromotoorjõud võrdub nulliga

$$0 = 0,012 + 0,0295 \lg \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]}, \text{ millest } \lg \frac{[\text{Pb}^{2+}]}{[\text{Sn}^{2+}]} = \frac{-0,012}{0,0295} = -0,4068$$

Sellest avaldame suhte $[\text{Pb}^{2+}]/[\text{Sn}^{2+}]=0,40$. Et elemendis potentsiaali määravate ionide üldkontsentratsioon on konstantne, saame teise võrrandi $[\text{Pb}^{2+}]+[\text{Sn}^{2+}] = 0,70 \text{ mol/dm}^3$, mis koos eelmise suhtega võimaldab leida mõlemaiooni kontsentratsiooni.

$$\frac{[\text{Pb}^{2+}]}{0,70 - [\text{Pb}^{2+}]} = 0,40 \quad [\text{Pb}^{2+}] = 0,20 \text{ mol/dm}^3; [\text{Sn}^{2+}] = 0,50 \text{ mol/dm}^3$$

6. a) A - Cu; B - Fe; C - Hg; D - Cu(Hg) vaskamalgaam; E - Cu(NO₃)₂; F - FeCl₃

b) 1) Cu + Hg → Cu(Hg); 2) Cu(Hg) $\xrightarrow{t^\circ}$ Cu + Hg↑; 3) Cu + 4HNO₃ →
→ Cu(NO₃)₂ + 2NO₂ + 2H₂O; 4) 2Fe + 3Cl₂ → 2FeCl₃

c) m g 3,80 g
Cu ⇌ Cu(NO₃)₂·3H₂O
63,54 g 242 g/mol

$$m(\text{Cu}) = \frac{3,80 \text{ g}}{242 \text{ g/mol}} \cdot 63,5 \text{ g/mol} = 0,997 = 1,00 \text{ g}$$

$$V(\text{NO}_2) = \frac{2}{1} \cdot \frac{3,80}{242} \cdot 22,4 \text{ dm}^3 / \text{mol} = 0,703 \text{ dm}^3$$

$$M(\text{Cu(NO}_3)_2) = 187,6 \text{ g/mol};$$

$$M(\text{Cu}) = 187,6 \cdot 0,339 = 63,6 \text{ g/mol}$$

d) Kui raud reageerib Cl₂-ga, siis peab tekkima FeCl₃ (M=162 g/mol)

$$M(\text{Fe}) = 162 \cdot 0,344 = 55,7 \text{ g/mol}$$

e) Mõlema metalli massiprotsent on 50,0 $\left(\frac{1,00}{2,00} \cdot 100 = 50,0 \right)$

$$n(\text{Cu}) = \frac{1,00 \text{ g}}{63,5 \text{ g/mol}} = 0,0157 \text{ mol}; \quad n(\text{Fe}) = \frac{1,00 \text{ g}}{55,8 \text{ g/mol}} = 0,0179 \text{ mol}$$

$$\%(\text{Cu}) = \frac{0,0157}{0,0336} \cdot 100 = 46,7 \%$$

$$\%(\text{Fe}) = \frac{0,0179}{0,0336} = 53,3 \%$$