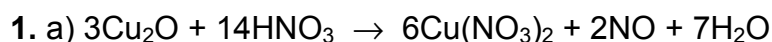


# 1996/97 õa keemiaolümpiaadi lõppvooru ülesannete lahendused

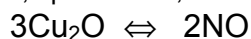
## 10. klass



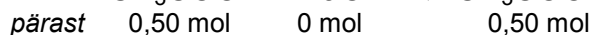
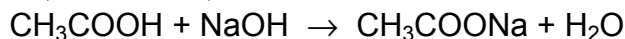
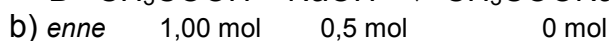
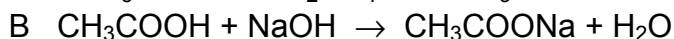
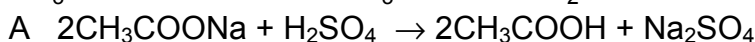
$$m[\text{Cu}(\text{NO}_3)_2] = \frac{6}{3} \cdot 10,0 \text{ g} \cdot \frac{1 \text{ mol}}{143 \text{ g}} \cdot 188 \text{ g/mol} = 26,3 \text{ g}$$

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

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



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



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

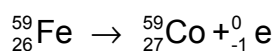
e)  $K_{\text{diss}} = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]}$       Puhverlahuses  $[\text{CH}_3\text{COO}^-] \sim c_{\text{sool}} ; [\text{CH}_3\text{COOH}] \sim$

$c_{\text{hape}}$

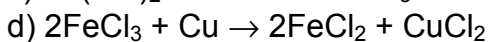
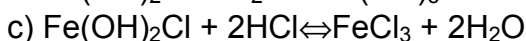
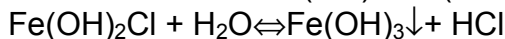
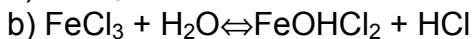
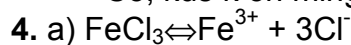
$$[\text{H}^+] = K_{\text{diss}} \cdot \frac{[\text{CH}_3\text{COOH}]}{[\text{CH}_3\text{COO}^-]} = K_{\text{diss}} \cdot \frac{c_{\text{sool}}}{c_{\text{hape}}}$$

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 -  ${}_{26}\text{Fe}$ .

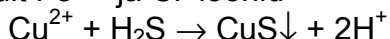
b) Isotoobis A' on 26+7=33 neutronit ja tema massiarv on 59



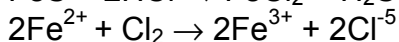
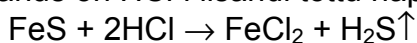
c) Tabelis antakse looduslike isotoopide keskmised aatommassid.  $M(\text{Co})=58,93$  g/mol. On igati õigustatud arvamus, et looduslik Co koosneb peamiselt isotoobist  ${}_{27}^{59}\text{Co}$ . On vähetõenäone, et looduses on 50 % isotoopi  ${}^{(59+k)}\text{Co}$  ja 50 % isotoopi  ${}^{(59-k)}\text{Co}$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



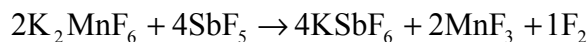
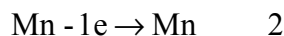
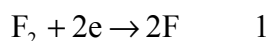
e)  $\text{Cu}^{2+}$ -ioonid tuleb selliselt välja sadestada, et lõpptulemusena jääksid lahusesse ainult  $\text{Fe}^{3+}$ - ja  $\text{Cl}^-$ -ioonid



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



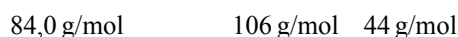
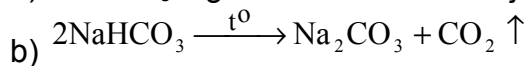
5. a)



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

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

6. a)  $\text{NaHCO}_3$  laguneb kuumutamisel ja tekib naatriumkarbonaat  $\text{Na}_2\text{CO}_3$



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

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

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

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

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