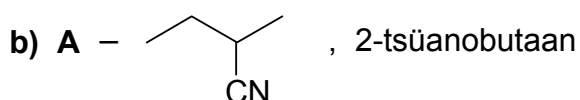


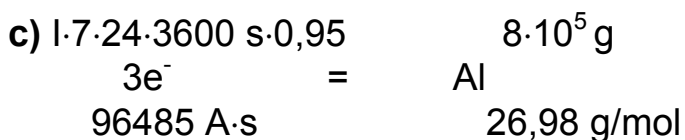
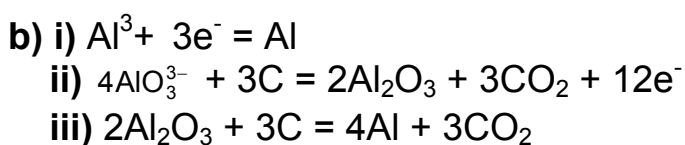
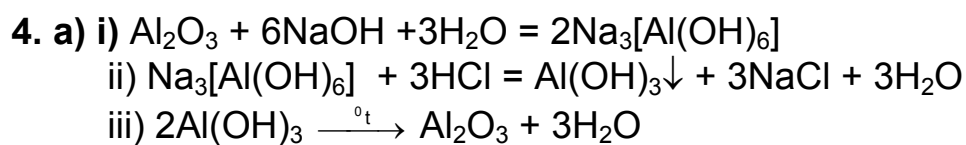
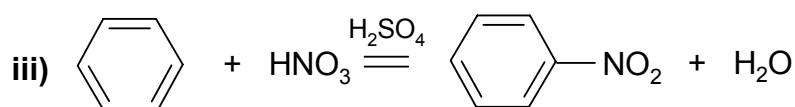
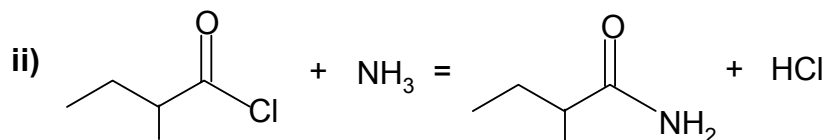
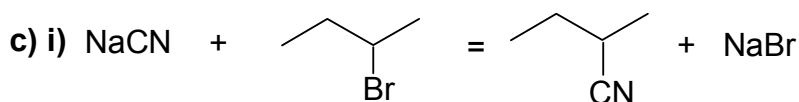
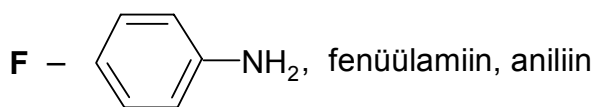
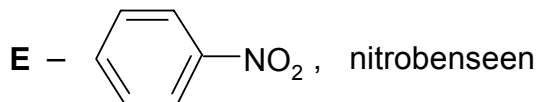
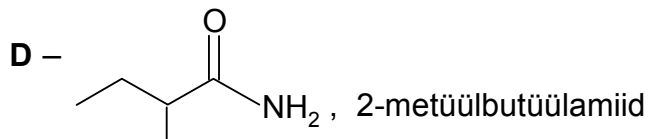
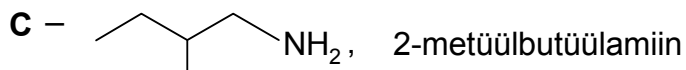
**2004/2005 õa keemiaolümpiaadi lõppvooru ülesannete lahendused**  
**11. klass**

- 1. a)**  $m(\text{H}_2\text{O}) = 55 \text{ m} \cdot 1,5 \text{ m} \cdot 0,05 \cdot 920 \text{ kg/m}^3 = 3795 \text{ kg}$   
 molaalne kontsentratsioon  $m(\text{ioonid}) = 3,0 \text{ K} \cdot \frac{1 \text{ mol}}{1,86 \cdot \text{K} \cdot \text{kg}} = 1,613 \text{ mol/kg}$   
 $n(\text{NaCl}) = 1,613 \text{ mol/kg} \cdot \frac{1}{2} \cdot 3795 \text{ kg} = 3060,5 \text{ mol}$   
 $m(\text{NaCl}) = 3060,5 \text{ mol} \cdot 58,44 \text{ g/mol} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} = 178,8 \text{ kg} \approx \mathbf{180 \text{ kg}}$
- b)** Kui lahustuvus on 30,0 g, siis 1 kg vee kohta on lahustunud 300 g.  
 $\Delta T = 2 \cdot 300 \text{ g} \cdot \frac{1 \text{ mol}}{58,44 \text{ g}} \cdot \frac{1}{\text{kg}} \cdot 1,86 \frac{\text{K} \cdot \text{kg}}{\text{mol}} = 19,09 \text{ K} \approx 19,1 \text{ K}$   
 $t_{\text{külm}}^{\circ} = 0^{\circ} \text{C} - 19,1 \text{ K} = \mathbf{-19,1^{\circ} \text{C}}$

- 2. a) i)** **A** –  $\text{NCl}_3$ , lämmastiktrikloriid; kloronitriid  
**B** –  $\text{NBr}_3$ , lämmastiktribromiid; brominitriid  
**C** –  $\text{NI}_3$ , lämmastiktrijodiid; jodonitriid  
**D** –  $\text{NF}_3$ , lämmastiktrifluoriid; fluoronitriid  
**E** –  $\text{CO}_2$ , süsinikdioksiid  
**F** –  $\text{HCl}$ , vesinikkloriid (soolhape)  
**G** –  $\text{NH}_3$ , ammoniaak
- ii)**  $\text{Me}_3\text{SiCl}$
- iii)**  $n(\text{NH}_3) = \frac{446 - (14 + 3 \cdot 127)}{17} = 3$   
 Kompleksmolekuli valem on  $\mathbf{NI}_3(\text{NH}_3)_3$
- b) i)**  $\text{NH}_4\text{Cl} + 3\text{Cl}_2 = \text{NCl}_3 + 4\text{HCl}$   
**ii)**  $(\text{NH}_2)_2\text{CO} + 6\text{Cl}_2 + \text{H}_2\text{O} = 2\text{NCl}_3 + \text{CO}_2 + 6\text{HCl}$   
 elektrolüüs  
**iii)**  $3\text{NH}_4\text{Cl} = \text{NCl}_3 + 3\text{H}_2 + 2\text{NH}_3$   
**iv)**  $(\text{Me}_3\text{Si})_2\text{NBr} + 2\text{ClBr} = \text{NBr}_3 + 2\text{Me}_3\text{SiCl}$   
**v)**  $3\text{I}_2 + 7\text{NH}_3 \cdot \text{H}_2\text{O} = \text{NI}_3 \cdot (\text{NH}_3)_3 + 3\text{NH}_4\text{I} + 7\text{H}_2\text{O}$   
**vi)**  $\text{BN} + 3\text{IF} = \text{NI}_3 + \text{BF}_3$   
 detonatsioon  
**vii)**  $2\text{NI}_3 = \text{N}_2 + 3\text{I}_2$   
 vaskkatalüsaator  
**viii)**  $3\text{F}_2 + \text{NH}_3 = \text{NF}_3 + 3\text{HF}$

**3. a) amiinid**





$$I = \frac{3}{1} \cdot 8 \cdot 10^5 \text{ g} \cdot \frac{1 \text{ mol}}{26,98 \text{ g}} \cdot 96485 \frac{\text{A} \cdot \text{s}}{\text{mol}} \cdot \frac{1}{7} \cdot \frac{1}{24} \cdot \frac{1}{3600 \text{ s}} \cdot \frac{1}{0,950} = 14,93 \text{ kA} \approx \mathbf{14,9 \text{ kA}}$$

d)  $t \cdot 14,93 \text{ kA} \cdot 0,95 = 10^6$   
 $3e^- = \text{Al}$   
 $96485 \text{ A} \cdot \text{s} = 26,98 \text{ g/mol}$

$$t = \frac{3}{1} \cdot 10^6 \text{ g} \cdot \frac{1}{26,98 \text{ g}} \cdot 96485 \text{ A} \cdot \text{s} \cdot \frac{1 \text{ h}}{3600 \text{ s}} \cdot \frac{1}{14938 \text{ A}} = 199,5 \text{ h}$$

$$\Sigma = 6,00 \text{ V} \cdot 14,9 \text{ kA} \cdot 199,5 \text{ h} \cdot \frac{1 \text{EEK}}{1 \text{V} \cdot \text{kA} \cdot \text{h}} \approx \mathbf{17800 \text{ EEK}}$$

5. a)  $L_M(\text{KClO}_4) = \frac{n(\text{KClO}_4)}{V} = \frac{1,30 \text{ g} - 0,59 \text{ g}}{138,6 \text{ g/mol}} \cdot \frac{1}{(0,0500 + 0,0003) \text{ dm}^3} = 0,1018 \text{ M} \approx \mathbf{1,02 \cdot 10^{-1} \text{ M}}$

b)  $LK(\text{KClO}_4) = [\text{K}^+] \cdot [\text{ClO}_4^-] = (0,1018 \text{ M})^2 = 0,01036 \text{ M}^2 \approx \mathbf{1,04 \cdot 10^{-2} \text{ M}^2}$

c) i)  $[\text{H}^+] = [\text{ClO}_4^-]$

$$\text{pH} = -\lg[\text{H}^+]$$

$$[\text{ClO}_4^-] = [\text{H}^+] = 10^{-2} \text{ M} = 0,01 \text{ M} = c(\text{ClO}_4^-)$$

ii)  $LK = [\text{K}^+][\text{ClO}_4^-]$

$$[\text{K}^+] = L'_M(\text{KClO}_4); [\text{ClO}_4^-] = [L'_M(\text{KClO}_4) + c(\text{ClO}_4^-)]$$

$$0,01036 = L'_M(\text{KClO}_4) \cdot [L'_M(\text{KClO}_4) + 0,01]$$

$$[L'_M(\text{KClO}_4)]^2 + 0,01 \cdot L'_M(\text{KClO}_4) - 0,01036 = 0$$

$$L'_M(\text{KClO}_4) = 0,09672 \text{ M} \approx \mathbf{0,0967 \text{ M}}$$

d)  $m(1 \text{ dm}^3 \text{ lahust}) = 1000 \text{ cm}^3 \cdot 1,01 \text{ g/cm}^3 = 1010 \text{ g}$

$$m(\text{KClO}_4) = 0,0967 \text{ mol} \cdot 138,6 \text{ g/mol} = 13,40 \text{ g}$$

$$m(\text{HClO}_4 \text{ lahust}) = 1010 \text{ g} - 13,40 \text{ g} = 996,6 \text{ g}$$

$$L(\text{KClO}_4 \text{ HClO}_4 \text{ lahuses}) = 13,4 \text{ g} \cdot \frac{1}{996,6 \text{ g}} \cdot 100 \text{ g} = 1,3445 \text{ g} \approx \mathbf{1,34 \text{ g}}$$

e)  $m(\text{KClO}_4, 70 \text{ g HClO}_4 \text{ lahuses}) = 13,4 \text{ g} \cdot \frac{1}{996,6 \text{ g}} \cdot 70 \text{ g} \approx 0,94 \text{ g}$

$$m(\text{KClO}_4, \text{mittelahustunud}) = 1,30 \text{ g} - 0,94 \text{ g} = \mathbf{0,36 \text{ g}}$$

6. a) i)  ${}^0_t$



ii)  $A_r(\text{D}) = \frac{465,96 - 3 \cdot 16}{2} = 208,98$

iii) **D** – Bi, vismut

b) **A** – Cu, vask. Vaskhüdrosiid on valge pulber, mis kuumutamisel muutub mustaks.

**B** – Ni, nikkel. Selle järjenumbrist erineb vase järjenumbrist ühe võrra. Zn ei saa olla, sest Zn soolade lahused on värvitud.

**C** – Mn, mangaan. Ga oksüdatsiooniaste on III, mistõttu ei sobi.

**E** – Sb, antimon, mille määrab vismut.

