

**2005/2006 õa keemiaolümpiaadi piirkonnavooru  
ülesannete lahendused  
10. klass**

1. a) i) Kristallvõre lõhkumine, ii) "keemilise ühendi" teke (solvatatsioon).

b) i)  $(20 + 273) \text{ K} = 293 \text{ K}$

$(-20 + 273) \text{ K} = 253 \text{ K}$

c)  $\Delta H(\text{A} \rightarrow \text{E}) = (-20 - 12 + 28 + 16) \text{ kJ} = +12 \text{ kJ}$



$\Delta H_f(\text{CO}_2) = \Delta H_r$

$\Delta H_c(\text{C}) = \Delta H_r$

e)  $\rho = \frac{13,5 \text{ kg}}{0,00125 \text{ m}^3} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} \cdot \frac{1 \text{ m}^3}{1000000 \text{ cm}^3} = 10,8 \text{ g/cm}^3$

2.  $M_r(10\text{H}_2\text{O}) = 180$

a) Kõige suurem vee protsendiline sisaldus on kõige väiksema molaarmassiga kristallhüdraadis ja kõige väiksem vee protsendiline sisaldus on kõige suurema molaarmassiga kristallhüdraadis.

i) kristallhüdraat **B**       $\%(\text{H}_2\text{O}) = \frac{180}{286} \cdot 100 = 62,9$

ii) kristallhüdraat **C**       $\%(\text{H}_2\text{O}) = \frac{180}{484} \cdot 100 = 37,2$

b) i)  $0,1 = \frac{m(\text{E}) \cdot \frac{(322 - 180)}{322}}{300}$

$30 \text{ g} = 0,441 m(\text{E})$

$m(\text{E}) = 68,0 \text{ g}$

ii)  $\%(\text{aine}) = \frac{10 \text{ g} \cdot \frac{201}{381}}{10 \text{ g} + 50 \text{ g}} \cdot 100$

$\%(\text{aine}) = 8,79$

iii)  $0,1 = \frac{10 \cdot \frac{266}{446}}{10 + m(\text{H}_2\text{O})}$

$1 + 0,1m(\text{H}_2\text{O}) = 5,96$

$m(\text{H}_2\text{O}) = 49,6 \text{ g}$

3. a) i) **A** – C, süsinik

ii) teemant ja grafiit

iii) **B** – süsi, koks

b) +IV CO<sub>2</sub>, süsinikdioksiid

+II CO, süsinikoksiid

-I C<sub>2</sub>H<sub>2</sub>, etüün

-II C<sub>2</sub>H<sub>4</sub>, eteen

-III C<sub>2</sub>H<sub>6</sub>, etaan

-IV CH<sub>4</sub>, metaan

c) **D** – Y<sub>2</sub>O<sub>3</sub>

$$A_r(Y) = 3 \cdot 16 \cdot \frac{1}{0,3} \cdot 0,7 \cdot \frac{1}{2} = 56$$

**Y** – Fe, raud

**D** – Fe<sub>2</sub>O<sub>3</sub>, raud(III)oksiid

d) i) C + O<sub>2</sub> = CO<sub>2</sub>

ii) Fe<sub>2</sub>O<sub>3</sub> + C = 2FeO (ühend **E**) + CO

iii) 2CO + O<sub>2</sub> = 2CO<sub>2</sub>

e) i) gaasilise CO<sub>2</sub> külmutamisel moodustub tahke CO<sub>2</sub>

ii) sublimatsioon

4. a) i) **A**<sub>2</sub> – F<sub>2</sub>, fluor

ii) **X** – H, vesinik

**Y** – O, hapnik

iii) **X**<sub>2</sub>**Y** – H<sub>2</sub>O, vesi

**XA** – HF, vesinikfluoriid

b) M<sub>r</sub>(HF) = 20

$$\%(\mathbf{F}) = \frac{19}{20} \cdot 100 = \mathbf{95}$$

$$\%(\mathbf{O}) = \frac{16}{18} \cdot 100 = 88,89 \approx \mathbf{89}$$

c) **EX** – NaH, naatriumhüdriid

**EYX** – NaOH, naatriumhüdroksoiid

$$\%(\mathbf{Na}) = \frac{23,0}{40,0} \cdot 100 = \mathbf{57,5}$$

d) Vee molekulide vahel on vesinikside.

$$5. a) \%(\text{H}_2\text{O}) = \frac{910 \text{ g}}{1000 \text{ cm}^3 \cdot 1,025 \text{ g/cm}^3} \cdot 100 = 88,8 \approx \mathbf{89}$$

b) Kuna vereplasma summaarne elektriline laeng on 0, siis

$$c(\text{Na}^+) + c(\text{K}^+) + 2 \cdot c(\text{Ca}^{2+}) + 2 \cdot c(\text{Mg}^{2+}) = c(\text{HCO}_3^-) + 2 \cdot c(\text{HPO}_4^{2-}) + 2 \cdot c(\text{SO}_4^{2-}) + c(\text{Cl}^-)$$

$$c(\text{Cl}^-) = c(\text{Na}^+) + c(\text{K}^+) + 2 \cdot c(\text{Ca}^{2+}) + 2 \cdot c(\text{Mg}^{2+}) - c(\text{HCO}_3^-) - 2 \cdot c(\text{HPO}_4^{2-}) - 2 \cdot c(\text{SO}_4^{2-})$$

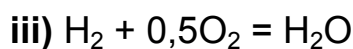
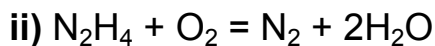
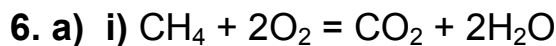
$$c(\text{Cl}^-) = 133,4 + 3 + 2 \cdot 2,2 + 2 \cdot 0,7 - 28 - 2 \cdot 1,5 - 2 \cdot 0,6 = \mathbf{110 \text{ mM}}$$

$$c) n(\text{Cl}^-) \Leftrightarrow n(\text{NaCl})$$

$$m(\text{NaCl}) = \frac{1}{1} \cdot 1 \text{ L} \cdot 0,110 \text{ M} \cdot 58,5 \text{ g/mol} = 6,435 \text{ g}$$

$$V(\text{füs.lahus}) = 6,435 \text{ g} \cdot \frac{1}{0,0090} \cdot \frac{1 \text{ cm}^3}{1,005 \text{ g}} = 711 \text{ cm}^3 \approx \mathbf{710 \text{ cm}^3}$$

d) Ioonide summaarne kontsentratsioon on ligilähedaselt sama.



$$b) i) \Delta H_c(\text{CH}_4) = [-394 + 2 \cdot (-286) - (-74)] \text{ kJ} \cdot \frac{1}{\text{mol}} = \mathbf{-892 \text{ kJ/mol}}$$

$$ii) \Delta H_c(\text{N}_2\text{H}_4) = [2 \cdot (-286) - 51] \text{ kJ} \cdot \frac{1}{\text{mol}} = \mathbf{-623 \text{ kJ/mol}}$$

$$iii) \Delta H_c(\text{H}_2) = \Delta H_f(\text{H}_2\text{O}) = \mathbf{-286 \text{ kJ/mol}}$$

$$c) i) 2n(\text{O}_2) \Leftrightarrow n(\text{CH}_4) \quad \mathbf{2 : 1}$$

$$ii) n(\text{O}_2) \Leftrightarrow n(\text{N}_2\text{H}_4) \quad \mathbf{1 : 1}$$

$$iii) 0,5n(\text{O}_2) \Leftrightarrow n(\text{H}_2) \quad \mathbf{1 : 2}$$

$$d) i) n(\text{CH}_4) \cdot M(\text{CH}_4) + 2n(\text{O}_2) \cdot M(\text{O}_2) = 5000 \text{ g}$$

$$16 \cdot \frac{1}{\text{mol}} \cdot n + 64 \cdot \frac{1}{\text{mol}} \cdot n = 5000$$

$$n = \frac{5000}{80} \text{ mol} = 62,5 \text{ mol}$$

$$n(\text{CH}_4) = \mathbf{62,5 \text{ mol}}$$

$$ii) 32 \cdot \frac{1}{\text{mol}} \cdot n + 32 \cdot \frac{1}{\text{mol}} \cdot n = 5000$$

$$n(\text{N}_2\text{H}_4) = \frac{5000}{64} \text{ mol} = \mathbf{78,125 \approx 78,1 \text{ mol}}$$

$$\text{iii) } 2.02 \cdot \frac{1}{\text{mol}} \cdot n + 16 \cdot \frac{1}{\text{mol}} \cdot n = 5000$$

$$n(\text{H}_2) = \frac{5000}{18.02} \text{ mol} = \mathbf{277.5 \text{ mol}}$$

e) i)  $\Delta H(\text{CH}_4) = 62,5 \text{ mol} \cdot (-892 \text{ kJ/mol}) = -55750 \text{ kJ} \approx \mathbf{-55,8 \text{ MJ}}$

ii)  $\Delta H(\text{N}_2\text{H}_4) = 78.1 \text{ mol} \cdot (-623 \text{ kJ/mol}) = -48656 \text{ kJ} \approx \mathbf{-48,7 \text{ MJ}}$

iii)  $\Delta H(\text{H}_2) = 277.5 \text{ mol} \cdot (-286 \text{ kJ/mol}) = -79365 \text{ kJ} \approx \mathbf{-79.4 \text{ MJ}}$

iv) 2 osa vesinikku ja 1 osa hapnikku