

2001/2002 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
9. klass

1. a) $M(CuSO_4 \cdot 5H_2O) = 250 \text{ g/mol}$

$$m(CuSO_4) = 5,0 \text{ kg} \cdot 0,040 = 0,20 \text{ kg}$$

$$m(CuSO_4 \cdot 5H_2O) = 0,20 \text{ kg } (CuSO_4) \cdot \frac{250 \text{ (CuSO}_4 \cdot 5H_2O)}{160 \text{ (CuSO}_4)} = 0,312 \text{ kg} \approx \\ \gg 0,31 \text{ kg}$$

$$m(H_2O) = 5,0 \text{ kg} - 0,31 \text{ kg} = 4,69 \text{ kg} \approx 4,7 \text{ kg}$$

b) $M(FeSO_4 \cdot 7H_2O) = 278 \text{ g/mol}$

Olgu $m(FeSO_4 \cdot 7H_2O) = x$

$$0,050 = \frac{9,0 \text{ kg} \cdot 0,030 + x \cdot \frac{152}{278}}{9,00 \text{ kg} + x}$$

$$0,45 \text{ kg} + 0,05 x = 0,27 \text{ kg} + x \cdot 0,547$$

$$0,18 \text{ kg} = 0,497x$$

$$x = 0,362 \text{ kg} \approx 0,36 \text{ kg}$$

$$m(FeSO_4 \cdot 7H_2O) = 0,36 \text{ kg}$$

2. a) i) X – Al, alumiinium

ii) Alumiinium on kaetud oksiidi Al_2O_3 tiheda kihiga.

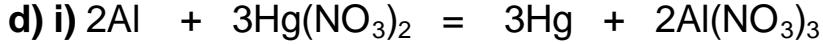
b) i) Y – Hg, elavhõbe

ii) Al_2O_3 kaitsekiht eemaldati

iii) Lusika pinnale moodustus alumiiniumamalgaam (alumiiniumi lahus elavhõbedas).

iv) Tilgakesed C on metalliline elavhõbe.

c) i) Alumiinium kattub tiheda Al_2O_3 kaitsekihiga.



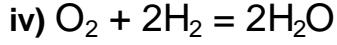
X A – elavhõbe(II)nitraat



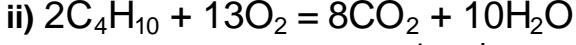
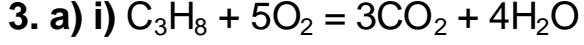
X_{akt} D – vesi B – alumiiniumhüdroksiid F – vesinik



X_{akt} E – hapnik D B



E F D



b) i) $n(C_3H_8) = 21,0 \cdot 10^3 \text{ g} \cdot \frac{1 \text{ mol}}{44,1 \text{ g}} = 4,76 \cdot 10^2 \text{ mol}$

$$DH(C_3H_8) = 4,76 \cdot 10^2 \text{ mol} \cdot (-2221 \text{ kJ/mol}) = -1,06 \cdot 10^6 \text{ kJ} = -1,06 \cdot 10^3 \text{ MJ} = \\ -1,06 \text{ GJ}$$

ii) $n(C_4H_{10}) = 21,0 \cdot 10^3 \text{ g} \cdot \frac{1 \text{ mol}}{58,1 \text{ g}} = 3,61 \cdot 10^2 \text{ mol}$

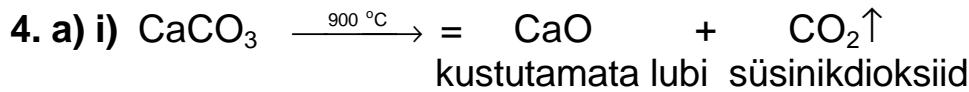
$$\Delta H(C_4H_{10}) = 3,61 \cdot 10^2 \text{ mol} \cdot (-2,889 \cdot 10^3 \text{ kJ/mol}) = -1,04 \cdot 10^6 \text{ kJ} = -1,04 \cdot 10^3 \text{ MJ} = \mathbf{-1,04 \text{ GJ}}$$

c) Sama raha eest saadud energia hulk on antud juhul energiäühiku hinnaga pöördvõrdelises seoses.

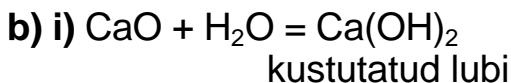
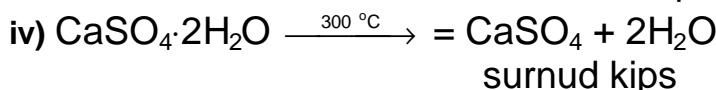
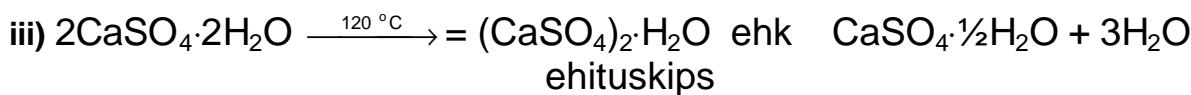
i) Propaani põletamisel saame sama energia väiksema raha eest. Propaan on odavam.

ii) Ühe ballonitääie ükskõik kumma gaasi põletamisel saame keskmiselt 1,05 GJ energiat (tarbija seisukohalt märk +).

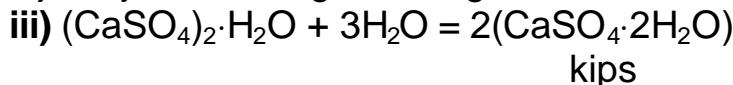
$$\text{Hind} = \frac{250 \text{ krooni}}{1,05 \text{ GJ}} = \mathbf{238 \text{ krooni/GJ}}$$



ii) $300 \text{ }^\circ\text{C}$ juures lubjakivi ei lagune.

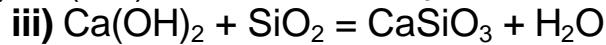
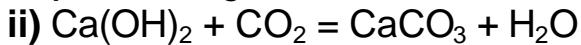


ii) Lubjakivi ei reageeri veega.

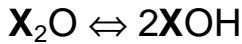


iv) Surnud kips ei reageeri veega.

c) i) Krohvisegu saadakse liiva, kustutatud lubja ja vee segamisel.



5. a) Leelismetalli oksiidi **D** valem on X_2O .



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

$$M(\text{XOH}) = \frac{8,00 \text{ g}}{0,200 \text{ mol}} = 40,0 \text{ g/mol}$$

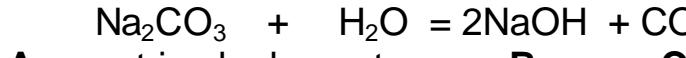
$$M_r(\text{X}) = 40,0 - 16,0 - 1,0 = 23$$

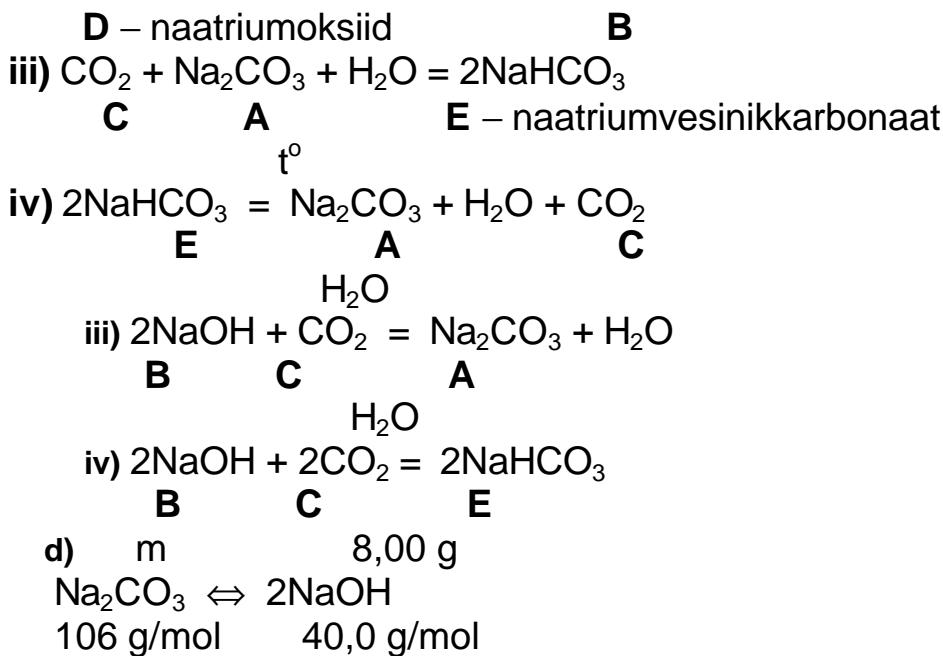
X – Na, naatrium

B – NaOH, naatriumhüdroksiid

b) Gaas **C** saab olla CO_2 , sest see on kolmeatomiline, värvitu ja lõhnatu. CO_2 reageerimisel süsihappe normaalsoolaga **A** moodustub vesiniksool **E**. Vesiniksool **E** laguneb vee keemistemperatuurist madalamal tempe-ratuuril normaalsoolaks **A**. CO_2 (**C**) juhtimisel NaOH (**B**) vesilahusesse moodustub alguses normaalsool **A** ja seejärel vesiniksool **E**.

c) i) $\text{Na}_2\text{CO}_3 + \text{H}_2\text{O} \xrightarrow{0 \text{ }^\circ\text{C}} 2\text{NaOH} + \text{CO}_2$





$$m(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot 8,00 \text{ g} \cdot 1 \text{ mol} / 40,0 \text{ g} \cdot 106 \text{ g/mol} = \mathbf{10,6 \text{ g}}$$

6. a) i) Indikaatoriks oli **fenoolfaleiin**.
 ii) Indikaator oli lisatud happe lahusele **A**.
- b) $\text{HCl} + \text{NaOH} = \text{NaCl} + \text{H}_2\text{O}$
- c) i) $n(\text{HCl,lahuses A}) = 100 \text{ cm}^3 \cdot 1,011 \text{ g/cm}^3 \cdot 0,0325 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} = \mathbf{0,0900 \text{ mol}}$
 ii) $n(\text{NaOH,lahuses B}) = 100 \text{ cm}^3 \cdot 1,012 \text{ g/cm}^3 \cdot 0,0415 \cdot \frac{1 \text{ mol}}{40,0 \text{ g}} = \mathbf{0,105 \text{ mol}}$
- d) i) Lahuses C:
 $n(\text{HCl}) = 0$
 $n(\text{NaOH}) = 0,105 \text{ mol} - \frac{1}{2} \cdot 0,0900 \text{ mol} = \mathbf{0,060 \text{ mol}}$
- ii) Lahuses D:
 $n(\text{HCl}) = \frac{1}{2} \cdot 0,0900 \text{ mol} - \frac{1}{3} \cdot 0,060 \text{ mol} = \mathbf{0,025 \text{ mol}}$
 $n(\text{NaOH}) = 0$
- iii) Lahuses E:
 $n(\text{HCl}) = 0$
 $n(\text{NaOH}) = \frac{2}{3} \cdot 0,060 \text{ mol} - \frac{1}{2} \cdot 0,025 \text{ mol} = 0,0275 \text{ mol} \approx \mathbf{0,028 \text{ mol}}$
- e) Lahuses H ei saa enam olla hapet, sest lahus on värviline. Seega peab see sisaldama alust ja loomulikult reaktsioonis moodustunud naatrium-kloriidi.