1999/2000 õa keemiaolümpiaadi III vooru ülesannete lahendused
9. klass

1. a) H_2SO_4 – väävelhape
b) HNO_3 – lämmastikhape
c) H_2SO_3 – väävlishape
d) HIO – hüpojoodishape
e) HClO – hüpokloorishape
f) HBrO – hüpobroomishape
g) H_2CO_2 – metaanhape (HCOOH)

2. a) **m'($FeSO_4$)** = 250 g·(1,00-0,82) = **45 g**

b) **i) m'($FeSO_4 \cdot 7H_2O$)** = 45 g· $\frac{278}{152}$ = 82,3 g ≈ **82 g**

ii) m(H_2O) = 250 g - 82 g = **168 g**

c) m"($FeSO_4$) = 103 g · 0,136 = 14 g
m($FeSO_4$) = 45 g - 14 g = 31 g
m($FeSO_4 \cdot 7H_2O$) = 31 g · $\frac{278}{152}$ = 56,7 g ≈ **57 g**

3. a) Me + 2HCl = $MeCl_2$ + $H_2\uparrow$
Me Y H_2

b) **n(H_2)** = 3,136 dm^3· $\frac{1\ mol}{22,4\ dm^3}$ = **0,14 mol**

c) 4 : 2 : 1
n(A) + n(B) + n(C) = 0,14 mol
i) n(A) = $\frac{4}{7}$·0,14 = **0,08 mol**
ii) n(B) = $\frac{2}{7}$·0,14= **0,04 mol**
iii) n(C) = $\frac{1}{7}$·0,14 = **0,02 mol**

d) 0,08 mol·3x g/mol + 0,04 mol·5x g/mol + 0,02 mol·7x g/mol = 4,64 g; **x = 8**

e) **i)** M(A) = 3 g/mol·8 = 24 g/mol — **A** – Mg, magneesium
ii) M(B) = 5 g/mol·8 = 40 g/mol — **B** – Ca, kaltsium
iii) M(C) = 7 g/mol·8 = 56 g/mol — **C** – Fe, raud

4. a) **i)** $Ba(OH)_2$ + H_2SO_4 = $BaSO_4\varnothing$+ $2H_2O$
ii) 2NaOH + H_2SO_4 = Na_2SO_4 + $2H_2O$

b) $Ba(OH)_2$ Y $BaSO_4$
171 g/mol 233 g/mol
m[$Ba(OH)_2$] = $\frac{1}{1}$·14,0 g· $\frac{1\ mol}{233\ g}$·171 g/mol = **10,3 g**
m(leelised) = 250 g · 0,105 = 26,3 g
m(NaOH) = 26,3 g - 10,3 g = **16,0 g**

c) **n(H_2SO_4)** = 250 g · 0,100 · $\frac{1\ mol}{98,1\ g}$ = **0,255 mol**

d) $Ba(OH)_2$ Y H_2SO_4
171 g/mol
n'(H_2SO_4) = 10,3 g · $\frac{1\ mol}{171\ g}$ = 0,0602 mol ≈ 0,060 mol
NaOH neutraliseerimiseks jääb

n”(H_2SO_4) = 0,255 mol - 0,060 mol = 0,195 mol
NaOH neutraliseerimiseks kuluks
2NaOH Y H_2SO_4
40,0 g/mol

$$n(H_2SO_4) = \frac{1}{2}\cdot 16{,}0\ \text{g}\cdot\frac{1\ \text{mol}}{40{,}0\ \text{g}} = 0{,}200\ \text{mol}$$

Na_2SO_4 Y H_2SO_4 (n” = 0,195 mol)

n(Na_2SO_4) = $\frac{1}{1}\cdot 0{,}195$ mol = **0,195 mol**

2NaOH Y H_2SO_4 (n = 0,200 mol - 0,195 mol = 0,005 mol)

n(NaOH) = $\frac{2}{1}\cdot 0{,}005$ mol = **0,010 mol**

5. a) **i)** $C_3H_8 + 5O_2 = 3CO_2 + 4H_2O$
ii) $2C_4H_{10} + 13O_2 = 8CO_2 + 10H_2O$

b) **i)** $2NaOH(liias) + CO_2 = Na_2CO_3 + H_2O$
ii) $NaOH + CO_2(liias) = NaHCO_3$
ehk $Na_2CO_3 + CO_2 + H_2O = 2NaHCO_3$

c) $$n'(CO_2) = \frac{1}{1}\cdot 95{,}4\ \text{g}\cdot\frac{1\ \text{mol}}{106\ \text{g}} = 0{,}900\ \text{mol}$$

$$n''(CO_2) = \frac{1}{1}\cdot 84{,}0\ \text{g}\cdot\frac{1\ \text{mol}}{84{,}0\ \text{g}} = 1{,}00\ \text{mol}$$

n(CO_2) = n’ + n” = **1,90 mol**

d) $$n(\text{gaase}) = 11{,}2\ \text{dm}^3\cdot\frac{1\ \text{mol}}{22{,}4\ \text{dm}^3} = 0{,}500\ \text{mol}$$

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(0,500 mol - x)·3 + x·4 = 1,90 mol
1,50 mol - 3x + 4x = 1,90 mol; x = 0,40 mol
n(C_4H_{10}) = 0,40 mol
n(C_3H_8) = 0,50 mol - 0,40 mol = 0,10 mol
i) m(C_3H_8) = 0,10 mol·44,0 g/mol = **4,4 g**
ii) m(C_4H_{10}) = 0,40 mol·58,0 g/mol = **23,2 g**

6. a) $M(X) = 7{,}87\ \text{g/cm}^3\cdot 7{,}09\ \text{cm}^3/\text{mol} = 55{,}8\ \text{g/mol}$
X – Fe, raud

b) **Y** – Al, alumiinium
A – H_2O, vesi
B – H_2, vesinik
C – Fe_3O_4, raud(II,III)oksiid
D – Al_2O_3, alumiiniumoksiid
E – Cl_2, kloor
F – $FeCl_3$, raud(III)kloriid
G – $FeCl_2$, raud(II)kloriid
H – O_2, hapnik
I – Fe_2O_3, raud(III)oksiid

c) **i)** $3Fe + 4H_2O \xrightarrow{^0t^0t} Fe_3O_4 + 4H_2\uparrow$
ii) $3Fe_3O_4 + 8Al = 9Fe + 4Al_2O_3$
iii) $2Fe + 3Cl_2 = 2FeCl_3$
iv) $Fe + 2HCl = FeCl_2 + H_2\uparrow$
v) $4Fe + 12HCl + 3O_2 = 4FeCl_3 + 6H_2O$
vi) $4Fe + 3O_2 = 2Fe_2O_3$