

Keemia lahtine võistlus
Noorem rühm (9. ja 10. klass)

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1. a) i) $m(\text{võluaine}) = 5450 \text{ cm}^3 \cdot 1,5 \text{ g/cm}^3 \cdot 0,0545 = 445,5 \text{ g} \approx \mathbf{450 \text{ g}}$

ii) $0,5 = \frac{445,5 \text{ g}}{445,5 \text{ g} + m(\text{H}_2\text{O})}$

$222,75 + 0,5 m(\text{H}_2\text{O}) = 445,5 \text{ g}$

$m(\text{H}_2\text{O}) = \frac{222,75}{0,5} = 445,5 \text{ g} \approx \mathbf{450 \text{ g}}$

b) i) $\%(\text{võluaine}) = \frac{400 \text{ cm}^3 \cdot 1,5 \text{ g/cm}^3 \cdot 0,47}{400 \text{ cm}^3 \cdot 1,5 \text{ g} + 348 \text{ g}} \cdot 100 = 29,7 \approx \mathbf{30}$

ii) Violetne → sinine → helesinine → roheline

c) Lahus muutub oranžist kollaseks, sest osa vett aurustub ja võluaine protsendiline sisaldus suureneb.

d) i) $\%(\text{võluaine}) = \frac{540 \text{ cm}^3 \cdot 1,5 \text{ g/cm}^3 \cdot 0,05 + 435 \text{ g} \cdot 0,42}{540 \text{ cm}^3 \cdot 1,5 \text{ g/cm}^3 + 435} \cdot 100 = 17,9 \approx \mathbf{18}$

ii) Punane, sinine ja kollane

iii) Reaalses maailmas punase ja sinise värvi segamine annab violetse värvi.

2. a) X – C, süsinik

Y – O, hapnik

Z – N, lämmastik

Q – H, vesinik

b) $M(\text{hemoglobiin}) = 14,00674 \text{ g/mol} \cdot 780 \text{ mol/mol} \cdot \frac{1}{0,164012} = \mathbf{66631 \text{ g/mol}}$

c) i) $M(\text{A}) = 16 \text{ g/mol} \cdot 2 = \mathbf{32 \text{ g/mol}}$

$\%(\text{B}) = 100 - 54,6550 - 20,9383 - 16,4012 - 7,2852 - 0,3850 = 0,3353$

$m(\text{B}) = 66631 \text{ g} \cdot 0,003353 = 223,414 \text{ g}$

VIII B rühma elemendi saame siis, kui võtta $n = 4 \text{ mol}$

$M(\text{B}) = 223,414 \text{ g} \cdot \frac{1}{4 \text{ mol}} \approx \mathbf{55,85 \text{ g/mol}}$

ii) A – S, väävel

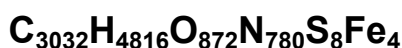
B – Fe, raud

d) $n(\text{C}) = 1 \text{ mol} \cdot 6631 \text{ g/mol} \cdot 0,546550 \cdot 1 \text{ mol}/12,011 \text{ g} \approx 3032 \text{ mol}$

$n(\text{O}) = 1 \text{ mol} \cdot 6631 \text{ g/mol} \cdot 0,209383 \cdot 1 \text{ mol}/15,9994 \text{ g} \approx 872 \text{ mol}$

$n(\text{H}) = 1 \text{ mol} \cdot 6631 \text{ g/mol} \cdot 0,072852 \cdot 1 \text{ mol}/1,00794 \text{ g} \approx 4816 \text{ mol}$

$n(\text{S}) = 1 \text{ mol} \cdot 6631 \text{ g/mol} \cdot 0,003850 \cdot 1 \text{ mol}/32,066 \text{ g} \approx 8 \text{ mol}$



$$\frac{M(Y)}{0,29} - \frac{M(Y)}{0,392} = 32 \text{ g/mol}$$

$$M(Y) = \frac{32 \text{ g/mol}}{1/0,29 - 1/0,392} = \frac{32 \text{ g/mol}}{3,45 - 2,55} = 35,5 \text{ g/mol}$$

Y – Cl, kloor

b) i) $M(E) = \frac{35,5 \text{ g/mol}}{0,392} = 90,5 \text{ g/mol}$

ii) $M(F) = \frac{35,5 \text{ g/mol}}{0,29} = 122,5 \text{ g/mol} \approx 123 \text{ g/mol}$

c) X – Cl₂, kloor

A – H₂, vesinik

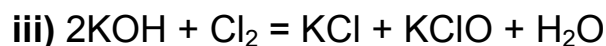
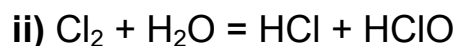
B – HCl, vesinikkloriid

C – HClO, hüpokloorishape

D – KCl, kaaliumkloriid

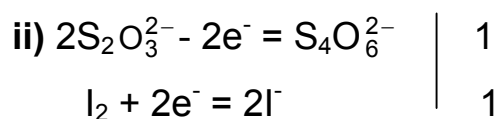
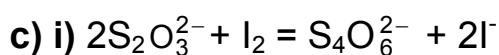
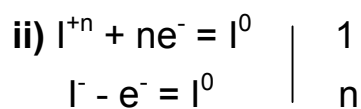
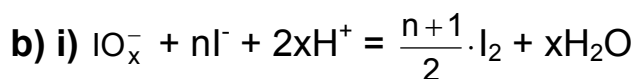
E – KClO, kaaliumhüpoklorit

F – KClO₃, kaaliumkloraat



6. a) i) Y – Na, naatrium (värvib leegi kollaseks)

ii) A – I₂, jood



d) Et NaIO_x annab neutraalse lahuse, siis HIO_x peab olema tugev hape, milleks saab olla kas HIO₃ või HIO₄.

$$n(I_2) = \frac{1}{2} \cdot 0,03077 \text{ dm}^3 \cdot 0,65 \text{ mol/dm}^3 = 0,01000 \text{ mol}$$

$$m(\text{NaIO}_x) = 10,35 \text{ cm}^3 \cdot 1,034 \text{ g/cm}^3 \cdot 0,05 = 0,535 \text{ g}$$

Kui võrrandis **b) i)** iooniks on $\overset{\text{V}}{\text{IO}}_3^-$, siis $nI^- = 5I^-$ ja $\frac{5+1}{2} \cdot I_2 = 3I_2$, mis annab vastavuse $\text{IO}_3^- \Leftrightarrow 3I_2$. Sellisel juhul $n(\text{IO}_3^-) = \frac{1}{3} \cdot 0,01 \text{ mol} = 0,00333 \text{ mol}$ ja

$M(\text{NaIO}_3, \text{ määratud}) = \frac{0,535 \text{ g}}{0,0033 \text{ mol}} \approx 161 \text{ g/mol}$. See pole kooskõlas tabeli

$M(\text{NaIO}_3) = 198 \text{ g/mol}$. Kui iooniks on $\overset{\text{VII}}{\text{IO}}_4^-$, siis $nI^- = 7I^-$ ja $\frac{7+1}{2} \cdot I_2 = 4I_2$, mis annab vastavuse $\text{IO}_4^- \Leftrightarrow 4I_2$. Sellisel juhul $n(\text{IO}_4^-) = \frac{1}{4} \cdot 0,01 \text{ mol} = 0,0025 \text{ mol}$ ja

$M(\text{NaIO}_4, \text{ määratud}) = \frac{0,535 \text{ g}}{0,0025 \text{ mol}} = 214 \text{ g/mol}$, mis on kooskõlas tabeli andmetega.