

2004/2005 õa keemiaolümpiaadi lõppvooru ülesannete lahendused  
12. klass

1. a) Normaalsoola **G** reageerimisel vesinikjodiidiga moodustuv binaarne sool peab olema **Al<sub>x</sub>**

$$A_r(\mathbf{A}) = 126,9 \cdot \frac{40,25}{59,75} \cdot x = 85,48x$$

Kui  $x = 1$ , siis

**A** – Rb, rubiidium

b) **B** – RbO<sub>2</sub>, rubiidiumhüperoksiid

**C** – Rb<sub>2</sub>O, rubiidiumoksiid

**D** – RbOH, rubiidiumhüdrosiid

**E** – Rb<sub>2</sub>SO<sub>4</sub>, rubiidiumsulfaat

**F** – RbHCO<sub>3</sub>, rubiidiumvesinikkarbonaat

**G** – RbCO<sub>3</sub>, rubiidiumkarbonaat

**H** – RbI, rubiidiumjodiid

**I** – RbH, rubiidiumhüdriid

**X** – O<sub>2</sub>, hapnik

**Q** – H<sub>2</sub>O<sub>2</sub>, vesinikperoksiid

c) i)  $\text{Rb} + \text{O}_2 = \text{RbO}_2$

ii)  $\text{RbO}_2 + 3\text{Rb} = 2\text{Rb}_2\text{O}$

iii)  $\text{Rb}_2\text{O} + \text{H}_2 = \text{RbOH} + \text{RbH}$

iv)  $\text{RbH} + \text{H}_2\text{O} = \text{RbOH} + \text{H}_2$

v)  $2\text{RbO}_2 + 2\text{H}_2\text{O} = 2\text{RbOH} + \text{H}_2\text{O}_2 + \text{O}_2$

vi)  $2\text{RbO}_2 + \text{H}_2\text{SO}_4 = \text{Rb}_2\text{SO}_4 + \text{H}_2\text{O}_2 + \text{O}_2$

MnO<sub>2</sub>

vii)  $2\text{H}_2\text{O}_2 = 2\text{H}_2\text{O} + \text{O}_2$

viii)  $\text{Rb}_2\text{SO}_4 + \text{Ba}(\text{OH})_2 = 2\text{RbOH} + \text{BaSO}_4 \downarrow$

ix)  $\text{RbOH} + \text{CO}_2 = \text{RbHCO}_3$

x)  $2\text{RbOH} + (\text{NH}_4)_2\text{CO}_3 = \text{Rb}_2\text{CO}_3 + 2\text{NH}_3 + 2\text{H}_2\text{O}$

xi)  $\text{Rb}_2\text{CO}_3 + 2\text{HI} = 2\text{RbI} + \text{H}_2\text{O} + \text{CO}_2$

$$2. a) k = \frac{\ln 2}{\tau_{1/2}} = \frac{0,6931}{1,06 \cdot 10^{11} \text{ aastat}} = 6,54 \cdot 10^{-12} \text{ aasta}^{-1}$$

$$t = \frac{\tau_{1/2}}{\ln 2} \cdot \ln \frac{100}{90} = \frac{1,06 \cdot 10^{11} \text{ aastat}}{\ln 2} \cdot 0,1053 = 1,61 \cdot 10^{10} \text{ aastat}$$

$$b) c_t = c_0 \cdot e^{-k \cdot t} = 100\% \cdot e^{-6,54 \cdot 10^{-12} \text{ aastat}^{-1} \cdot 1,61 \cdot 10^{10} \text{ aastat}} = 100\% \cdot e^{-0,1053} = 100\%$$

c) punktist b) järeldub, et 5 aasta möödudes preparaadi aktiivsus pole muutunud. Seega võib algaktiivsuseks lugeda 89,2 Bq/1g.

$$m(\text{Sm}) = 1 \text{ g} \cdot \frac{150,4 \cdot 2}{150,4 \cdot 2 + 3 \cdot 16} = 0,862 \text{ g}$$

$$v = k \cdot N_0, \text{ millest } N_0 = \frac{v}{k}$$

$$m(^{147}\text{Sm}) = \frac{89,2 \text{ tuuma}}{1 \text{ g} \cdot \text{s}} \cdot \frac{\tau_{1/2}}{\ln 2} \cdot (365,25 \cdot 24 \cdot 3600) \text{ s} \cdot$$

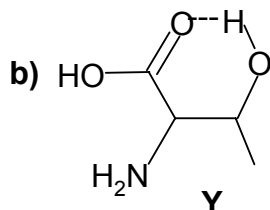
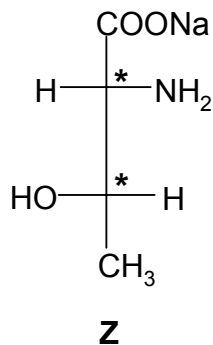
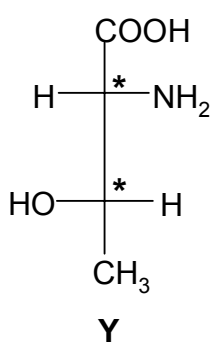
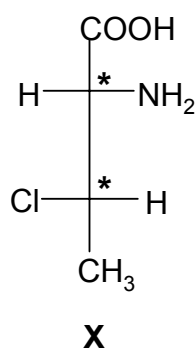
$$\cdot \frac{1 \text{ mol}}{6,02 \cdot 10^{23} \text{ tuuma}} \cdot 147 \text{ g/mol} = 0,105 \text{ g}$$

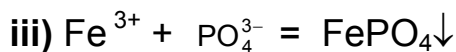
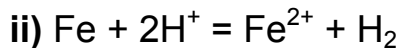
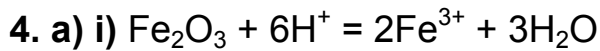
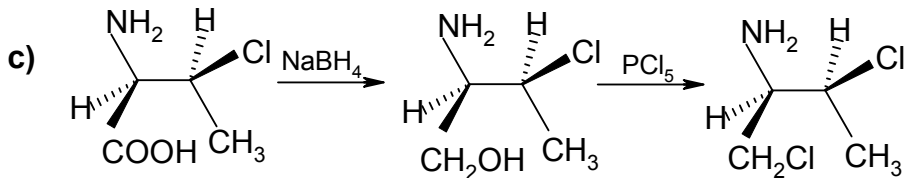
$$\%(^{147}\text{Sm}) = \frac{0,105}{0,862} \cdot 100 = 12,2$$

$$d) N = v \cdot t$$

$$N = \frac{89,2 \text{ tuuma}}{1 \text{ g} \cdot \text{s}} \cdot 10 \text{ g} \cdot (5 \cdot 365,25 \cdot 24 \cdot 3600) \text{ s} = 1,41 \cdot 10^{12} \text{ tuuma}$$

3. a)





b) i) [H<sup>+</sup>] saadakse happe dissotsiatsiooni esimesest astmest. Ostwaldi lahjendusseadus ei anna nõutud täpsust. I ja II astme vahe on 5 suurusjärku, seetõttu II ja III astmest lisanduv H<sup>+</sup> hulk on tühine

$$[\text{H}^+] = \frac{-K_1 + \sqrt{K_1^2 + 4c \cdot K_1}}{2} \Rightarrow \frac{-7,52 \cdot 10^{-3} + \sqrt{(7,52 \cdot 10^{-3})^2 + 4 \cdot 0,1 \cdot 7,52 \cdot 10^{-3}}}{2} = 0,02392 \text{ M}$$

**pH = 1,62**

ii) H<sup>+</sup>, hapest < H<sup>+</sup>, veest

**pH ≈ 7** (ühe tüvenumbri täpsus)

c)  $10^{-21,9} = 1,26 \cdot 10^{-22}$

i)  $[\text{Fe}^{3+}] = \frac{\text{LK}[\text{Fe}(\text{OH})_3]}{(10^{-7})^3} = 3,98 \cdot 10^{-17} \text{ M} \approx 4 \cdot 10^{-17} \text{ M}$

ii)  $[\text{Fe}^{3+}] = \frac{\text{LK}(\text{FePO}_4)}{c_0 \cdot \alpha} = 3,77 \cdot 10^{-5} \text{ M}$

5. a) A – Hg, elavhõbe

B – S, väävel

C – SO<sub>2</sub>, vääveldioksiid

D – Na<sub>2</sub>S, naatriumsulfiid

E – Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>, naatriumtiosulfaat

F – HgO, elavhõbe(II)oksiid

G – Hg<sub>2</sub>O, elavhõbe(I)oksiid

