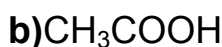


Keemia lahtine võistlus
Vanem rühm (11. ja 12. klass)

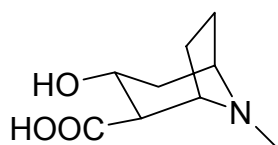
Tallinn, Tartu, Kuressaare, Narva, Pärnu, Kohtla-Järve 5. november 2005. a

1. a) Amino-, ester-, eeterühmad



c) Estri hüdroolüüs

d) Estri hüdroolüüsi tulemusena tekivad $\text{C}_6\text{H}_5\text{COOH}$, CH_3OH ning

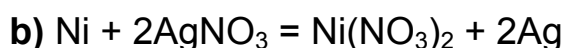


e) $\text{C}_6\text{H}_5\text{COOCH}_3$

f) Metüülbensoaat.

g) Kokaiini hüdroolüüsil tekkinud produktid reageerivad edasi omavahel, esterifikatsiooni tulemusena tekibki aine **B**.

2. a) $(-)\text{Ni} \mid \text{Ni}(\text{NO}_3)_2 \text{ lahus} \mid \mid \text{AgNO}_3 \text{ lahus} \mid \text{Ag}(+)$



c) i) $E(\text{Ag}^+/\text{Ag}) = 0,799 \text{ V} + 0,059 \text{ V} \cdot \log 0,300 = \mathbf{0,768 \text{ V}}$

$$E(\text{Ni}^{2+}/\text{Ni}) = -0,250 \text{ V} + \frac{0,059 \text{ V}}{2} \cdot \log 0,200 = \mathbf{-0,271 \text{ V}}$$

ii) $E = 0,768 - (-0,271) = \mathbf{1,039 \text{ V}}$

$$n(e^-) = 2,68 \text{ A} \cdot h \cdot 3600 \text{ s/h} \cdot \frac{1 \text{ mol}}{96485 \text{ A} \cdot \text{s}} = 0,100 \text{ mol}$$

d) $1 \text{ Ni} \Leftrightarrow 2e^- \quad n(\text{Ni}^{2+}) = 0,200 + 0,100/2 = 0,250 \text{ M}$

$$1 \text{ Ag}^+ \Leftrightarrow 1 e^- \quad n(\text{Ag}^+) = 0,300 - 0,100 = 0,200 \text{ M}$$

e) i) $E(\text{Ag}^+/\text{Ag}) = 0,799 + 0,059 \log 0,200 = \mathbf{0,758 \text{ V}}$

$$E(\text{Ni}^{2+}/\text{Ni}) = -0,250 + (0,059/2) \cdot \log 0,250 = \mathbf{-0,268 \text{ V}}$$

ii) $E = 0,758 - (-0,268) = \mathbf{1,026 \text{ V}}$

3. a) i) $\lambda(^{14}\text{C}) = \frac{\ln 2}{T_{1/2}} = \frac{0,6931}{5730 \text{ aastat}} \cdot \frac{1 \text{ aasta}}{365 \text{ päeva}} \cdot \frac{1 \text{ päev}}{24 \text{ tundi}} \cdot \frac{1 \text{ tund}}{3600 \text{ s}} = \mathbf{3,83 \cdot 10^{-12} \text{ s}}$

$$\text{ii) } \lambda(^{40}\text{K}) = \frac{\ln 2}{T_{1/2}} = \frac{0,6931}{1,277 \cdot 10^9 \text{ aastat}} \cdot \frac{1 \text{ aasta}}{365 \text{ päeva}} \cdot \frac{1 \text{ päev}}{24 \text{ tundi}} \cdot \frac{1 \text{ tund}}{3600 \text{ s}} = 1,72 \cdot 10^{-17} \text{ s}^{-1}$$

$$\text{b) i) } N(^{14}\text{C}) = \frac{12 \cdot 36 \text{ g} \cdot 6,02 \cdot 10^{23} \text{ mol}^{-1} \cdot 0,00000000000012}{(12,0 \cdot 12 + 1,0 \cdot 22 + 16,0 \cdot 11) \text{ g/mol}^{-1}} = 9,1 \cdot 10^{11} \text{ aatomit}$$

$$\alpha(^{14}\text{C}) = N \cdot \lambda = 9,1 \cdot 10^{11} \cdot 3,83 \cdot 10^{-12} \text{ s}^{-1} = 3,5 \text{ dps}$$

$$\text{ii) } N(^{40}\text{K}) = \frac{0,602 \text{ g} \cdot 6,02 \cdot 10^{23} \text{ mol}^{-1} \cdot 0,000117}{39,1 \text{ g} \cdot \text{mol}^{-1}} = 1,08 \cdot 10^{18} \text{ aatomit}$$

$$\alpha(^{40}\text{K}) = N \cdot \lambda = 1,08 \cdot 10^{18} \cdot 1,72 \cdot 10^{-17} \text{ s}^{-1} = 18,7 \text{ dps}$$

$$\text{iii) } \alpha(^{14}\text{C}) + \alpha(^{40}\text{K}) = 22,2 \text{ dps} \approx 22,2 \text{ dps}$$

$$\text{4. a) } M(\text{A}) = \frac{0,474}{n} \cdot 135,0 \text{ g/mol} = \frac{64,0}{n} \text{ g/mol}, \text{ kui } n = 2, \text{ siis } M(\text{A}) = 32 \text{ g/mol}$$

I II

B – S₂Cl₂, **C** – SCl₂

b) A – S **G** – SO₂

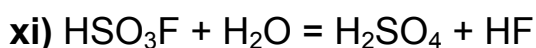
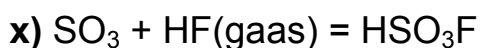
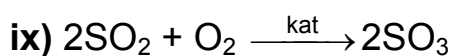
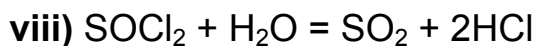
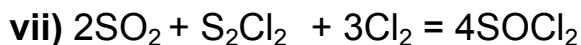
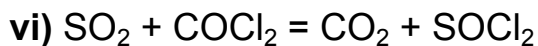
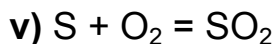
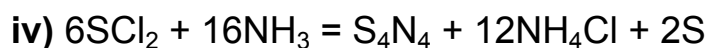
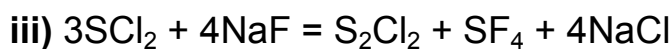
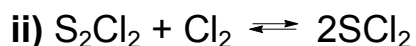
B – S₂Cl₂ **H** – SOCl₂

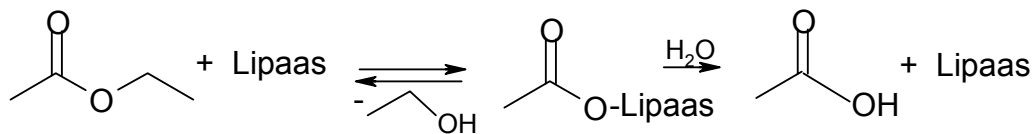
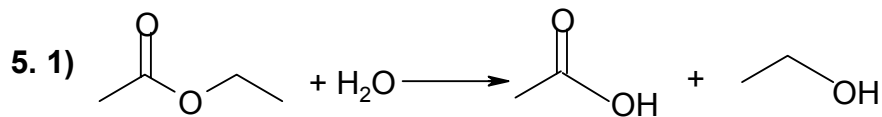
C – SCl₂ **I** – HCl

D – NaCl **J** – SO₃

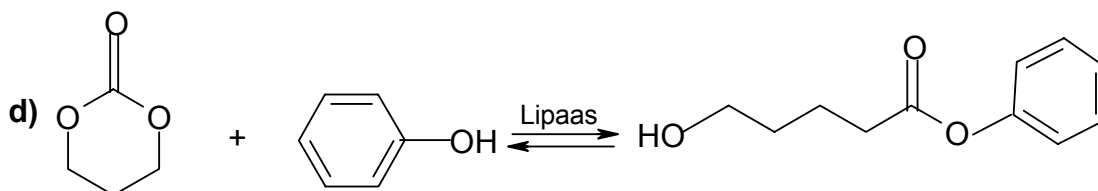
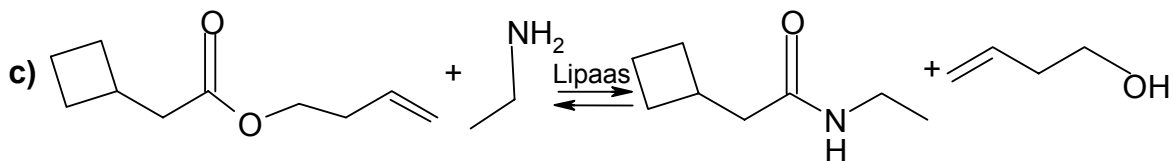
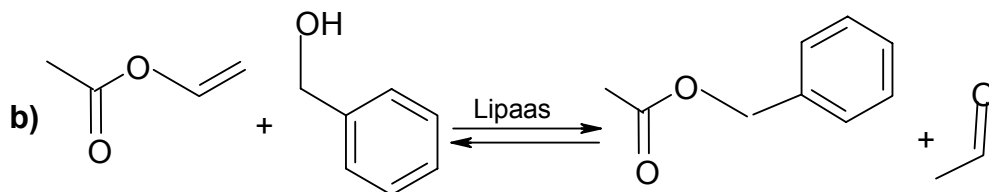
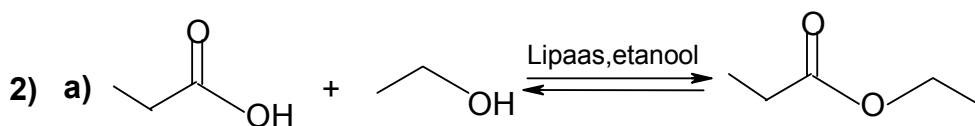
E – SF₄ **K** – HSO₃F

F – S₄N₄ **L** – H₂SO₄





Näide on etüülatsetaadiga, aga sobib ka iga teine ester.



6. a) **A** – Fe₂O₃, raud(III)oksiid

B – Fe₃O₄, triraudtetraoksiid

C – FeO, raud(II)oksiid

X – CO, süsinikmonooksiid

Y – CO₂, süsinikdioksiid

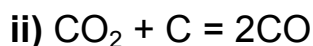
koks – C, süsinik

lubjakivi – CaCO₃, kaltsiumkarbonaat

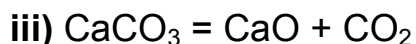
räbu – CaSiO₃, kaltsiumsilikaat

b) i) C + O₂ = CO₂

t⁰t⁰

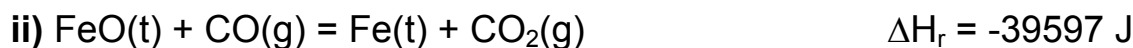
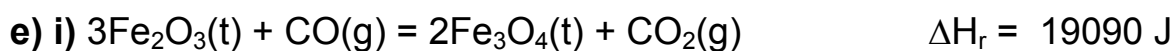


t⁰t⁰



$$\text{c) } \Delta H_r(\text{C} \rightarrow \text{CO}_2) = -397268 \text{ J/mol} \cdot 500 \text{ kg} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} \cdot \frac{1 \text{ mol}}{12 \text{ g}} = -1,65528 \cdot 10^{10} \text{ J} \approx \approx -1,66 \cdot 10^{10} \text{ J}$$

$$\text{d) } \Delta H_f(\text{CO}) = \frac{1}{2} \cdot (-1,655 \cdot 10^{10} - 6,93 \cdot 10^9) \text{ J} \cdot \frac{12 \text{ g}}{1 \text{ mol}} \cdot \frac{1}{500 \text{ kg}} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} = = -1,15 \cdot 10^5 \text{ J/mol} = -115 \text{ kJ/mol}$$



f) 2Fe ₃ O ₄ + CO ₂ = 3Fe ₂ O ₃ + CO - 19090 J	· 0,5
Fe ₂ O ₃ + 3CO = 2Fe + 3CO ₂ -83535 J	· 1,5
Fe + CO ₂ = FeO + CO +39597 J	· 3

i) Fe₃O₄ + 0,5CO₂ + 1,5Fe₂O₃ + 4,5CO + 3Fe + 3CO₂ =
 = 1,5 Fe₂O₃ + 0,5 CO + 3Fe + 4,5CO₂ + 3FeO + 3CO
 [0,5·(-19090) – 1,5·83535 + 3·39597]J = -16057 J

