2005/2006 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a) **A** – $Mn(OH)_2$, mangaan(II)hüdroksiid
B - K_2MnO_4, kaaliummanganaat
C – $Mn(NO_3)_2$, mangaan(II)nitraat
D – $MnCl_2$, mangaan(II)kloriid
E – $MnSO_4$, mangaan(II)sulfaat
F – $KMnO_4$, kaaliumpermanganaat
G – MnO_2, mangaan(IV)oksiid

b) i) $2MnO_2 + 4KOH + O_2 \xrightarrow{{}^0t^0t} 2K_2MnO_4 + 2H_2O$
ii) $MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$
iii) $4KMnO_4 + Mn(OH)_2 + 6KOH = 5K_2MnO_4 + 4H_2O$
iv) $MnCl_2 + 2AgNO_3 = Mn(NO_3)_2 + 2AgCl\downarrow$
v) $MnCl_2 + 2KOH = Mn(OH)_2\downarrow + 2KCl$
vi) $MnCl_2 \xrightarrow{\text{elektrolüüs}} Mn + Cl_2$
vii) $2KMnO_4 \xrightarrow{{}^0t} K_2MnO_4 + MnO_2\downarrow + O_2$
viii) $3MnO_2 + 4Al = 2Al_2O_3 + 3Mn$
ix) $2KMnO_4 + H_2O_2 + 2KOH = 2K_2MnO_4 + O_2 + 2H_2O$
x) $2KMnO_4 + 5H_2O_2 + 3H_2SO_4 = 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$

2. a) i) $\mathbf{c(C_6H_5COOH)_v} = \frac{m(C_6H_5COOH)_v}{M(C_6H_5COOH)\cdot V} = \frac{0{,}0107\ g}{122\ g/mol \cdot 50\ ml \cdot 10^{-3}\ l/ml} \approx$

$\approx$ **0,0018 M**

ii) $\mathbf{c(C_6H_5COOH)_b} = \frac{m(C_6H_5COOH)_b}{M(C_6H_5COOH)\cdot V} = \frac{0{,}0363\ g}{122\ g/mol \cdot 50\ ml \cdot 10^{-3}\ l/ml} \approx$

$\approx$ **0,0060 M**

b) $K_a = \frac{[H^+][C_6H_5COO^-]}{[C_6H_5COOH]}$

c) i) $c(C_6H_5COOH)_v = [C_6H_5COOH]_v + [C_6H_5COO^-]_v$

ii) $[C_6H_5COO^-]_v = [H^+]_v$

d) $[H^+]^2 + K_a\cdot[H^+] - K_a\cdot c(C_6H_5COOH)_v = 0 \Rightarrow$

$$\Rightarrow [H^+] = \frac{-K_a + \sqrt{K_a^2 + 4K_a \cdot c(C_6H_5COOH)_v}}{2}$$

$$[H^+]_v = \frac{-6{,}20\cdot10^{-5} + \sqrt{(6{,}20\cdot10^{-5})^2 + 4\cdot6{,}20\cdot10^{-5}\cdot0{,}0018}}{2} \approx \mathbf{0{,}00030\ M}$$

pH = 3,52

e) $\mathbf{[C_6H_5COO^-]_v} = [H^+]_v = \mathbf{0{,}00030\ M}$

$\mathbf{[C_6H_5COOH]_v} = 0{,}0018\ M - 0{,}0003\ M = \mathbf{0{,}0015\ M}$

$\mathbf{[OH^-]} = \frac{K_v}{[H^+_v]} \approx \mathbf{3{,}33\times10^{-11}\ M}$

f) i) $\mathbf{[C_6H_5COOH]_b} = K\cdot[C_6H_5COOH]_v = 1{,}43\cdot0{,}0015\ M \approx \mathbf{0{,}0021\ M}$

ii) $\mathbf{[(C_6H_5COO)_2]_b} = \frac{0{,}0060\ M - 0{,}0021M}{2} \approx \mathbf{0{,}0020\ M}$

g) i) $2(C_6H_5COOH)_b = (C_6H_5COOH)_{2,b}$

ii) $\mathbf{K_D} = \frac{[(C_6H_5COOH)_2]_b}{[C_6H_5COOH]_b^2} = \frac{0{,}0020}{(0{,}0021)^2} = 453.5 \approx \mathbf{450}$

3. a) **A** – $[Co(NH_3)_6]SO_4$, heksaammiinkoobalt(II)sulfaat

B – $Co_2SO_4(OH)_2$, koobalt(II)hüdroksiidsulfaat

C – $Co(OH)_2$, koobalt(II)hüdroksiid

D – CoO(OH), koobalt(III)hüdroksiidoksiid

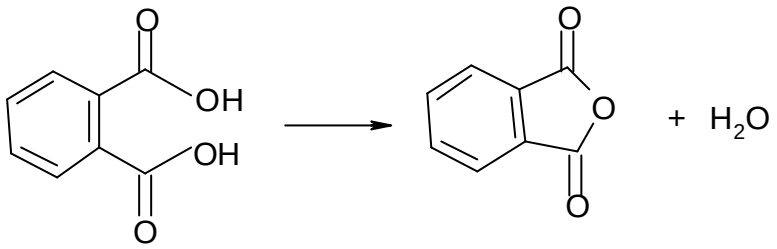
E – $[Co(NH_3)_6](OH)_3$, heksaammiinkoobalt(III)hüdroksiid

b) i) $CoSO_4 + 6NH_3 = [Co(NH_3)_6]SO_4$

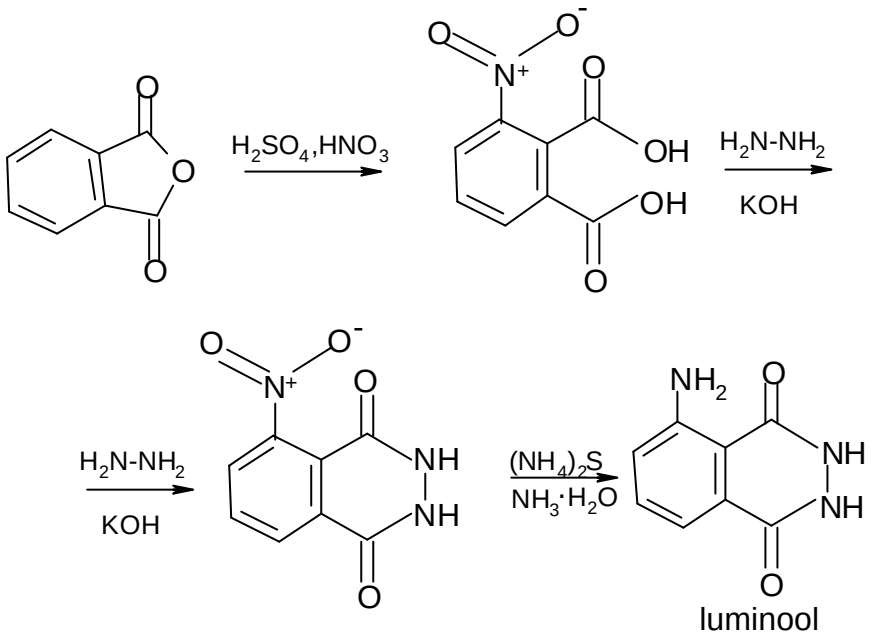
ii) $2CoSO_4 + 2NaOH = Co_2SO_4(OH)_2\downarrow + Na_2SO_4$
iii) $Co_2SO_4(OH)_2 + 2NaOH = 2Co(OH)_2\downarrow + Na_2SO_4$
iv) $4Co(OH)_2 + O_2 = 4CoO(OH)\downarrow + 2H_2O$
v) $2Co(OH)_2 + H_2O_2 = 2CoO(OH)\downarrow + 2H_2O$
vi) $CoO(OH) + 6NH_3 + H_2O = [Co(NH_3)_6](OH)_3$
vii) $[Co(NH_3)_6](OH)_3 = CoO(OH)\downarrow + 6NH_3 + H_2O$

4. a) **A** – benseen-1,2-dikarboksüülhappe anhüdriid e ftaalhappe anhüdriid
B – benseen-1,2-dikarboksüülhape e ftaalhape
C – 3-nitrobenseen-1,2-dikarboksüülhape e 3-nitroftaalhape

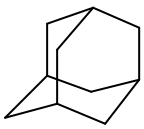
b)



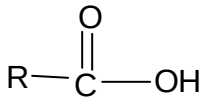
c)

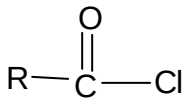


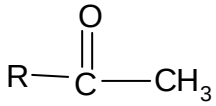
5. a)

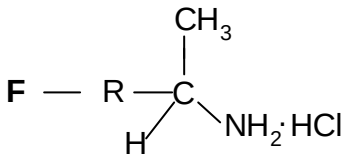


b) **B** – R–Br

C — 

D — 

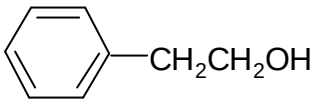
E — 



B - bromoadamantaan
C – adamantaankarboksüülhape
D – adamantaankarboksüülhappeklooranhüdriid

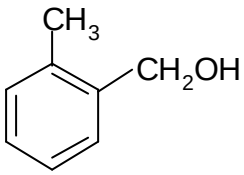
6. a) $PhCH_2Cl + Mg = PhCH_2MgCl$

b)

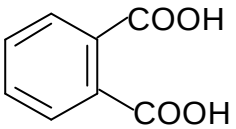


2-fenüületanool

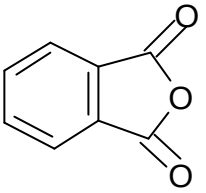
c)



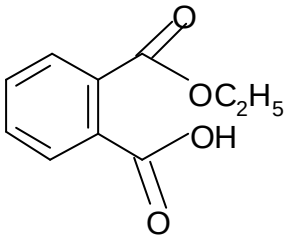
A



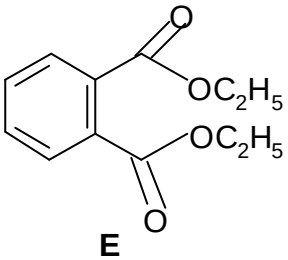
B



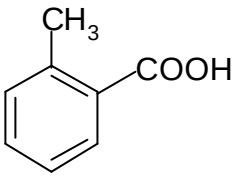
C



D



E



F