KEEMIAÜLESANNETE LAHENDAMISE LAHTINE VÕISTLUS

Vanem rühm (11. ja 12. klass)

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Ülesannete lahendused

1. a) $NaHCO_3$ – naatriumvesinikkarbonaat, söögisooda
K_2CO_3 – kaaliumkarbonaat, potas
HCl – vesinikkloriidhape, soolhape
CO_2 – süsinikdioksiid, süsihappegaas
$NaHCO_3 + HCl = NaCl + H_2O + CO_2\uparrow$
$K_2CO_3 + 2HCl = 2KCl + H_2O + CO_2\uparrow$

b) NaCl ja KCl on mõlemad värvitud kristallid, tahke jääk on valge pulber.

c) i) $\mathbf{n} = \frac{pV}{RT} = 1\,\text{atm} \cdot 19{,}7\,\text{dm}^3 \cdot \frac{1\,\text{mol} \cdot \text{K}}{0{,}082\,\text{atm} \cdot \text{dm}^3} \cdot \frac{1}{(273+25)\,\text{K}} = \mathbf{0{,}806\ mol}$

ii) Tähistame söögisooda massi x ja potase massi y-ga

$$\begin{cases} \frac{x}{84} + \frac{y}{138} = 0{,}806 \\ \frac{58{,}5x}{84} + \frac{2 \cdot 74{,}5y}{138} = 56{,}72 \end{cases} \qquad \begin{cases} m(NaHCO_3) = x = 58{,}8\ \text{g} \\ m(K_2CO_3) = y = 14{,}6\ \text{g} \end{cases}$$

$NaHCO_3$ ja K_2CO_3 massivahekord on **4,03 : 1**.

iii) $\mathbf{\%(H_2O)} = \frac{75\ \text{g} - 58{,}8\ \text{g} - 14{,}6\ \text{g}}{75\ \text{g}} \cdot 100 = \frac{1{,}6\ \text{g}}{75\ \text{g}} \cdot 100 = \mathbf{2{,}1}$

d) $\frac{58{,}5x}{84} + \frac{2 \cdot 74{,}5y}{138} = x + y$

Otsitav suurus $\frac{x}{y} = \frac{1 - 1{,}08}{0{,}696 - 1} = 0{,}26 = \frac{1}{3{,}8}$

$NaHCO_3$ ja K_2CO_3 massivahekord peab olema **1:3,8**.

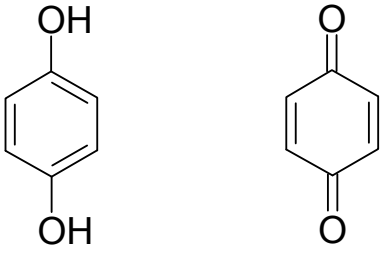
2. a) $DHB(OH)_2 \rightarrow DHB(=O)_2 + 2e^- + 2H^+$ (z = 2)

b) $n = \frac{q}{zF} = \frac{It}{zF} = 206\,\text{mA} \cdot \frac{1\,\text{A}}{1000\,\text{mA}} \cdot 1\,\text{h} \cdot \frac{3600\ \text{s}}{1\,\text{h}} \cdot \frac{1}{2} \cdot \frac{1\,\text{mol}}{96485\ \text{C}} =$

$= 0{,}00384\ \text{mol}$

$\mathbf{M} = 415\,\text{mg} \cdot \frac{1\,\text{g}}{1000\,\text{mg}} \cdot \frac{1}{0{,}00384\,\text{mol}} = \mathbf{108\ g/mol}$

c) lähteaine saadus



d) i) Ekstraheerimine süsteemis vesi - orgaaniline lahusti (nt etüüleeter): hüdrokinoon jääb veefaasi, kinoon – orgaanilisse faasi.

ii) Veest ümberkristalliseerimine ja filtreerimine: kinoon ei lahustu vees, seega sadeneb nõu põhja ning filtreeritakse välja.

3. a) i) **J** – $\mathbf{X}_n O_m$ $\quad \dfrac{m \cdot A_r(O)}{n \cdot A_r(\mathbf{X}) + m \cdot A_r(O)} = 0.6955 \quad A_r(\mathbf{X}) = \dfrac{7.0048 \cdot m}{n}$

Kui m = 2 ja n = 1, siis **J** – NO_2

ii) **A** – HI **D** – P **G** – H_2 **J** – NO_2
B – I_2 **E** – H_3PO_4 **H** – $H[AgI_2]$ **K** – HIO_3
C – $H[I(I_2)]$ **F** – AgI **I** – HNO_3

b) i) $4HI + O_2 \rightarrow 2I_2 + 2H_2O$
ii) $HI + I_2 \rightarrow H[I(I_2)]$
iii) $5H[I(I_2)] + 2P + 8H_2O \rightarrow 2H_3PO_4 + 15HI$
iv) $2HI + 2Ag \rightarrow H_2\uparrow + 2AgI\downarrow$
v) $AgI + HI \rightarrow H[AgI_2]$
vi) $HI + 6HNO_3 \rightarrow 6NO_2\uparrow + HIO_3 + 3H_2O$

4. a) $C_6H_{12}O_6 + 6O_2 + 38ADP + 38P_i = 6CO_2 + 44H_2O + 38ATP$

b) **ΔG(ATP teke)** $= 38\ \text{mol} \cdot \dfrac{50\ \text{kJ}}{1\ \text{mol}} =$ **1900 kJ**

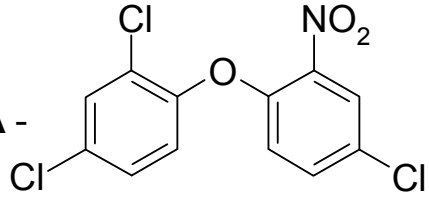
c) **ΔG(oks. fosfor.)** $= (-2823{,}2 + 1900)\ \text{kJ/mol} = -923{,}2\ \text{kJ/mol} =$
$= -$**900kJ/mol**

d) **Efektiivsus** $= \dfrac{1900}{2823{,}2} \cdot 100 =$ **67**

5. a) C : H : O : Cl $\quad \dfrac{49{,}78}{12{,}0} : \dfrac{2{,}44}{1{,}01} : \dfrac{11{,}05}{16{,}0} : \dfrac{36{,}73}{35{,}5}$ => 12 : 7 : 2 :3 **$C_{12}H_7O_2Cl_3$**

X – 2,4-diklorofenool **Y** – difenüüleeter, fenoksübenseen

b)

A -


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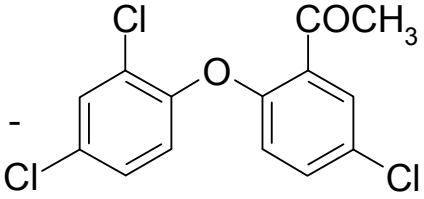

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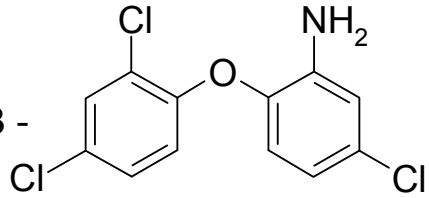

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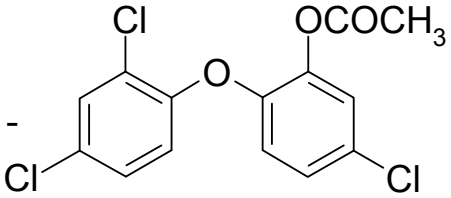

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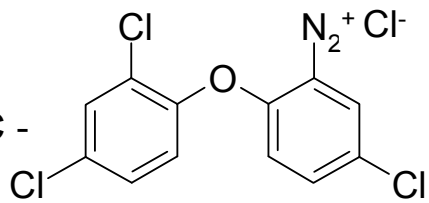
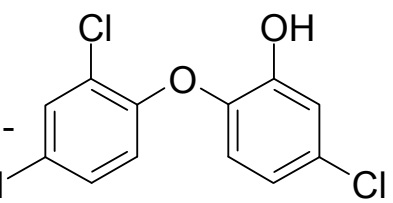
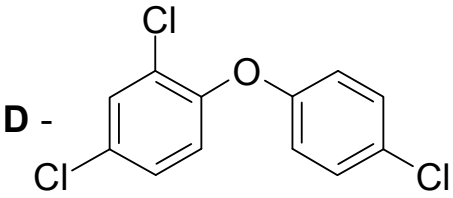
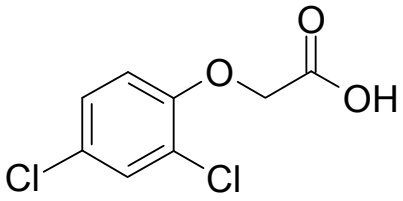


Triklosaan -


D -



c)



6. a) i) $\mathbf{p(CO_2)} = 0{,}000355 \cdot 1\,\text{atm} = 3{,}55 \cdot 10^{-4}\ \text{atm} = \mathbf{3.6 \cdot 10^{-4}\,atm}$

ii) $\mathbf{c(CO_2)_v} = \dfrac{3{,}38 \cdot 10^{-2}\ \text{M}}{1\,\text{atm}} \cdot 3{,}55 \cdot 10^{-4}\ \text{atm} = \mathbf{1{,}2 \cdot 10^{-5}\ M}$

b) i) $CO_2 + H_2O = H_2CO_3$

ii) $H_2CO_3 = H^+ + HCO_3^-$ $\qquad K_a = \dfrac{[H^+][HCO_3^-]}{[H_2CO_3]}$

iii) Kogu CO_2 on jaotunud H_2CO_3 ja HCO_3^- vahel, seega

$c(CO_2)_v = [H_2CO_3] + [HCO_3^-]$ (massibilanss)

Avaldame $[H_2CO_3]$: $[H_2CO_3] = c(CO_2)_v - [HCO_3^-]$ (I)

Puhta happe lahuses: $[H^+] = [HCO_3^-]$ (laengubilanss) (II)

Asendame seosed (I) ja (II) K_a avaldisse ja arvutame $[H^+]$:

$$K_a = \frac{[H^+]^2}{c(CO_2)_v - [HCO_3^-]} = \frac{[H^+]^2}{c(CO_2)_v - [H^+]}$$

$$[H^+]^2 + [H^+]K_a - c(CO_2)_v K_a = 0 \Rightarrow [H^+] = -K_a/2 \pm \sqrt{K_a^2/4 + c(CO_2)_v K_a}$$

$$[H^+] = -\frac{4{,}45 \cdot 10^{-7}}{2} + \sqrt{\left(\frac{4{,}45 \cdot 10^{-7}}{2}\right)^2 + 1{,}2 \cdot 10^{-5} \cdot 4{,}45 \cdot 10^{-7}} = 2{,}10 \cdot 10^{-6}\ \text{M}$$

$\mathbf{pH} = -\log[H^+] = -\log(2.10 \cdot 10^{-6}) = \mathbf{5{,}68}$

c) $\alpha = \dfrac{[HCO_3^-]}{c(H_2CO_3)_{\text{üld}}} = \dfrac{[H^+]}{c(CO_2)_v} = \dfrac{2{,}10 \cdot 10^{-6}\ \text{M}}{1{,}2 \cdot 10^{-5}\ \text{M}} \cdot 100 = 17{,}5 = \mathbf{18}$