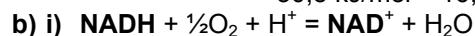


2006/2007 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a) i) $Q = \frac{[ADP] \cdot [P_i]}{[ATP]} = \frac{4,8 \cdot 10^{-3} \cdot 1,3 \cdot 10^{-3}}{3,4 \cdot 10^{-3}} = 1,8 \cdot 10^{-3}$

ii) $\Delta G = \Delta G^0 + RT \ln Q = -30,5 \frac{\text{kJ}}{\text{mol}} + 8,314 \frac{\text{J}}{\text{mol} \cdot \text{K}} \cdot \frac{1 \text{kJ}}{10^3 \text{J}} \cdot 310 \text{K} \ln 1,8 \cdot 10^{-3} =$
 $= -30,5 \text{ kJ/mol} - 16,2 \text{ kJ/mol} = -46,8 \text{ kJ/mol}$

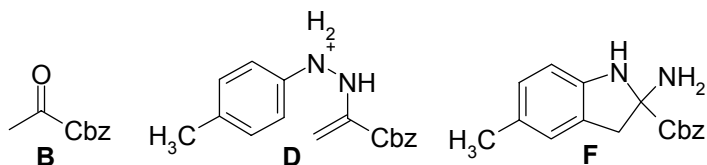


ii) $E^0 = E_2^0 + (-E_1^0) = 0,82 \text{ V} + 0,32 \text{ V} = 1,14 \text{ V}$

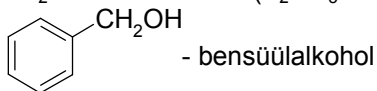
iii) $\Delta G^0 = -zFE^0 = 2 \cdot 96485 \frac{\text{J}}{\text{C} \cdot \text{V}} \cdot \frac{1 \text{kJ}}{10^3 \text{J}} \cdot 1,14 \text{ V} = 220 \text{ kJ/mol}$

c) $N = \frac{-220 \text{ kJ/mol} \cdot 0,63}{-46,8 \text{ kJ/mol}} = 3$

2. a)



b) CO_2 – süsinikdioksiid (K_2CO_3 – kaaliumkarbonaat KOH lahuses) ja



3. a) I kiht koosneb (borosilikaat)klaasist koostisega SiO_2 (60 %), Al_2O_3 (15 %), B_2O_3 (10 %), CaO (5,0 %), BaO (5,0 %), SrO (5,0 %).

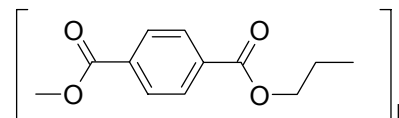
Oksiidi protsendiline sisaldus on leitav järgmiselt:

$$\%(\text{SiO}_2) = \frac{(28 + 2 \cdot 16) \cdot 280 / 28}{280 + 79 + 31 + 36 + 45 + 42 + 486} \cdot 100 = \frac{600}{999} \cdot 100 = 60$$

$$\%(\text{CaO}) = \frac{(40 + 16) \cdot 36 / 40}{280 + 79 + 31 + 36 + 45 + 42 + 486} \cdot 100 = \frac{50,4}{999} \cdot 100 = 5,0 \text{ jne.}$$

b) Hõbe, mis on teatavasti parim elektrijuht ja seepärast seda kasutatigi, et saaks teha nii peene juhtme, et see paistaks läbi.

c) polüetüleentereftalaat



d) Antud materjalil (koostisega In_2O_3 ja SnO_2) on pooljuhi omadused ja sellel baseerub mahtuvuse muutumine, kui elektrit juhtiva sõrmega kuskilt ekraanilt laengut vähendatakse.

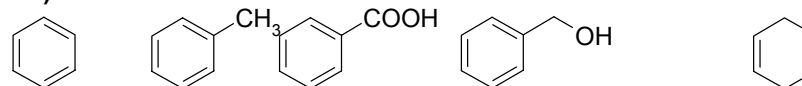
Oletame, et SnO_2 (151 g/mol) on 1 mool. In_2O_3 (278 g/mol) on seega 9/2 mooli.

$$\%(\text{In}_2\text{O}_3) = \frac{278 \cdot 9/2}{278 \cdot 9/2 + 151} \cdot 100 = 89,2\% = 89\%$$

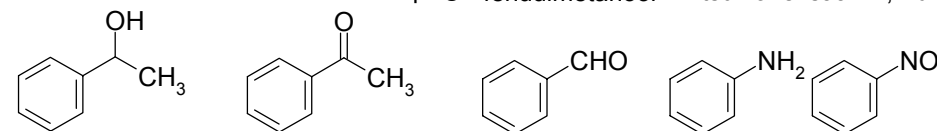
$$\%(\text{SnO}_2) = \frac{151}{151 + 278 \cdot 9/2} \cdot 100 = 10,8\% = 11\%$$

4. a) Areenid

b)



X - benseen A - toluen B - bensoehape C - fenüülmetanool D - tsükloheksaan-1,4-dieen



E - 1-fenüületanool F - 1-fenüületanoon G - bensaldehüüd H - aniliin I - nitrobenseen

c) i) $\text{CH}_3\text{Cl}/\text{AlCl}_3$

ii) algul NaOH, CO_2 (rõhu all), siis H^+

iii) KMnO_4 , OH^- , t°

iv) LiAlH_4

v) Na/NH_3

vi) $\text{CH}_3\text{COBr}/\text{FeBr}_3$

vii) H_2 (kat.)

viii) CO , HCl , AlCl_3

ix) HNO_3 , H_2SO_4

x) Sn , HCl

5. a) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH} + \text{OH}^- = \text{H}_3\text{N}^+\text{CH}_2\text{COO}^- + \text{H}_2\text{O}$

$\text{H}_3\text{N}^+\text{CH}_2\text{COO}^- + \text{OH}^- = \text{H}_2\text{NCH}_2\text{COO}^- + \text{H}_2\text{O}$

b) i) $\text{H}_3\text{N}^+\text{CH}_2\text{COOH}$

ii) $\text{H}_2\text{NCH}_2\text{COO}^-$



d) i) $\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = 100$

ii) $2,817 = 2,34 + \log \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]} \quad \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]} = 3$

$$[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 3[\text{H}_3\text{N}^+\text{CH}_2\text{COOH}]$$

$$c(\text{glütsiin}) = [\text{H}_3\text{N}^+\text{CH}_2\text{COOH}] + [\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{c(\text{glütsiin})} \cdot 100 =$$

$$= \frac{3[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} \cdot 100 = \frac{3}{4} \cdot 100 = 75$$

iii) $10,057 = 9,58 + \log \frac{[\text{H}_2\text{NCH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} \quad \frac{[\text{H}_2\text{NCH}_2\text{COO}^-]}{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]} = 3$

$$[\text{H}_2\text{NCH}_2\text{COO}^-] = 3[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$c(\text{glütsiin}) = [\text{H}_2\text{NCH}_2\text{COO}^-] + [\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-] = 4[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]$$

$$\%(\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-) = \frac{[\text{H}_3\text{N}^+\text{CH}_2\text{COO}^-]}{c(\text{glütsiin})} \cdot 100 = \frac{1}{4} \cdot 100 = 25$$

6. a) **A** – NO_3^- , nitraatioon

B – HNO_3 , lämmastikhape

C – NO_2^- , nitritioon

D – HNO_2 , lämmastikushape

E – NH_4^+ , ammooniumioon

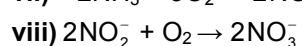
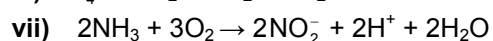
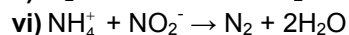
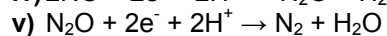
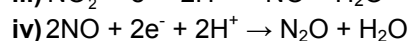
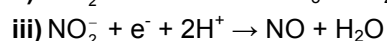
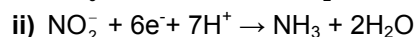
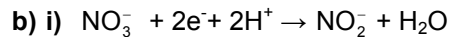
F – NH_3 , ammoniaak

G – NO , lämmastikmonooksiid

I – N_2O , dilämmastikoksiid

K – N_2 , lämmastik

X – N , atomaarne lämmastik



c) *Brocardia anammoxidans* elektronide aktseptoriks on **C** – NO_2^- , nitritioon ja doonoriks on **F** – NH_3 , ammoniaak.