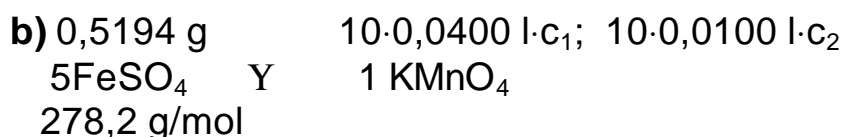
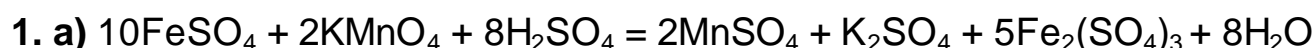


Keemia lahtise võistluse ülesannete lahendused

Vanem rühm (9. ja 10. klass)

18. november 2000. a.



$$c_1(\text{KMnO}_4) = \frac{1}{5} \cdot 0,5194 \text{ g} \cdot \frac{1 \text{ mol}}{278,2 \text{ g}} \cdot \frac{1}{10 \cdot 0,0400 \text{ l}} = 9,34 \cdot 10^{-4} \sim \mathbf{9,3 \times 10^{-4} \text{ mol/l}}$$

$$c_2(\text{KMnO}_4) = 4 \cdot 9,34 \cdot 10^{-4} \text{ mol/l} = \mathbf{3,73 \times 10^{-3} \text{ mol/l} \sim 3,7 \times 10^{-3} \text{ mol/l}}$$

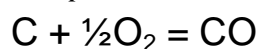
c) Raud(II)sulfaat-7-vesi, raudvitriol

d) Värvitu lahus muutub heleroosaks KMnO_4 lahuse tekke tõttu.

2. a) $\Delta H_{\text{tekke}}^0(\text{CO}_2) = -393 \text{ kJ/mol}$

$$\Delta H_{\text{tekke}}^0(\text{CO}_2) = \Delta H_{\text{põlem}}^0(\text{C})$$

$$\Delta H_{\text{põlem}}^0(\text{CO}) = -566 \text{ kJ/2 mol} = -283 \text{ kJ/mol}$$



$$\begin{aligned} \Delta H_{\text{tekke}}^0(\text{CO}) &= \Delta H_{\text{põlem}}^0(\text{C}) - \Delta H_{\text{põlem}}^0(\text{CO}) = \\ &= -393 \text{ kJ/mol} - (-283) \text{ kJ/mol} = \mathbf{-110 \text{ kJ/mol}} \end{aligned}$$

b) $n(\text{grafiit}) = 1000 \text{ g} \cdot \frac{1 \text{ mol}}{12,0 \text{ g}} = 83,33 \text{ mol}$

$n(\text{CO}) \cdot 28 \text{ g/mol} = 4 \cdot [83,33 \text{ mol} - n(\text{CO})] \cdot 44,0 \text{ g/mol}$, sest CO mass on 4 korda CO_2 massist suurem.

$$n(\text{CO}) = 71,9 \text{ mol}$$

$$n(\text{CO}_2) = 11,4 \text{ mol}$$

c) $V_M = 22,4 \frac{\text{dm}^3}{\text{mol}} \cdot \frac{298 \text{ K}}{273 \text{ K}} = 24,45 \text{ dm}^3/\text{mol}$

$$V(\text{CO}) = 71,9 \text{ mol} \cdot 24,45 \text{ dm}^3/\text{mol} \approx \mathbf{1760 \text{ dm}^3}$$

$$V(\text{CO}_2) = 11,4 \text{ mol} \cdot 24,45 \text{ dm}^3/\text{mol} \approx \mathbf{279 \text{ dm}^3}$$

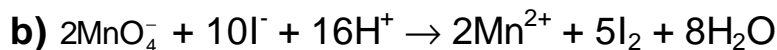
d) $DH^0 = 71,9 \text{ mol} \cdot (-110) \text{ kJ/mol} + 11,4 \text{ mol} \cdot (-393) \text{ kJ/mol} =$
 $= -7909 \text{ kJ} - 4480 \text{ kJ} \gg \mathbf{-12,4 \text{ MJ}}$

3. Kolb No 1

a) $n(\text{KMnO}_4) = 2 \text{ cm}^3 \cdot 0,02 \text{ mol/dm}^3 = 0,04 \text{ mmol}$

$n(\text{H}_2\text{SO}_4) = 60 \text{ cm}^3 \cdot 3 \text{ mol/dm}^3 = 180 \text{ mmol}$

$$n(\text{KI}) = \frac{20 \text{ cm}^3 \cdot 1,1 \text{ g/cm}^3 \cdot 0,1}{166 \text{ g/mol}} = 13,25 \text{ mmol}$$



c) $\text{I}_2 + \text{tärklis} \rightarrow \text{tumesinine kompleks} \rightarrow \text{lahus on musta värv}$

Kolb No 2

a) $n(\text{Na}_2\text{S}_2\text{O}_3) = 3 \text{ cm}^3 \cdot 0,10 \text{ mol/dm}^3 = 0,3 \text{ mmol}$

$n(\text{NaOH}) = 0,1 \text{ cm}^3 \cdot 5 \text{ mol/dm}^3 = 0,5 \text{ mmol}$

c) $\text{NaOH} \rightleftharpoons \text{Na}^+ + \text{OH}^- \rightarrow \text{aluseline keskkond} \rightarrow \text{fenooltaleiin} - \text{punane}$

Kolb No 3

a) $n(\text{MgSO}_4 \cdot 7\text{H}_2\text{O}) = n(\text{MgSO}_4) = \frac{71 \text{ g}}{246,3 \text{ g/mol}} \cdot \frac{1}{2} = 144 \text{ mmol}$

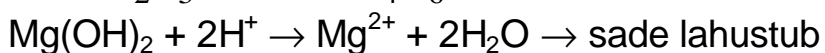
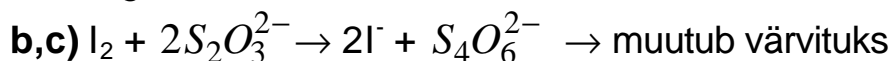
$n(\text{NH}_3 \cdot \text{H}_2\text{O}) = 60 \text{ cm}^3 \cdot 5 \text{ mol/dm}^3 = 300 \text{ mmol}$



valge suspensioon \rightarrow valge sade

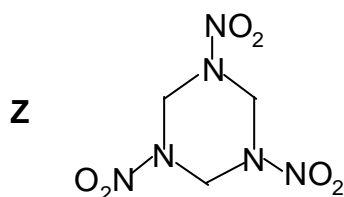
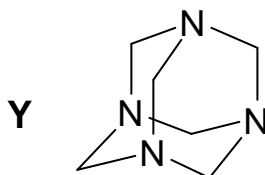
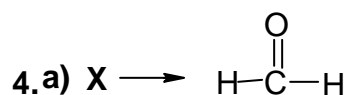
Keeduklaas

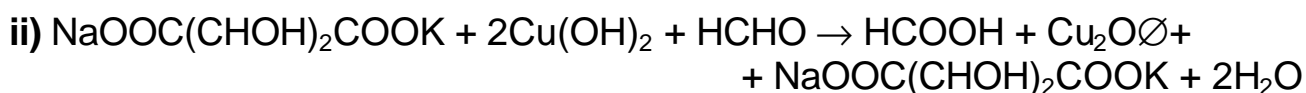
Üheaegsel kokkuvalamisel



Musta, punase ja valge (suspensioon) lahuse kokkuvalamisel

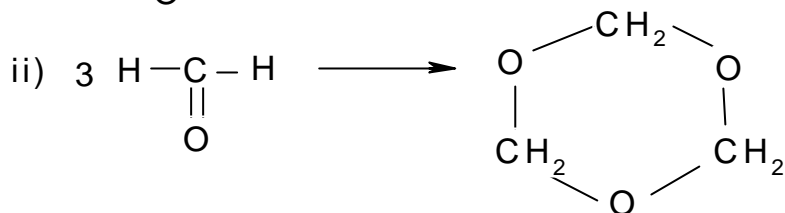
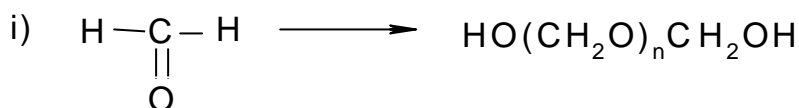
tekib värvitu lahus.



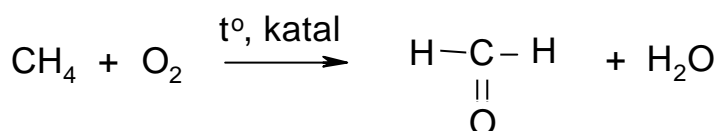
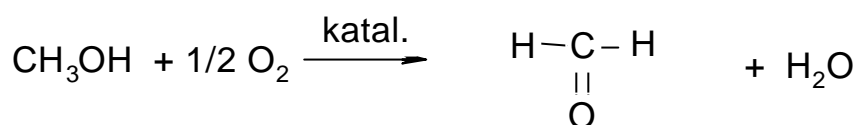


c) i) formaliin; ii) urotropiin.

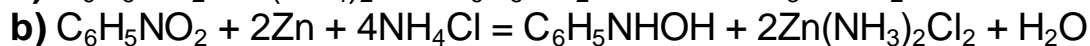
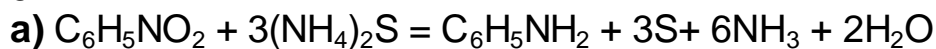
d)



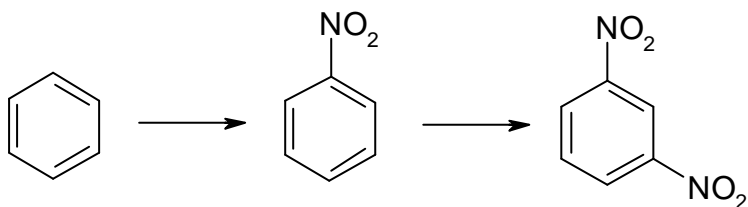
e)



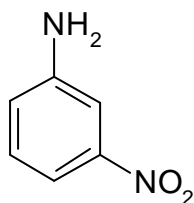
5.



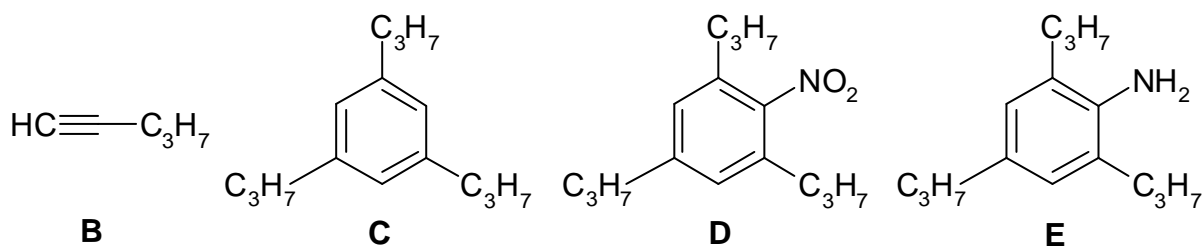
c) Benseeni nitreerimine:



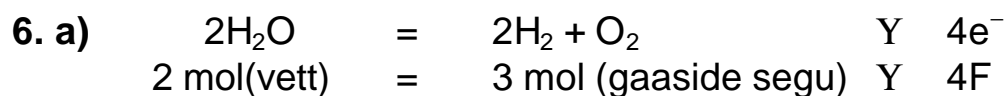
d) Ammooniumvesiniksulfiidiga redutseerimisel tekib m-nitroaniliin mis sisaldab 20.3% lämmastikku.



e) Konts. väävelhape juuresolekul alküünid trimeriseeruvad, andes 1,3,5-trialküülbenseeni.



f) 1,3,5-tripropüülbenseen sisaldab kolm +R rühma ja seetõttu omab olulist nukleofiilset iseloomu elektrofiilse asenduse reaktsioonidel. Tavaliste nitreerimise tingimuste kasutamisel areeni tuuma sisse läheb kaks kuni kolm nitrorühma ja mononitroderivaati ei õnnestu saada.



b) anum A:

$$0,935 \text{ g} \quad 5,00\text{A} \cdot 0,5\text{tundi} \cdot \frac{30 \text{ min}}{\text{tund}} \cdot \frac{60\text{s}}{\text{min}} = 9000 \text{ As}$$



$$\frac{0,935 \text{ g}}{M(\text{H}_2\text{O})} = \frac{2}{4} \cdot 0,09326 \text{ mol}$$

$$M(\text{H}_2\text{O}) = 2 \cdot 0,935 \text{ g} \cdot \frac{1}{0,09326 \text{ mol}} = 20,0 \text{ g/mol}$$

anum B:

$$M(\text{H}_2\text{O}) = 2 \cdot 0,841 \text{ g} \cdot \frac{1}{0,09326 \text{ mol}} = 18,0 \text{ g/mol}$$

c) Kuna vee mass ning molaarmass pole teada, siis on otstarbekas koostada võrrand, mille mõlemad pooled väljendavad võrdseid masse.

anum A: $2 \text{ mol} \cdot M(\text{vesi}) = 3 \text{ mol} \cdot M(\text{gaaside segu})$

$$M(\text{vesi}) = 3 \text{ mol} \cdot 0,595 \text{ g/dm}^3 \cdot 22,4 \text{ dm}^3/\text{mol}$$

$$M(\text{vesi}) = 3 \text{ mol} \cdot 0,595 \frac{\text{g}}{\text{dm}^3} \cdot 22,4 \frac{\text{dm}^3}{\text{mol}} \cdot \frac{1}{2 \text{ mol}} = 20,0 \text{ g/mol}$$

anum B:

$$M(\text{vesi}) = 3 \text{ mol} \cdot 0,536 \frac{\text{g}}{\text{dm}^3} \cdot 22,4 \frac{\text{dm}^3}{\text{mol}} \cdot \frac{1}{2 \text{ mol}} = 18,0 \text{ g/mol}$$

d) Et mõlema vee korral on reaktsioonis osalenud ainete hulgad samad, siis peab rasket vett rohkem kuluma ja raske vee elektrolüüsisaaduste segu on suurema tihedusega.