

**Keemia lahtine võistlus**  
**Ülesannete lahendused**  
*Noorem aste (9. ja 10. klass)*  
 28. november 1998. a.

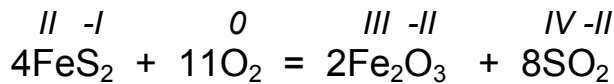
1.  $m(\text{Ni}) = 0,50 \text{ g} \cdot 0,0025 = 0,00125 \text{ g}$   
 $n(\text{Ni}) = \frac{0,00125 \text{ g}}{58,7 \text{ g/mol}} = 0,0000212 \text{ mol}$

$$V(\text{lahus}) = \frac{0,0000212 \text{ mol}}{0,000045 \text{ mol/dm}^3} = 0,471 \text{ dm}^3$$

$$V(\text{lahus}) = \frac{0,0000212 \text{ mol}}{0,000075 \text{ mol/dm}^3} = 0,283 \text{ dm}^3$$

**Sobib 500 cm<sup>3</sup> mõõtkolb.**

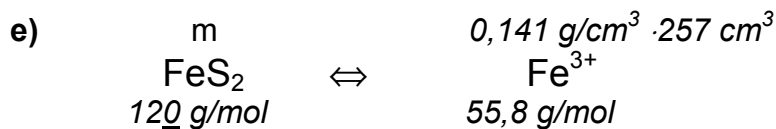
2. a) ja c)



b) Raud ja väävel oksüdeeruvad.  
 Hapnik redutseerub.

d) 
$$\begin{array}{ccc} 0,141 \text{ g/cm}^3 \cdot 257 \text{ cm}^3 & & V \\ 4\text{Fe}^{3+} & \Leftrightarrow & 8 \text{SO}_2 \\ 55,8 \text{ g/mol} & & 22,4 \text{ dm}^3/\text{mol} \end{array}$$
  

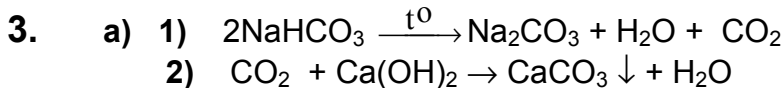
$$V(\text{SO}_2) = \frac{8}{4} 257 \text{ cm}^3 \cdot \frac{0,141 \text{ g}}{\text{cm}^3} \cdot \frac{\text{mol}}{55,8 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} \approx \mathbf{29,1 \text{ dm}^3}$$



$$m(\text{FeS}_2) = \frac{1}{1} 257 \text{ cm}^3 \cdot 0,141 \text{ g/cm}^3 \cdot \frac{1 \text{ mol}}{55,8 \text{ g}} \cdot 120 \text{ g/mol} \approx \mathbf{77,9 \text{ g}}$$

$$m(\text{lisandid}) = 100 \text{ g} - 77,9 \text{ g} \approx \mathbf{20 \text{ g}}$$

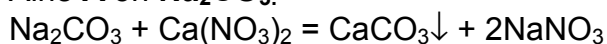
$$\%(\text{lisandid}) = (20/100) \cdot 100 = \mathbf{20 \%}$$



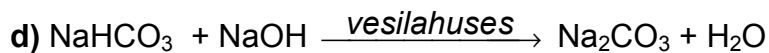
b) 
$$\begin{array}{ccc} 25,0 \text{ g} \cdot 0,212 & & 5,00 \text{ g} \\ \mathbf{A} & \Leftrightarrow & \text{CaCO}_3 \\ M & & 100 \text{ g/mol} \end{array}$$
  

$$M(\mathbf{A}) = \frac{1}{1} 100 \text{ g/mol} \cdot \frac{1}{5,00 \text{ g}} \cdot 25,0 \text{ g} \cdot 0,212 = \mathbf{106 \text{ g/mol}}$$

Aine **A** on **Na<sub>2</sub>CO<sub>3</sub>**.



c) Pulber **X** koosneb NaHCO<sub>3</sub> ja NaOH ekvimolaarsetest kogustest.



4. a)  $M(\text{amü}) = 1 \text{ g/mol}$

$$M(\text{elektron}) = \frac{1}{1823} \text{ g/mol} = 5,485 \cdot 10^{-4} \text{ g/mol}$$

b) Elektronide hulk ühes grammis aines **A** on

$$n(\text{elektron}) = 1 \text{ g} \cdot \frac{0,3048 \text{ g}}{1000 \text{ g}} \cdot \frac{1 \text{ mol}}{(1/1823) \text{ g}} = 0,5556 \text{ mol}$$

c) Üks mool elektrone on aine **A** massis:

$$m(\text{A}) = 1 \text{ mol} \cdot \frac{1 \text{ g}}{0,5556 \text{ mol}} = 1,8 \text{ g}$$

$n(\text{elektron})$	$m(\text{A})$
5 mol	9 g
10 mol	18 g
15 mol	27 g
20 mol	36 g

Sobib ainult elektronide arv 10 mol  $\Rightarrow M(\text{A}) = 18 \text{ g/mol}$

Aineks **A** on **vesi (H<sub>2</sub>O)**.

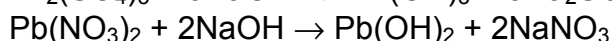
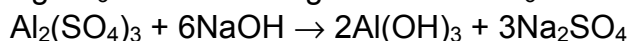
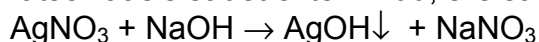
5. a)  $\text{BaS}$  - baariumsulfiid                       $\text{Al}(\text{NO}_3)_3$  - alumiiniumnitraat  
 $\text{Ba}(\text{NO}_3)_2$  - baariumnitraat                       $\text{Al}_2(\text{SO}_4)_3$  - alumiiniumsulfaat  
 $\text{BaI}_2$  - baariumjodiid                               $\text{AlI}_3$  - alumiiniumjodiid
- $\text{AgNO}_3$  - hõbenitraat                               $\text{Pb}(\text{NO}_3)_2$  - plii(II)nitraat

b) Võimalikes variantides esinevad sulfiid-, sulfaat-, hõbe- ja plii-ioonid üks kord.

Järelikult võimalikuks neljaks soolaks on:

**BaS; AgNO<sub>3</sub>; Pb(NO<sub>3</sub>)<sub>2</sub>; Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>.**

Viies sool peab olema jodiid (**BaI<sub>2</sub> või AlI<sub>3</sub>**). Et NaOH lahusega kahes katseklaasis sadet ei tekkinud, siis saab jodiidina esineda ainult **baarium**.



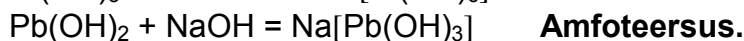
nr. 1. **BaI<sub>2</sub> või BaS**

nr. 2. **AgNO<sub>3</sub>**

nr. 3. **Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub> või Pb(NO<sub>3</sub>)<sub>2</sub>**

nr. 4. **BaS või BaI<sub>2</sub>**

nr. 5. **Pb(NO<sub>3</sub>)<sub>2</sub> või Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>**



6. Lähteained on vesi ja õli.

a) Vesi + õli + elavhõbe. Vedelikud ei segune.

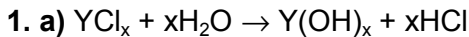
b) Vesi + õli + atsetoon. Atsetoon lahustub vees (vees lahustub ka piiritus).

c) Vesi + õli + pindaktiivne aine. Näiteks seebi lahus.

d) Vesi + õli + vedel fluor (F<sub>2</sub>). Fluor on tugev oksüdeerija. Reaktsioon on eksotermiline ja toimub plahvatusega. Kõik reaktsioonisaadused lähevad gaasifaasi.

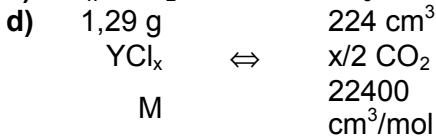
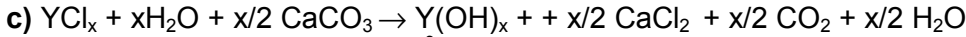
e) Vesi + õli + vedel N<sub>2</sub> (keemistemperatuur -196°C). Vesi külmub, õli tahkub ja lämmastik aurustub.

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b)  $M(\text{gaas}) = 29,0 \text{ g/mol} \cdot 1,52 = 44,08 \text{ g/mol}$

Gaas **C** on **CO<sub>2</sub>**



$$1,29 \cdot \frac{1}{M(A)} = \frac{1}{x/2} \cdot \frac{224 \text{ cm}^3}{22400 \text{ cm}^3/\text{mol}}$$

$$M(A) = \frac{x \cdot 22400 \text{ cm}^3}{2 \cdot 224 \text{ cm}^3} \cdot 1,29 \text{ g} = x \cdot 64,5 \text{ g/mol}$$

e)  $M(Y) = x \cdot 64,5 \text{ g/mol} - x \cdot 35,5 \text{ g/mol} = 29x$

kui  $x = 1$  siis  $M(Y) = 29$

g/mol

$x = 2$  siis  $M(Y) = 58$

g/mol

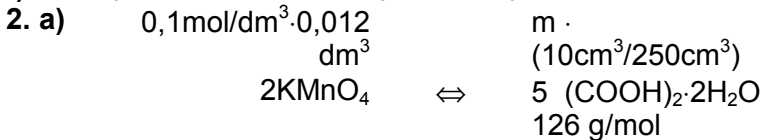
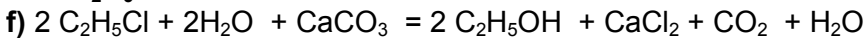
$x = 3$  siis  $M(Y) = 87$

g/mol

Ükski metall nendele tingimustele ei vasta, küll aga vastab etüülradikaal:

**A - C<sub>2</sub>H<sub>5</sub>Cl**

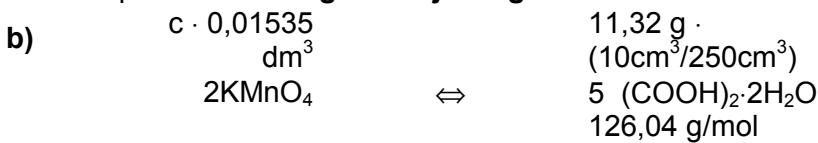
**B - C<sub>2</sub>H<sub>5</sub>OH**



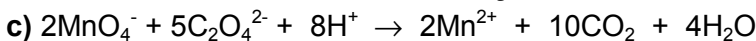
$$m_{\min} [(COOH)_2 \cdot 2H_2O] = \frac{5}{2} \cdot 0,1 \frac{\text{mol}}{\text{dm}^3} \cdot 0,012 \text{ dm}^3 \cdot 126 \frac{\text{g}}{\text{mol}} \cdot \frac{250 \text{ cm}^3}{10 \text{ cm}^3} = 9,45 \text{ g}$$

$$m_{\max} [(COOH)_2 \cdot 2H_2O] = \frac{5}{2} \cdot 0,1 \frac{\text{mol}}{\text{dm}^3} \cdot 0,017 \text{ dm}^3 \cdot 126 \frac{\text{g}}{\text{mol}} \cdot \frac{250 \text{ cm}^3}{10 \text{ cm}^3} = 13,4 \text{ g}$$

Kaalutis peaks olema **9 grammi ja 14 grammi vahel**.



$$c(KMnO_4) = \frac{2}{5} \cdot 11,32 \text{ g} \cdot \frac{10 \text{ cm}^3}{250 \text{ cm}^3} \cdot \frac{1 \text{ mol}}{126,04 \text{ g}} \cdot \frac{1}{0,01535 \text{ dm}^3} = 0,09362 \frac{\text{mol}}{\text{dm}^3}$$

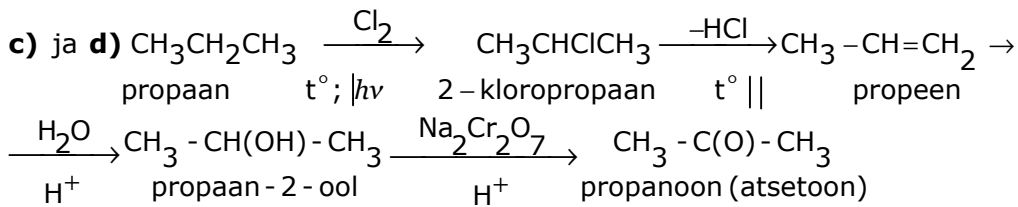


3. a)  $M(Z) = 2,0 \text{ g/mol} \cdot 21 = 42 \text{ g/mol}$

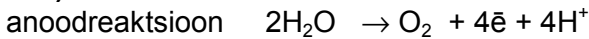
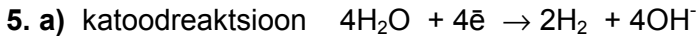
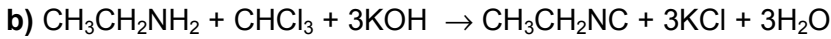
b)  $n(c) = \frac{22,4 \text{ dm}^3}{0,112 \text{ dm}^3} \cdot 0,66 \text{ g} \cdot \frac{1 \text{ mol}}{44 \text{ g}} = 3 \text{ mol}$

b)  $n(H) = (42 \text{ g} - 36 \text{ g}) \cdot \frac{1 \text{ mol}}{1,0 \text{ g}} = 6 \text{ mol}$

Ühend **Z** on **C<sub>3</sub>H<sub>6</sub>**



4. a) **A** -  $\text{CH}_3\text{CH}_2\text{CN}$ ; etüülitril  
**B** -  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ ; propüülamiin  
**C** -  $\text{CH}_3\text{CH}_2\text{COOH}$ ; propaanhape  
**D** -  $\text{NH}_3$ ; ammoniaak  
**E** -  $\text{CH}_3\text{CH}_2\text{NC}$ ; etüülisonitril  
**F** -  $\text{CH}_3\text{CH}_2\text{NHCH}_3$ ; etüülmetüülamiin  
**G** -  $\text{CH}_3\text{CH}_2\text{NH}_2$ ; etüülamiin  
**H** -  $\text{HCOOH}$ ; metaanhape



b)  $V_m = 0,0820 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 293\text{K} \cdot \frac{1}{750\text{mm Hg}} \cdot \frac{750\text{mm Hg}}{1\text{atm}} = 24,3 \frac{\text{dm}^3}{\text{mol}}$

$t \cdot 3,50\text{A} \quad 1,00 \text{ dm}^3$   
 $4 \text{ e}^- \Leftrightarrow 3 \text{ (paukgaas)}$   
 $96500 \quad 24,3$   
 $\text{A} \cdot \text{s/mol} \quad \text{dm}^3/\text{mol}$

$t = \frac{4}{3} \cdot 1,00 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{24,3 \text{ dm}^3} \cdot 96500 \text{ A} \cdot (\text{s/mol}) \cdot \frac{1}{3,50 \text{ A}} \cdot \frac{1 \text{ min}}{60 \text{ sek}} = 25,2 \text{ min}$

c)  $m(\text{lahus}) = \frac{20,00\text{g}}{0,1700} = 117,65 \text{ g}$

$m(\text{reageerinud H}_2\text{O}) = 120,00 \text{ g} - 117,65 \text{ g} = 2,35 \text{ g}$

$2 \text{ e}^- = \frac{t \cdot 3,50\text{A}}{96500 \text{ A} \cdot \text{s/mol}} \cdot \frac{2,35 \text{ g}}{18,0 \text{ g/mol}}$

$t = \frac{2}{1} \cdot 2,35\text{g} \cdot \frac{1 \text{ mol}}{18,0\text{g}} \cdot 96500 \text{ A} \cdot (\text{s/mol}) \cdot \frac{1}{3,50 \text{ A}} \cdot \frac{1 \text{ h}}{3600 \text{ sek}} = 2,00 \text{ h}$

6. a) **A** -  $\text{H}_2\text{O}$ , vesi

**B** -  $\text{C}_2\text{H}_5\text{OH}$ , etanool

