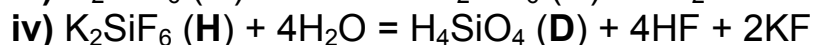
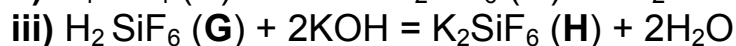
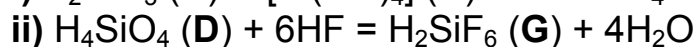
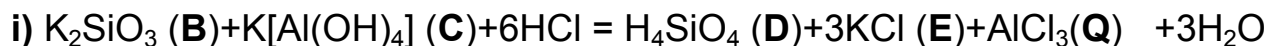


Keemia lahtise võistluse ülesannete lahendused

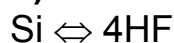
Vanem rühm (11. ja 12. klass)

13. november 2004. a.

1. a)



b) Reaktsioonivõrrandist v) saame vastavuse



$$\%(\text{Si}) = \frac{1}{4} \cdot 0,09296 \text{ mol} \cdot 28,09 \text{ g/mol} \cdot \frac{1}{3,000 \text{ g}} \cdot 100 = \mathbf{21,76}$$

c) Vöttes aluseks täpselt 100 g savi saame

$$m(\text{H}) = 100 - 20,90 - 21,76 - 55,78 = 1,56 \text{ g}$$

$$n(\text{Al}) = \frac{20,90}{26,98} = 0,7746 \text{ mol}$$

$$n(\text{Si}) = \frac{21,76}{28,09} = 0,7747 \text{ mol}$$

$$n(\text{H}) = \frac{1,56}{1,008} = 1,55 \text{ mol}$$

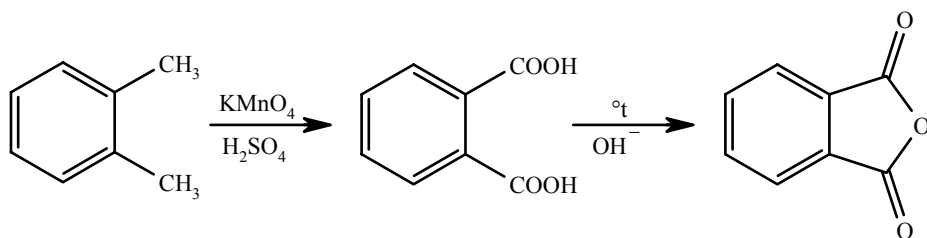
$$n(\text{O}) = \frac{55,78}{16,00} = 3,486 \text{ mol}$$

$$n(\text{Al}):n(\text{Si}):n(\text{H}):n(\text{O}) = 0,7746:0,7747:1,55:3,486 \approx 1:1:2:4,5 \approx 2:2:4:9$$

Brutovalem on $Al_2Si_2H_4O_9$, esitatuna oksiidide kaudu



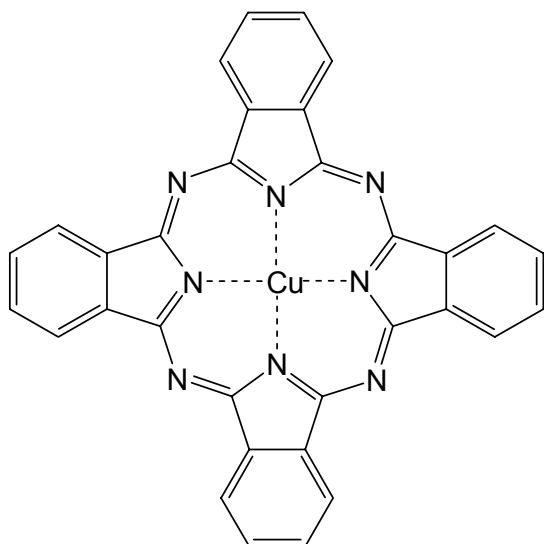
2. a)



b) $\%(\text{H}) = 100 - 66,7 - 19,5 - 11,0 = 2,8$

$$C : H : N : Cu = \frac{66,7}{12,0} : \frac{2,8}{1,0} : \frac{19,5}{14,0} : \frac{11,0}{63,5} = 32 : 16 : 8 : 1$$

Vaskftalotsüaniini brutovalem – $C_{32}H_{16}N_8Cu$



c) **A** – 2-tsüanobensamiid

B – benseen-1,2-dikarboksüülhappe anhüdriid

3. a) $M = \frac{m}{n}$; $n = \frac{V}{V_M}$; $V_M = \frac{R \cdot T}{p}$

$$M(\text{K}) = 2,86 \text{ kg/m}^3 \cdot 8,314 \text{ N}\cdot\text{m}/(\text{K}\cdot\text{mol}) \cdot 298 \text{ K} \cdot \frac{1\text{m}^2}{10^5 \text{ N}} = 7,086 \cdot 10^3 \cdot \frac{1}{10^5} \text{ kg/mol} \approx \\ \approx 0,0709 \text{ kg/mol} \approx 70,9 \text{ g/mol}$$

K – kloor (Cl_2)

b) **A** – Au

B – NO

C – $\text{H}[\text{AuCl}_4]$

D – $\text{H}[\text{AuCl}_2]$

E – $\text{Au}(\text{OH})_3$

F – Au_2O_3

G – AuOH

H – Au_2O

I – $[\text{NH}_3\text{AuCl}_3]$

J – $[\text{NH}_3\text{AuCl}]$

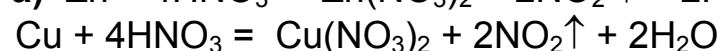
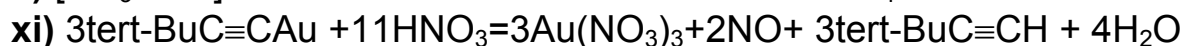
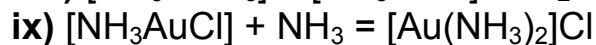
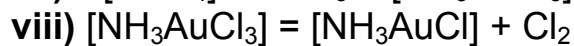
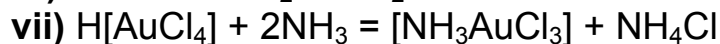
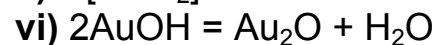
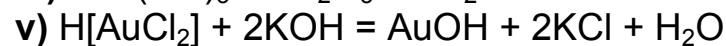
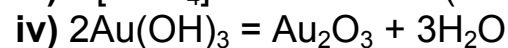
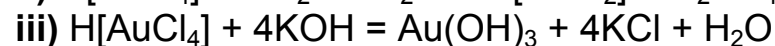
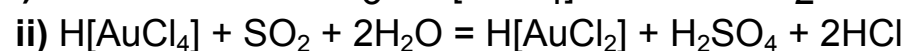
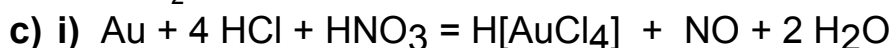
K – Cl_2

L – $[\text{Au}(\text{NH}_3)_2]\text{Cl}$

M – tert-BuC \equiv CAu

N – $\text{Au}(\text{NO}_3)_3$

O – NO



$$\text{b) } n(\text{Zn} + \text{Cu}) = 10 \cdot 9,69 \text{ mL} \cdot 0,02015 \text{ mol/L} \cdot \frac{1 \text{ L}}{1000 \text{ mL}} \cdot \frac{1000 \text{ mmol}}{1 \text{ mol}} = 1,9525 \text{ mmol}$$

Maskeeritakse Cu^{2+} , sest $\text{Cu}^{2+} \rightarrow \text{Cu}^+$

$$n(\text{Zn}) = \frac{100}{25} \cdot 5,93 \text{ mL} \cdot 0,02015 \text{ mol/L} = 0,47796 \text{ mmol} \approx \mathbf{0,478 \text{ mmol}}$$

$$n(\text{Cu}) = 1,9525 \text{ mmol} - 0,47796 \text{ mmol} = 1,4749 \text{ mmol} \approx \mathbf{1,47 \text{ mmol}}$$

$$\text{c) } \%(\text{Zn}) = \frac{0,47796 \text{ mmol} \cdot 65,37 \text{ g/mol}}{125,0 \text{ mg}} = 24,99 \approx \mathbf{25,0}$$

$$\%(\text{Cu}) = 100 - 25,0 = \mathbf{75,0}$$

$$\begin{aligned} \text{5. a) } v &= N \cdot \ln 2 / \tau = \frac{1 \text{ g}}{238 \text{ g/mol}} \cdot 6,022 \cdot 10^{23} \frac{\text{aatomit}}{\text{mol}} \cdot \frac{\ln 2}{87,2 \text{ aastat}} = \\ &= 2,01 \cdot 10^{19} \frac{\text{aatomit}}{\text{aastas}} \cdot \frac{1 \text{ aasta}}{365 \text{ päeva}} = 5,51 \cdot 10^{16} \frac{\text{aatomit}}{\text{päevas}} \cdot \frac{1 \text{ päev}}{24 \text{ h}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = \\ &= \mathbf{6,38 \cdot 10^{11} \text{ aatomit/s}} \end{aligned}$$

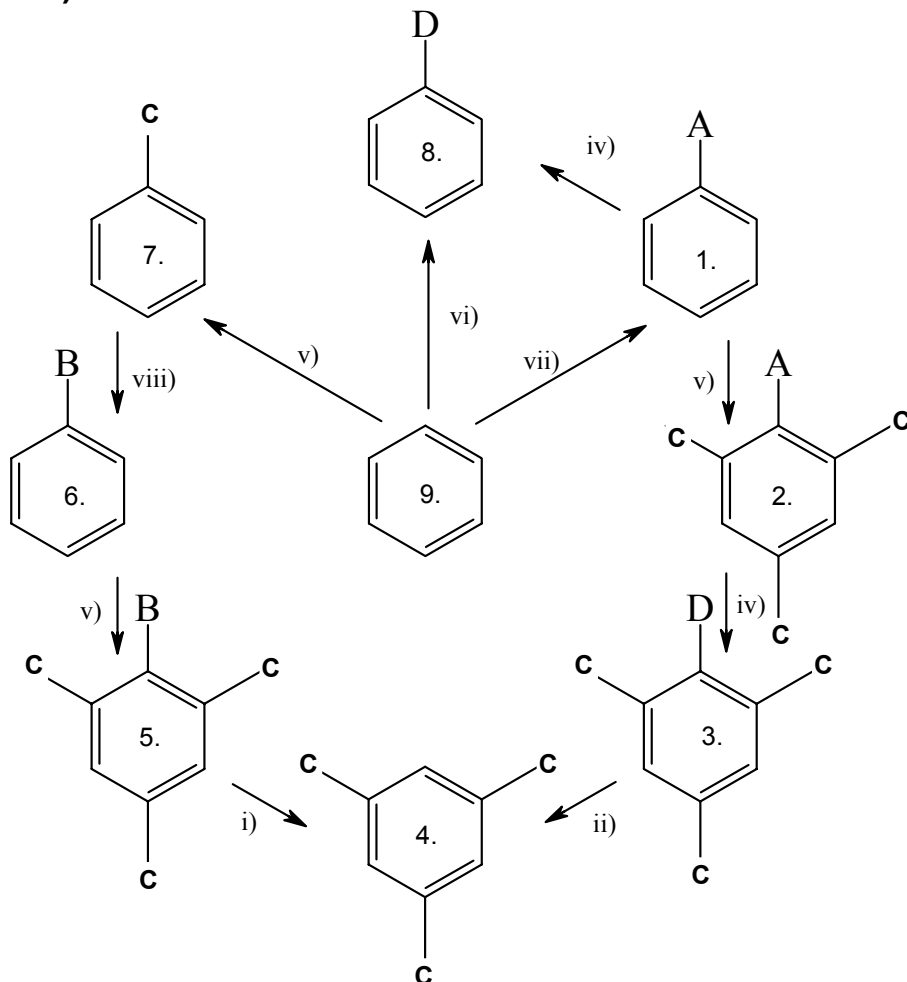
$$\text{b) } E = 8,8 \cdot 10^{-13} \text{ J/aatom} \cdot 6,38 \cdot 10^{11} \text{ aatomit/s} = \mathbf{0,56 \text{ J/s}}$$

$$\text{c) } A_r(\text{Pu}) = 0,71 \cdot 238 + 0,29 \cdot 244 = 239,7 \approx \mathbf{240}$$

$$\begin{aligned} \text{d) } \Delta N &= N_0 - N_0 \cdot e^{-kt} = \frac{2,7 \text{ g}}{272 \text{ g/mol}} \cdot 6,022 \cdot 10^{23} \text{ aatomit/mol} \cdot 0,71 \cdot (1 - e^{-\ln 2 \cdot 10 / 87,2}) = \\ &= \mathbf{3,24 \cdot 10^{20} \text{ aatomit}} \end{aligned}$$

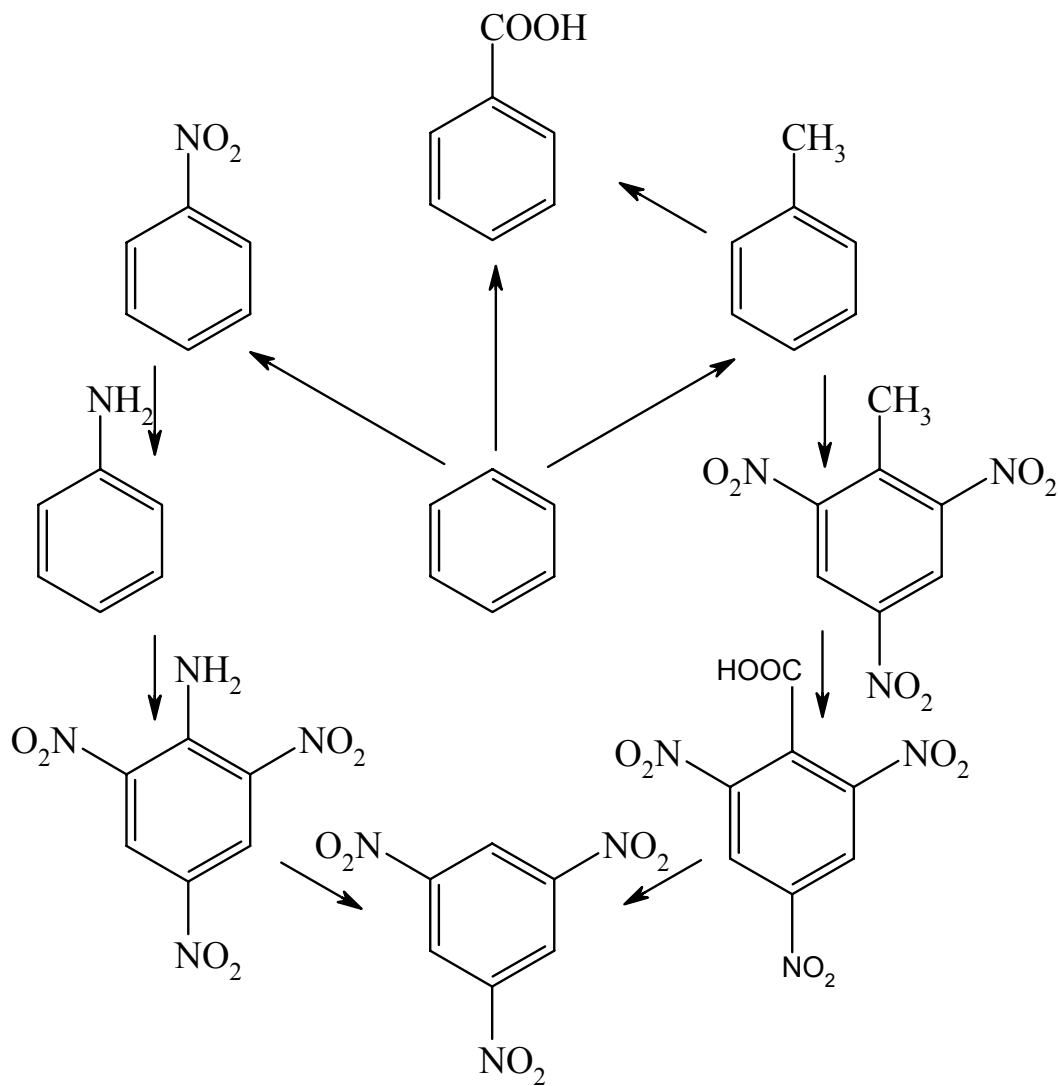
$$E = 8,8 \cdot 10^{-13} \text{ J/aatom} \cdot 3,24 \cdot 10^{20} \text{ aatomit} = 2,9 \cdot 10^8 \text{ J} \cdot \frac{1 \text{ kWh}}{3,6 \cdot 10^6 \text{ J}} = 79,2 \text{ kWh} \approx \mathbf{79 \text{ kWh}}$$

6. a)



- A - metüül
- B - amiin
- C - nitro
- D - karboksüül

b)



- 1 – metüülbenseen, toluen
- 2 – 2,4,6–trinitro–1–metüülbenseen
- 3 – 2,4,6–trinitrobensoehape
- 4 – 1,3,5–trinitrobenseen
- 5 – 2,4,6–trinitroaniliin

- 6 – aniliin
- 7 – nitrobenseen
- 8 – bensoehape
- 9 – benseen