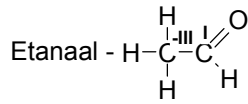
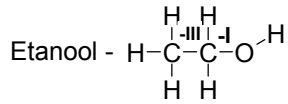
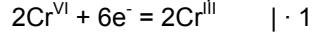
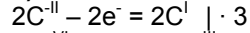
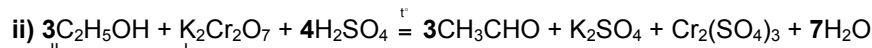
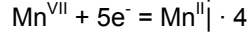
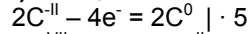
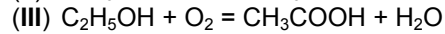
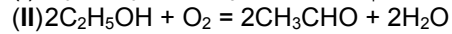
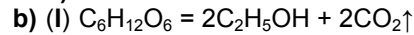
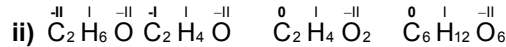
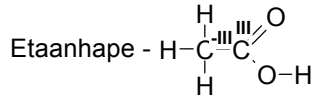


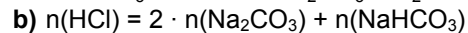
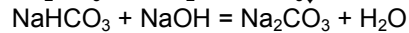
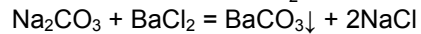
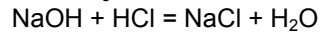
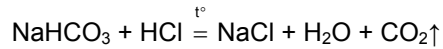
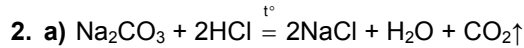
2006/2007 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
9. klass



1. a) i)



d) KMnO_4



$$n(\text{HCl}) = \left(50 \text{ cm}^3 \cdot \frac{0,01255 \text{ mol}}{1 \text{ dm}^3} - 2,34 \text{ cm}^3 \cdot \frac{0,01063 \text{ mol}}{1 \text{ dm}^3} \right) \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} =$$

$$= (6,275 \cdot 10^{-4} - 0,2487 \cdot 10^{-4}) \text{ mol} = 6,026 \cdot 10^{-4} \text{ mol}$$

$$n(\text{NaHCO}_3) = n(\text{NaOH}) = \left(25 \text{ cm}^3 \cdot \frac{0,01063 \text{ mol}}{1 \text{ dm}^3} - 7,63 \text{ cm}^3 \cdot \frac{0,01255 \text{ mol}}{1 \text{ dm}^3} \right) \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = (2,658 - 0,958) \cdot 10^{-4} \text{ mol} = 1,700 \cdot 10^{-4} \text{ mol}$$

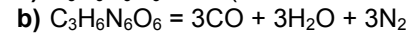
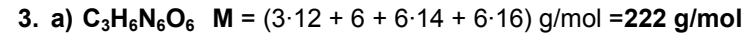
$$n(\text{Na}_2\text{CO}_3) = \frac{1}{2} \cdot (6,026 \cdot 10^{-4} \text{ mol} - 1,700 \cdot 10^{-4} \text{ mol}) = 2,163 \cdot 10^{-4} \text{ mol}$$

$$m(\text{Na}_2\text{CO}_3) = \frac{250 \text{ cm}^3}{25 \text{ cm}^3} \cdot 2,163 \cdot 10^{-4} \text{ mol} \cdot \frac{105,99 \text{ g}}{1 \text{ mol}} = 0,2293 \text{ g}$$

$$m(\text{NaHCO}_3) = 10 \cdot 1,700 \cdot 10^{-4} \text{ mol} \cdot \frac{84,007 \text{ g}}{1 \text{ mol}} = 0,1428 \text{ g}$$

$$\%(\text{Na}_2\text{CO}_3) = \frac{0,2293 \text{ g}}{0,5 \text{ g}} \cdot 100 = 45,85$$

$$\%(\text{NaHCO}_3) = \frac{0,1428 \text{ g}}{0,5 \text{ g}} \cdot 100 = 28,56$$



$$c) V(\text{tahke } \text{C}_3\text{H}_6\text{N}_6\text{O}_6) = 1 \text{ mol} \cdot \frac{222 \text{ g}}{1 \text{ mol}} \cdot \frac{1 \text{ cm}^3}{1,8 \text{ g}} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 0,123 \text{ dm}^3$$

$V(\text{C}_3\text{H}_6\text{N}_6\text{O}_6 \text{ plahvatusgaasid}) =$

$$= \frac{nRT}{p} = 9 \text{ mol} \cdot 0,082 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 2600 \text{ K} \cdot \frac{1}{1 \text{ atm}} = 1920 \text{ dm}^3$$

$$\text{Ruumalade suhe} = \frac{1920 \text{ dm}^3}{0,123 \text{ dm}^3} = 15600 \approx 16000$$

4. a) Oletame, et mahla on täpselt 1 dm^3 .

$$m(\text{bensoehape}) = 1 \text{ dm}^3 \cdot \frac{200 \text{ mg}}{1 \text{ dm}^3} \cdot \frac{1 \text{ g}}{1000 \text{ mg}} = 0,2 \text{ g}$$

$$m(\text{mahl}) = 1 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{1,08 \text{ g}}{1 \text{ cm}^3} = 1080 \text{ g}$$

$$\%(\text{bensoehape}) = \frac{0,2 \text{ g}}{1080 \text{ g}} \cdot 100 = 0,0185$$

$$b) V(\text{mahl}) = 100 \text{ g} \cdot \frac{100}{0,0185} \cdot \frac{1 \text{ cm}^3}{1,08 \text{ g}} \cdot \frac{1 \text{ m}^3}{10^6 \text{ cm}^3} = 0,501 \text{ m}^3$$

$$c) m(\text{mahl, enne aurutamist}) = \frac{1080 \text{ g}}{2} = 540 \text{ g}$$

$$m(\text{bensoehape}) = 540 \text{ g} \cdot 0,000185 = 0,0999 \text{ g}$$

$$m(\text{mahl, peale aurutamist}) = 540 \text{ g} \cdot (1 - 0,03) = 523,8 \text{ g}$$

$$\%(\text{bensoehape}) = \frac{0,0999 \text{ g}}{523,8 \text{ g}} \cdot 100 = 0,0191$$

d) x – lisatava 0,05 % lahuse mass

$$900 \text{ g} \cdot 0,0001 + x \cdot 0,0005 = 0,03 \%$$

$$900 \text{ g} + x = 100 \%$$

$$900 \text{ g} \cdot 0,0001 + x \cdot 0,0005 = (900 \text{ g} + x) \cdot 0,0003$$

$$0,0002x = 0,18 \text{ g} \quad \mathbf{m(\text{lisatav } 0,05 \% \text{ lahuse}) = x = 900 \text{ g}}$$

5. a) A – HgO, elavhõbe(II)oksiid

B – Hg, elavhõbe

C – O₂, hapnik

D – Hg(NO₃)₂, elavhõbe(II)nitraat

E – H₂O, vesi

F – NO₂, lämmastikdioksiid

G – H₂SO₄, väävelhape

H – SO₃, vääveltrioksiid

I – SO₂, vääveldioksiid

b) i) $2\text{HgO} \xrightarrow{t} 2\text{Hg} + \text{O}_2\uparrow$

ii) $\text{Hg} + 4\text{HNO}_3 \text{ (konts.)} = \text{Hg}(\text{NO}_3)_2 + 2\text{NO}_2\uparrow + 2\text{H}_2\text{O}$

iii) $\text{Hg} + 2\text{H}_2\text{SO}_4 = \text{HgSO}_4 + \text{SO}_2\uparrow + 2\text{H}_2\text{O}$

iv) $\text{SO}_3 + \text{H}_2\text{O} = \text{H}_2\text{SO}_4$

v) $\text{SO}_2 + 2\text{H}_2\text{S} = 3\text{S} + 2\text{H}_2\text{O}$

6. a) X – N, element lämmastik

A – N₂, lämmastik

B – NH₄NO₂, ammooniumnitrit

C – Li, liitium

D – Li₃N, liitiumnitriid

E – N₂O, dilämmastikoksiid

F – NO, lämmastikmonooksiid

G – NO₂, lämmastikdioksiid

H – HNO₂, lämmastikhape

I – HNO₃, lämmastikhape

J – NH₃, ammoniaak

b) i) $\text{NH}_4\text{NO}_2 \xrightarrow{t} \text{N}_2\uparrow + 2\text{H}_2\text{O}$

ii) $6\text{Li} + \text{N}_2 = 2\text{Li}_3\text{N}$

iii) $2\text{NO} + \text{O}_2 = 2\text{NO}_2$

iv) $2\text{NO}_2 + \text{H}_2\text{O} = \text{HNO}_2 + \text{HNO}_3$

v) $3\text{HNO}_2 = \text{HNO}_3 + 2\text{NO} + \text{H}_2\text{O}$

vi) $\text{NH}_4\text{NO}_3 \xrightarrow{t} \text{N}_2\text{O} + 2\text{H}_2\text{O}$

vii) $2\text{NH}_3 + \text{CO}_2 = \text{CO}(\text{NH}_2)_2 + \text{H}_2\text{O}$