

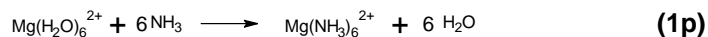
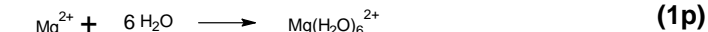
2011/2012 õ.a. keemiaolümpiaadi piirkonnavooru ülesannete lahendused

10. klass

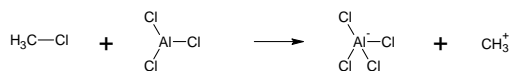
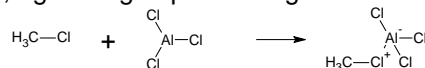
1. a) Happed: i, iii, iv ja alused: ii, v, vi
vii) ei ole hape ega alus

(7*0,5p = 3,5p)

b)



- c) Kaks varianti, aga laengud peavad õiged olema.



Süsinik muutub palju elektrofiilsemaks (CH_3^+ , seega kompleksis suurem positiivne osalaeng) ja seega reaktiivsemaks/Karbkatioon muutub stabiilsemaks või mõni muu analoogne näide (võrrand 1p + seletus 0,5p)

(1,5p)

(kokku 7p)

2. a) A- NH_3 – ammoniaak (valem 0,25 p+nimetud 0,25 p)

B - N_2 – lämmastik

C - H_2O – vesi (divesinikoksiid)

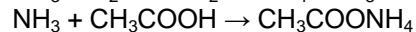
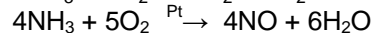
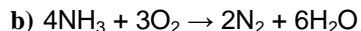
D - NO – lämmastik(II)oksiid

E - $(\text{NH}_4)_2\text{CO}_3$ – ammooniumkarbonaat

F - NH_4HCO_3 – ammooniumvesinikarbonaat

G - $\text{CH}_3\text{COONH}_4$ – ammooniumatsetaat (ammooniummetanaat)

(7*0,5p = 3,5 p)



(5*1p = 5p)

(kokku 8,5p)

3.

$$PV = nRT$$

a) $n(B) = \frac{PV}{RT} = \frac{101300 \text{ Pa} \cdot 0,211 \cdot 10^{-3} \text{ m}^3}{8,314 \text{ J/(K} \cdot \text{mol)} \cdot 298 \text{ K}} \approx 8,63 \cdot 10^{-3} \text{ mol}$ (1p)

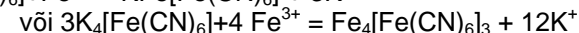
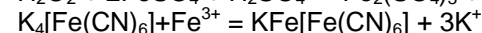
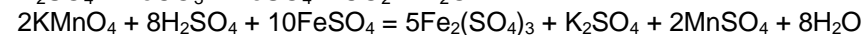
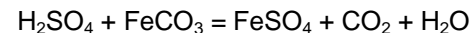
$$M(B) = \frac{m}{n} = \frac{0,38 \text{ g}}{8,63 \cdot 10^{-3} \text{ mol}} \approx 44 \text{ g/mol}$$
 (1p)

b) X – FeCO_3

Y – CO_2

Z – FeSO_4

(3*0,5p = 1,5p)



(4*1p = 4p)

c)

$$n(\text{KMnO}_4) = cV = 0,0200 \text{ M} \cdot 43,15 \cdot 10^{-3} \text{ L} = 8,63 \cdot 10^{-4} \text{ mol}$$
 (1p)

$$1(\text{KMnO}_4) \Leftrightarrow 5(\text{FeSO}_4)$$
 (1p)

$$n(\text{FeSO}_4, \text{ kokku}) = (5 \cdot 8,63 \cdot 10^{-4} \text{ mol}) = 4,32 \cdot 10^{-3} \text{ mol}$$
 (1p)

$$1(\text{FeSO}_4) \Leftrightarrow 1(\text{FeCO}_3)$$

$$n(\text{FeCO}_3) = 4,32 \cdot 10^{-3} \text{ mol}$$
 (1p)

$$m(\text{FeCO}_3) = nM = 4,32 \cdot 10^{-3} \text{ mol} \cdot 115,86 \text{ g/mol} \approx 0,50 \text{ g}$$
 (1p)

(5*1p = 5p)

(kokku 12,5p)

4. a) $\text{C}_{20}\text{H}_{30}\text{N}_2\text{O}_5$ (1p)

$$\text{b) } M = 12,01 \text{ g/mol} \cdot 20 + 1,008 \text{ g/mol} \cdot 30 + 2 \cdot 14,01 \text{ g/mol} + 5 \cdot 16,00 \text{ g/mol} = 378,5$$

g/mol (1p)

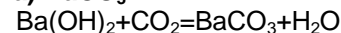
$$\text{c) } \frac{100 \frac{\text{g}}{\text{L}}}{\frac{0,044 \text{ mmol}}{1 \text{ L}} \cdot \frac{1 \text{ mol}}{1000 \text{ mmol}} \cdot \frac{378,5 \text{ g}}{1 \text{ mol}}} = 6000 \text{ korda}$$
 (2p)

$$\text{d) } m = 365 \text{ päeva} \cdot \frac{0,50 \text{ L}}{1 \text{ päev}} \cdot \frac{100 \text{ g}}{1 \text{ L}} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} = 18 \text{ kg}$$
 (2p)

e) Võimalik on kujutada mitut ühendit, sest pildil toodud ühendil on kiraalsete tsentrite tõttu mitu isomeeri. (1p)

(kokku 7p)

5. a) BaCO_3 (1p)



$$\text{b) } n(\text{BaCO}_3) = \frac{0,40 \text{ g}}{197 \text{ g mol}^{-1}} = 2,03 \cdot 10^{-3} \text{ mol}$$
 (1p)

$$n[\text{Ba}(\text{OH})_2] = \frac{(20 \cdot 1,02) \text{ g} + 0,05}{171 \text{ g mol}^{-1}} = 5,96 \cdot 10^{-3} \text{ mol}$$
 (1p)

ehk CO₂ on limiteeriv reagent.

$$\text{Seega } V(\text{CO}_2) = V_m \cdot n(\text{CO}_2) = \frac{22,4 \text{ L}}{\text{mol}} \cdot 2,03 \cdot 10^{-3} \text{ mol} = 0,045 \text{ L} \quad (1\text{p})$$

$$\text{Seega } \%_{\text{vol}}(\text{CO}_2) = \frac{0,045 \text{ L}}{10 \text{ L}} \cdot 100\% = 0,45 \quad (1\text{p})$$

(4*1p=4p)

c) Eeldame, et moodustunud segul lastakse piisavalt kaua liikuda, et gaasid jõuaksid ühtlaselt seguneda. Olgu siseneva õhujoa kiirus A (mol/h). Massibilanss ja CO₂ massibilanss annavad järgmise tabeli:

	Sisenev õhujuga/mol h ⁻¹	Puhas CO ₂ /mol h ⁻¹	Väljuv õhk/mol h ⁻¹
Kogu õhk	A	$\frac{10}{0,044}$	$\frac{10}{0,044} + A$
CO ₂	$\frac{330}{10^5} \cdot A$	$\frac{10}{0,044}$	$\frac{0,45}{100} \cdot \left(\frac{10}{0,044} + A \right)$

(6p)

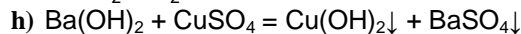
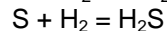
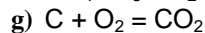
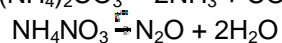
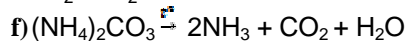
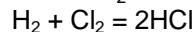
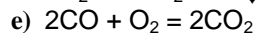
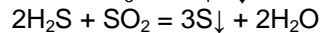
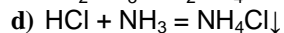
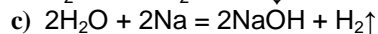
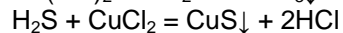
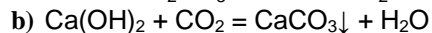
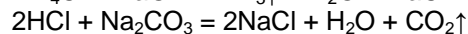
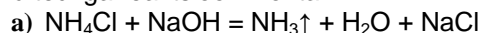
(n.t iga lahtri eest 1 punkt, kokku 6p. Aga loomikul 6p ka mis tahes teise võrrandi eest, mille lahendamine annab õige tulemuse)

$$\text{Seega saame võrrandi: } \frac{10}{0,044} + \frac{330}{10^5} \cdot A = \frac{0,45}{100} \cdot \left(\frac{10}{0,044} + A \right)$$

$$\text{mille lahendamisel } A = 5,43 \cdot 10^4 \frac{\text{mol}}{\text{h}} \cdot 22,4 \frac{\text{L}}{\text{mol}} \cdot \frac{1 \text{ m}^3}{1000 \text{ L}} = 1200 \text{ m}^3/\text{h}$$

(0,5p õige vastus+0,5p õigetes ühikutes)
(6p + 1p=7p)
(13p)

6. Näited iga reaktsiooni kohta:



(8*1,5p = 12 p)
(60 p)