

Tallinna XXI koolinoorte keemiaolümpiaadi koolivoor 2020 / 2021 õ.a

Ülesannete lahendused\*

10. klass

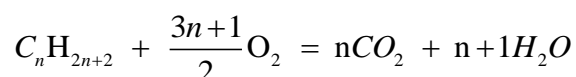
1. (10)

1.

Aine nimetus	Molekulivalem	Molaarmass g/mol	Orgaanilise aine klass	Klassi üldine molekulivalem	Süsiniku aatomi keskmine oksüdatsiooniaste	Lahustuvus vees: a. mittelahustuv b. hästi lahustuv c. vähelahustuv	Hapniku moolide arv, mis on vajalik ühe mooli aine oksüdeerimiseks	Max punkt
<i>etaan</i>	<i>C<sub>2</sub>H<sub>6</sub></i>	<i>30</i>	<i>alkaan</i>	<i>C<sub>n</sub>H<sub>2n+2</sub></i>	<i>-III</i>	<i>a.</i>	<i>3,5</i>	<i>1,6</i>
etanool	C <sub>2</sub> H <sub>5</sub> OH	X	X	C <sub>n</sub> H <sub>2n+1</sub> OH	-II	b.	3,0	1,2
etanaal	CH <sub>3</sub> CHO	44	aldehüüd	X	-I	X	X	1,0
etaanhape	CH <sub>3</sub> COOH	X	X	C <sub>n</sub> H <sub>2n+1</sub> COOH	X	b.	2,0	1,0
X	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	180	süsivesik / sahhariid	X	X	b.	6	1,0
X	C <sub>8</sub> H <sub>18</sub>	X	X	X	-2 $\frac{1}{4}$	a.	12 $\frac{1}{2}$	0,8

5

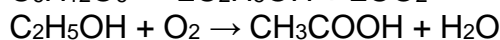
2.



2

3.

Moolsuhe: C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> → 2CH<sub>3</sub>COOH, sest



1

$$V(CH_3COOH \text{ lahuse}) = 2 \cdot \frac{1000 \text{ g} \cdot 60 \frac{\text{g}}{\text{mol}} \cdot (100\% - 21\%) \cdot 100\%}{180 \frac{\text{g}}{\text{mol}} \cdot 1,012 \frac{\text{g}}{\text{cm}^3} \cdot 100\% \cdot 9\%} \approx 5780 \text{ cm}^3$$

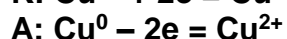
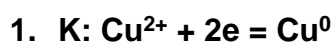
$$\approx 5,8 \text{ dm}^3$$

Võimalik punktijaotus:

glükoosi hulk – 0,5p; etaanhappe hulk e moolsuhte tuvastamine ja rakendamine – 1,0p; etaanhappe mass – 0,5p; etaanhappe lahuse massi ja ruumala arvutamine – 0,5p; kao arvestamine – 0,5p.

$\frac{2}{10p}$

2. (10)



2. Katood – silindriline ese 1

Anood – vasetükk 1

3. m(CuSO<sub>4</sub>)<sub>lahus</sub> = 320cm<sup>3</sup> · 1,2059  $\frac{\text{g}}{\text{cm}^3}$  = 385,9 g

m(CuSO<sub>4</sub>) = 385,9g · 0,12 = 46,3 g

n(CuSO<sub>4</sub>) =  $\frac{46,3\text{g}}{159,5 \frac{\text{g}}{\text{mol}}}$  = 0,290 mol 2

$$4. m(\text{Cu}) = \frac{63,5 \frac{\text{g}}{\text{mol}} \cdot 0,640 \text{A} \cdot 1330 \text{s}}{2 \cdot 96485 \frac{\text{A} \cdot \text{s}}{\text{mol}}} = 0,280 \text{ g}$$

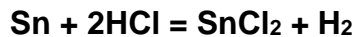
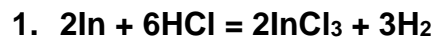
$$m(\text{silindriline ese}) = 15,25 \text{ g} + 0,280 \text{ g} = 15,53 \text{ g}$$

$$5. m(\text{vasetükk}) = 7,48 \text{ g} - 0,280 \text{ g} = 7,20 \text{ g}$$

6. Vask(II)sulfaadi moolide arv lahuses ei muutunud.

2  
1  
1  
10p

3. (10)



0,5  
0,5

$$2. m(\text{HCl})_{\text{lahus}} = 14,23 \text{cm}^3 \cdot 1,060 \frac{\text{g}}{\text{cm}^3} = 15,08 \text{ g}$$

$$m(\text{HCl}) = 15,08 \text{g} \cdot 0,1251 = 1,887 \text{ g}$$

$$n(\text{HCl}) = \frac{1,887 \text{g}}{36,5 \frac{\text{g}}{\text{mol}}} = 0,05169 \text{ mol}$$

1,0



0,5

$$4. n(\text{NaOH}) = 0,0123 \frac{\text{mol}}{\text{l}} \cdot 0,03015 \text{l} = 0,000370845 \text{ mol}$$

0,5

$$n(\text{HCl})_{\text{NaOH}} = 0,000370845 \text{mol} \cdot 25 = 0,009271 \text{ mol}$$

0,5

5. Tiitrimise alguses – punane

Tiitrimise lõpus – kollane

0,5

$$6. m(\text{Ga}) = 5,820 \text{g} \cdot 0,6850 = 3,987 \text{ g}$$

$$m(\text{In} + \text{Sn}) = 5,820 \text{g} - 3,987 \text{g} = 1,833 \text{ g}$$

$$n(\text{HCl})_{\text{In} + \text{Sn}} = 0,05169 \text{mol} - 0,009271 \text{ mol} = 0,04242 \text{ mol}$$

$$n(\text{In}) = x \text{ mol}, n(\text{Sn}) = y \text{ mol}$$

$$115x + 119y = 1,833$$

$$3x + 2y = 0,04242 \text{ mol}$$

$$x = 0,01088 \text{ mol}, y = 0,004891 \text{ mol}$$

$$m(\text{In}) = 0,01088 \text{mol} \cdot 115 \frac{\text{g}}{\text{mol}} = 1,251 \text{ g}$$

2

$$m(\text{Sn}) = 0,004891 \text{mol} \cdot 119 \frac{\text{g}}{\text{mol}} = 0,5820 \text{ g}$$

2

$$7. P(\text{In}) = \frac{1,251 \text{g}}{5,820 \text{g}} \cdot 100\% = 21,49 \%$$

0,5

$$P(\text{Sn}) = \frac{0,5820 \text{g}}{5,820 \text{g}} \cdot 100\% = 10,00 \%$$

0,5

8. Gaas A – vesinik

0,5

$$n(\text{H}_2) = \frac{0,01088 \text{mol}}{2} \cdot 3 \text{mol} + 0,004891 \text{mol} = 0,02121 \text{ mol}$$

$$V(\text{H}_2) = 0,02121 \text{mol} \cdot 22,4 \frac{\text{dm}^3}{\text{mol}} = 0,475 \text{ dm}^3 = 0,000475 \text{ m}^3$$

0,5

10p

#### 4. (10)

1. A – fluor, B – lämmastik C – hapnik 1
2.  $2F_2 + O_2 = 2OF_2$  hapnikdifluoriid 1  
 $N_2 + O_2 = 2NO$  lämmastik(II)oksiid, lämmastikmonooksiid 1
3.  $2NO + O_2 = 2NO_2$  lämmastik(IV)oksiid, lämmastikdioksiid 1
4.  $OF_2 + H_2O = 2HF + O_2$  1  
vesinikfluoriidhape (плавиковая кислота), hapnik 0,5  
 $4NO_2 + 2H_2O + O_2 = 4HNO_3$  1  
lämmastikhape 0,5
5.  $n(F_2) = \frac{10l}{22,4 \frac{l}{mol}} = 0,446 \text{ mol}$   
 $n(HF) = 0,446 \text{ mol} \cdot 2 = 0,892 \text{ mol}$  0,5  
 $c(HF) = \frac{0,892 \text{ mol}}{3,000 \text{ l}} = 0,297 \text{ M}$  0,5  
 $n(N_2) = \frac{10l}{22,4 \frac{l}{mol}} = 0,446 \text{ mol}$   
 $n(HNO_3) = 0,446 \text{ mol} \cdot 2 = 0,892 \text{ mol}$  0,5  
 $c(HNO_3) = \frac{0,892 \text{ mol}}{3,000 \text{ l}} = 0,297 \text{ M}$  0,5
6.  $pH = -\lg(0,297) = 0,53$  1,0  
**10p**

\* Keemiaolümpiaadi koolivooru komisjon võib iseseisvalt hinnata võimalikke alternatiivseid lahendusvariante.