

2010/2011 õ.a. keemiaolümpiaadi piirkonnavooru ülesannete lahendused
10. klass

1. a) Veele annavad aluselise keskkonna K_2CO_3 ja $NaOH$. (2·0,5) 1
(kaks õiget – 1; üks õige, üks vale – 0,5; kaks õiget, üks vale – 0,5;
muud variandid – 0)

b) $T = (-78 + 273)K = 195 K$

$T = (20 + 273)K = 293 K$ (2·0,5) 1

c) i) $1 \text{ \AA} = 1 \text{ \AA} \cdot \frac{10^{-1} \text{ nm}}{1 \text{ \AA}} \cdot \frac{1 \text{ cm}}{10^7 \text{ nm}} \cdot \frac{1 \text{ toll}}{2,54 \text{ cm}} \cdot \frac{1 \text{ jalg}}{12 \text{ toll}} \cdot \frac{1 \text{ jard}}{3 \text{ jalg}} = 1,09 \cdot 10^{-10} \text{ jard}$

ii) $1 \text{ v.a} = 1 \text{ v.a} \cdot \frac{365,25 \text{ päev}}{1 \text{ v.a}} \cdot \frac{24 \text{ h}}{1 \text{ päev}} \cdot \frac{3600 \text{ s}}{1 \text{ päev}} \cdot \frac{3 \cdot 10^5 \text{ km}}{1 \text{ s}} = 9,47 \cdot 10^{12} \text{ km}$

$1 \text{ v.a} = 9,47 \cdot 10^{12} \text{ km} \cdot \frac{10^5 \text{ cm}}{1 \text{ km}} \cdot \frac{1 \text{ jard}}{91,44 \text{ cm}} = 1,04 \cdot 10^{16} \text{ jard}$ (1+2) 3

d) $m(\text{CaCl}_2) = 250 \text{ g} \cdot 0,06 = 15 \text{ g}$

$m(\text{CaCl}_2 \cdot 6\text{H}_2\text{O}) = \frac{1}{1} \cdot 15 \text{ g} \cdot \frac{1 \text{ mol}}{110,9 \text{ g}} \cdot \frac{219,1 \text{ g}}{1 \text{ mol}} = 29,6 \text{ g}$

$m(\text{H}_2\text{O}) = 250 \text{ g} - 29,6 \text{ g} = 220 \text{ g}$ 2

e) Kristallhüdraadi valem võib esitada kujul $\text{LiNO}_3 \cdot x\text{H}_2\text{O}$. Sel juhul avaldub hapniku sisaldus järgmiselt:

$\%(\text{O}) = \frac{3 \cdot M(\text{O}) + x \cdot M(\text{O})}{M(\text{LiNO}_3) + x \cdot M(\text{H}_2\text{O})} = 0,718 \quad \frac{3 \cdot 16 + 16x}{69 + 18,02x} = 0,718 \quad x = 0,504$

Kristallhüdraadi valem on seega $\text{LiNO}_3 \cdot 0,5\text{H}_2\text{O}$ ehk **$2\text{LiNO}_3 \cdot \text{H}_2\text{O}$** 3
10 p

2. a) $m(\text{sahharoos pirukas}) = 70 \text{ g} \cdot \frac{2,59 \text{ g}}{100 \text{ g}} = 1,813 \text{ g}$

$m(\text{glükoos pirukas}) = 70 \text{ g} \cdot \frac{0,794 \text{ g}}{100 \text{ g}} = 0,5558 \text{ g}$

$n(\text{sahharoos pirukas}) = 1,813 \text{ g} \cdot \frac{1 \text{ mol}}{342 \text{ g}} \cdot \frac{1000 \text{ mmol}}{1 \text{ mol}} = 5,30 \text{ mmol}$ 5

$n(\text{glükoos pirukas}) = 0,5558 \text{ g} \cdot \frac{1 \text{ mol}}{180 \text{ g}} \cdot \frac{1000 \text{ mmol}}{1 \text{ mol}} = 3,09 \text{ mmol}$

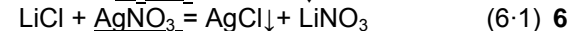
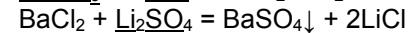
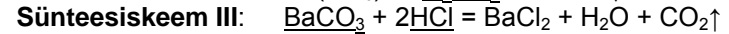
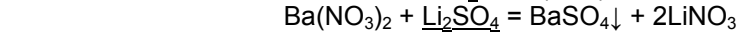
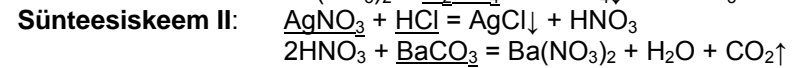
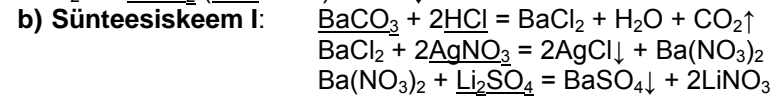
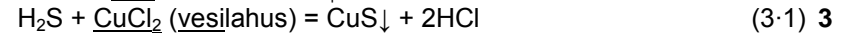
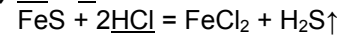
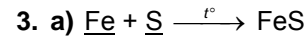
$n(\text{glükoos pirukast verre}) = \frac{1}{1} \cdot 5,30 \text{ mmol} + 3,09 \text{ mmol} = 8,39 \text{ mmol}$

$c(\text{veresuhkur}) = c(\text{glükoos veres}) = \frac{4,1 \text{ mmol}}{1 \text{ dm}^3} + \frac{8,39 \text{ mmol}}{5 \text{ dm}^3} = 5,8 \frac{\text{mmol}}{\text{dm}^3}$

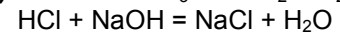
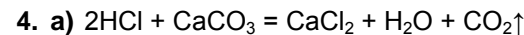
b) $N(\text{pirukas}) = \frac{(40 - 5,78) \text{ mmol}}{1 \text{ dm}^3} \cdot 5 \text{ dm}^3 \cdot \frac{1}{8,39 \text{ mmol}} = 20,4 \approx 20$ 3

c) $E(\text{pirukas}) = \left[(35,2 + 6,46) \text{ g} \cdot \frac{4 \text{ kcal}}{100 \text{ g}} + 4,82 \text{ g} \cdot \frac{9 \text{ kcal}}{100 \text{ g}} \right] \cdot 70 \text{ g} = 146 \text{ kcal}$

$t = 146 \text{ kcal} \cdot \frac{1 \text{ h}}{240 \text{ kcal}} \cdot \frac{60 \text{ min}}{1 \text{ h}} = 36,5 \text{ min} \approx 37 \text{ min}$ 4
12 p



c) Pürotehnilistes segudes saab kasutada oksüdeerijana **liitiumnitraati**.
Liitiumnitraat annab leegile **värvuse** (roosa). (2·1) 2
11 p



b) Oletame, et lahust on 1 dm^3 .

$c(\text{HCl}) = 1 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{1,048 \text{ g}}{1 \text{ cm}^3} \cdot 0,1 \cdot \frac{1 \text{ mol}}{36,46 \text{ g}} \cdot \frac{1}{1 \text{ dm}^3} =$
 $= 2,874 \text{ mol/dm}^3 \approx 2,87 \text{ M}$ 3

c) Enne munakoortega reageerimist oli hapet:

$n_{\text{enne}}(\text{HCl}) = 25 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot \frac{2,874 \text{ mol}}{1 \text{ dm}^3} = 0,07185 \text{ mol}$

Peale munakoorte happega reageerimist jäi lahusesse alles:

$n_{\text{peale}}(\text{HCl}) = \frac{1}{1} \cdot 18,7 \text{ cm}^3 \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} \cdot \frac{0,203 \text{ mol}}{1 \text{ dm}^3} = 0,0038 \text{ mol}$

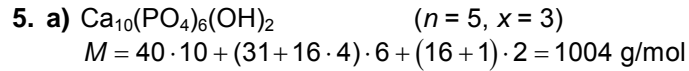
Seega pidi kaltsiumkarbonaadiga ära reageerima:

$n(\text{HCl}) = (0,07185 - 0,0038) \text{ mol} = 0,06805 \text{ mol}$

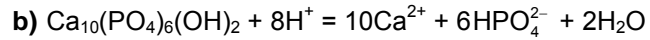
$$\% = \frac{1}{2} \cdot 0,06805 \cdot \frac{100,1 \text{ g}}{1 \text{ mol}} \cdot \frac{1}{3,59 \text{ g}} \cdot 100 = \mathbf{94,9}$$

5

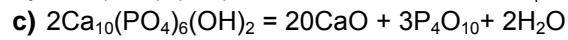
9 p



1



2

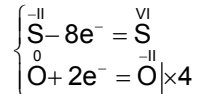
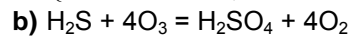
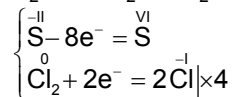
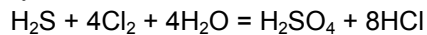
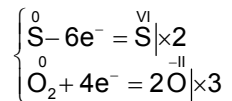
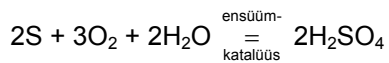
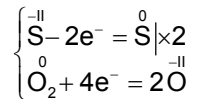
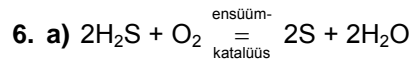


2

d) $\rho = \frac{1004 \text{ g}}{1 \text{ mol}} \cdot \frac{1 \text{ kg}}{1000 \text{ g}} \cdot \frac{1 \text{ mol}}{6,02 \cdot 10^{23}} \cdot \frac{1}{(8,15 \cdot 10^{-10} \text{ m})^3} = \mathbf{3080 \text{ kg/m}^3}$

2

7 p



c) $n(\text{Cl}_2) = 2,68 \text{ cm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} \cdot \frac{1 \text{ dm}^3}{1000 \text{ cm}^3} = 1,196 \cdot 10^{-4} \text{ mol}$

$m(\text{H}_2\text{S}) = \frac{1}{4} \cdot 1,196 \cdot 10^{-4} \text{ mol} \cdot \frac{34 \text{ g}}{1 \text{ mol}} \cdot \frac{1000 \text{ mg}}{1 \text{ g}} = \mathbf{1,02 \text{ mg}}$

3

11 p