

**2004/2005 õa keemiaolümpiaadi piirkonnavooru
ülesannete lahendused
12. klass**

1. a) 2,2,3,3-tetrametüülpentaan

b) i) katoodprotsess, redutseerumine

ii) anoodprotsess, oksüdeerumine

c) $O_2 \leftrightarrow 4e^-$

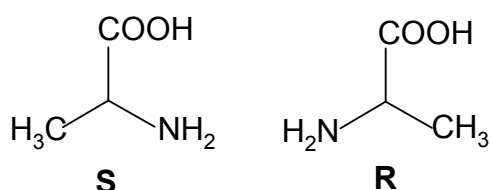
$$n(O_2) = 48 \text{ g} \cdot \frac{1 \text{ mol}}{32 \text{ g}} = 1,5 \text{ mol}$$

$$F = \frac{4}{1} \cdot 1,5 = 6$$

d) pH on 7, sest me lahjendame hapet veega, mille pH on 7.

$[H^+] = 10^{-7}$ (vees) + 10^{-9} (hapest). Happelahuse lahjendamisel moodustunud vesinikioonide tühine kontsentratsioon ei suuda vees olevat vesinikioonide kontsentratsiooni mõjutada.

e)



2. a)

$$\text{I } \%(\text{Y}) = \frac{M(\text{Y})}{M(\text{Y}) + (n-1) \cdot M(\text{Q})} \cdot 100$$

$$0,1793 \cdot M(\text{Y}) + 0,1793(n-1) \cdot M(\text{Q}) = M(\text{Y})$$

$$M(\text{Y}) = \frac{0,1793}{0,8207} \cdot (n-1) \cdot M(\text{Q})$$

$$\text{II } 100 - \%(\text{Y}) = \frac{M(\text{Y})}{M(\text{Y}) + (n+1) \cdot M(\text{Q})} \cdot 100$$

$$0,1271 \cdot M(\text{Y}) + 0,1271(n+1) \cdot M(\text{Q}) = M(\text{Y})$$

$$M(\text{Y}) = \frac{0,1271}{0,8729} \cdot (n+1) \cdot M(\text{Q})$$

$$\frac{0,1793}{0,8207} \cdot (n-1) = \frac{0,1271}{0,8729} \cdot (n+1)$$

$$1,500(n-1) = n+1$$

$$0,500n = 2,5$$

$$n=5$$

Järelikult **X**, **Y** ja **Z** on V peaarühma elemendid.

b) Kui halogeen **Q** on fluor F, siis

$$M(\text{Y}) = 4 \cdot 19 \text{ g/mol} \cdot \frac{0,1793}{0,8207} = 16,6 \text{ g/mol} \quad \text{ei sobi}$$

Kui halogeen **Q** on kloor Cl, siis

$$M(\text{Y}) = 4 \cdot 35,5 \text{ g/mol} \cdot \frac{0,1793}{0,8207} = 31,0 \text{ g/mol, see on fosfor}$$

Ei sobi ka Br [$M(\text{Y}) = 69,8 \text{ g/mol}$] ja I [$M(\text{Y}) = 110 \text{ g/mol}$]

Y – P, fosfor

Q – Cl, kloor

$$\text{c) } 0,4072 = \frac{2M(\text{Z})}{2M(\text{Z}) + 2 \cdot 5 \cdot 35,45 \text{ g/mol}}$$

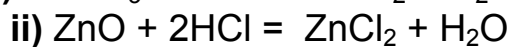
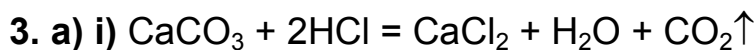
$$0,4072[M(\text{Z}) + 5 \cdot 35,45 \text{ g/mol}] = M(\text{Z})$$

$$0,5928 M(\text{Z}) = 72,18 \text{ g/mol}$$

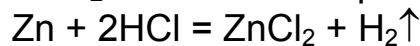
$$M(\text{Z}) = 121,8 \text{ g/mol}$$

Z – Sb, antimon

X – As, arseen, mis asub fosfori ja antimoni vahel.



ZnCl₂ eemaldatakse pesemisega



b) $M(\text{ZnSO}_4) = 287,54 - 7 \cdot 18,02 = 161,40 \text{ g/mol}$

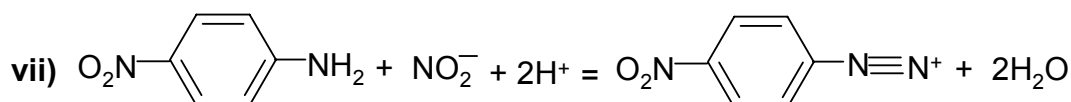
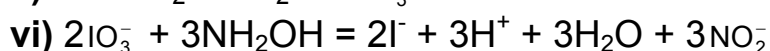
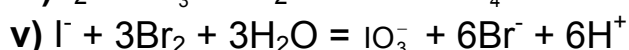
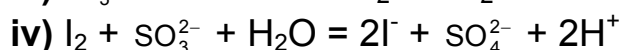
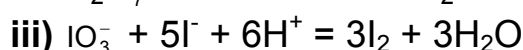
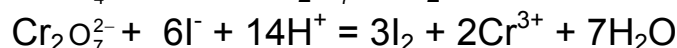
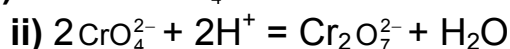
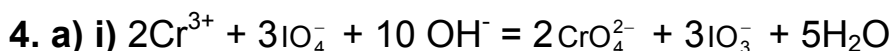
$$x = \frac{287,54 \cdot 0,6240 - 161,40}{18,02} = 1,000$$

Q - ZnSO₄·H₂O; m(Q) = 179,42 g/mol

c) i) $c(\text{EDTA, lahus A}) = 10 \cdot \frac{1,0104 \text{ g}}{100,089 \text{ g/mol}} \cdot \frac{1}{\text{dm}^3} \cdot \frac{10 \text{ cm}^3}{10,44 \text{ cm}^3} = 0,09670 \text{ mol/dm}^3$

ii) $c(\text{EDTA, lahus B}) = 10 \cdot \frac{1,3554 \text{ g}}{65,39 \text{ g/mol}} \cdot \frac{1}{\text{dm}^3} \cdot \frac{10 \text{ cm}^3}{21,44 \text{ cm}^3} = 0,09668 \text{ mol/dm}^3$

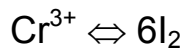
iii) $c(\text{EDTA, lahus C}) = 10 \cdot \frac{1,8450 \text{ g}}{179,42 \text{ g/mol}} \cdot \frac{1}{\text{dm}^3} \cdot \frac{10 \text{ cm}^3}{10,63 \text{ cm}^3} = 0,09674 \text{ mol/dm}^3$



b) Avaldame, mitu korda erineb Cr³⁺ hulk I₂ hulgast

$$\text{Cr}^{3+} = \frac{2}{2} \cdot \frac{2}{1} \cdot \frac{1}{3} \text{I}_2 = \frac{2}{3} \text{I}_2 \quad \text{võrrandid i) ja ii)}$$

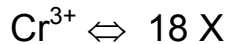
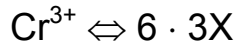
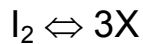
$$\text{Cr}^{3+} = \frac{2}{3} \cdot \frac{1}{3} \text{I}_2 = \frac{2}{9} \text{I}_2 \quad \text{võrrandid i) ja iii)}$$



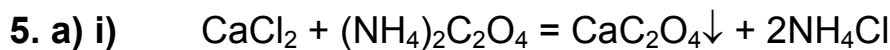
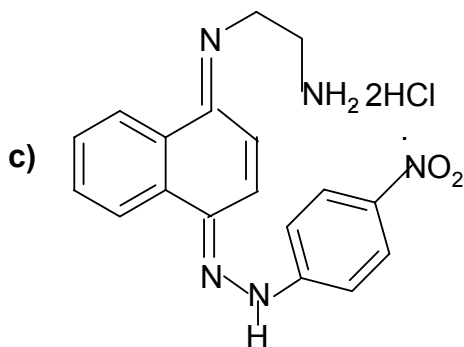
Summaarses reaktsioonivõrrandis on kroomi ja kloori koefitsiendid vastavalt 1 ja 6.

Avaldame, mitu korda erineb I_2 hulk aine **X** hulgest

$$\text{I}_2 = \frac{1}{2} \cdot \frac{1}{1} \cdot \frac{2}{3} \cdot \frac{1}{1} \cdot \frac{1}{1} \cdot \mathbf{x} = \frac{1}{3} \mathbf{x} \quad \text{võrrandid iv), v), vi), vii) ja tekst}$$



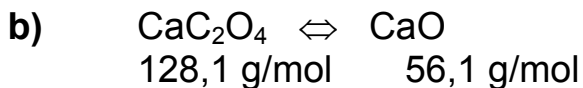
Summaarses reaktsioonivõrrandis on koefitsiendid vastavalt 1 ja 18.



ii) **B** – CO, süsinikmonooksiid

C – CO₂, süsinikdioksiid

D – CaO, kaltsiumoksiid

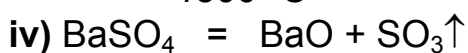
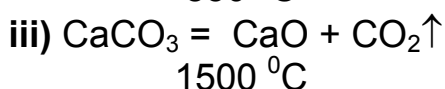
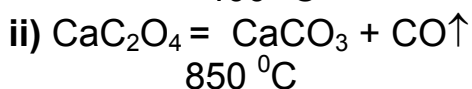
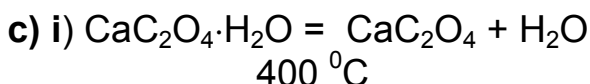


$$m(\text{CaC}_2\text{O}_4) \cdot \frac{1}{1} \cdot 5,61 \text{ g} \cdot \frac{1 \text{ mol}}{56,1 \text{ g}} \cdot 128,1 \text{ g/mol} = 12,81 \text{ g}$$

Kuna esmalt eraldus vesi, siis peab kaltsiumoksalaat sisaldama kristallvett

$$n(\text{H}_2\text{O}) = (14,61 - 12,81 \text{ g}) \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 0,100 \text{ mol}$$

A – CaC₂O₄·H₂O, kaltsiumoksalaat vesi (1:1)
 135 °C



d) $\%(\text{CaCl}_2) = \frac{0,1 \text{ mol} \cdot 111 \text{ g/mol}}{12,00 \text{ g}} \cdot 100 = 92,5$

