

2003/2004 õa keemiaolümpiaadi lõppvooru ülesannete lahendused

9. klass

1. a) i) **A** – S^{2-} , sulfiidioon, $18e^-$ ii) ${}_{16}S$, väävel
B – Ar, argoon, $18e^-$ ${}_{18}Ar$, argoon
C – Ca^{2+} , kaltsiumioon, $18e^-$ ${}_{20}Ca$, kaltsium
D – Cl^- , kloriidioon, $18e^-$ ${}_{17}Cl$, kloor
E – K^+ , kaaliumioon, $18e^-$ ${}_{19}K$, kaalium

b) CaS, kaltsiumsulfiid, ei lahustu vees (neutraalne)

K_2S , kaaliumsulfiid, aluseline

$CaCl_2$, kaltsiumkloriid, neutraalne

KCl, kaaliumkloriid, neutraalne

c) i) $Ca^{2+} + S^{2-} = CaS$ (ühend **X**)

ii) $CaCl_2 + Na_2CO_3 = CaCO_3 \downarrow$ (ühend **Q**) + $2NaCl$

iii) $2CaS + 3O_2 = 2CaO$ (ühend **Z**) + $2SO_2$ (ühend **Y**)

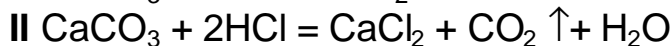
d) $M(Y) = 29,0 \text{ g/mol} \cdot 2,21 = 64,1 \text{ g/mol}$

$M(SO_2) = 32,1 + 2 \cdot 16,0 = 64,1 \text{ g/mol}$

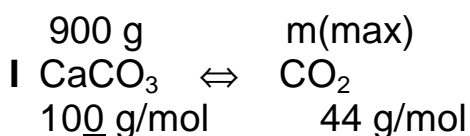
$M(Z) = 56,1 \text{ g/mol}$

$M(CaO) = 40,1 + 16,0 = 56,1 \text{ g/mol}$

2. a) I ${}^0_t{}^0_t$



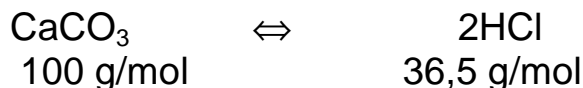
b) $m(CaCO_3) = 1,00 \text{ kg} \cdot 0,90 = 900 \text{ g}$



$$m(CO_2, \text{max}) = \frac{1}{1} \cdot 900 \text{ g} \cdot \frac{1 \text{ mol}}{100 \text{ g}} \cdot 44 \text{ g/mol} = 396 \text{ g} \approx \mathbf{400 \text{ g}}$$

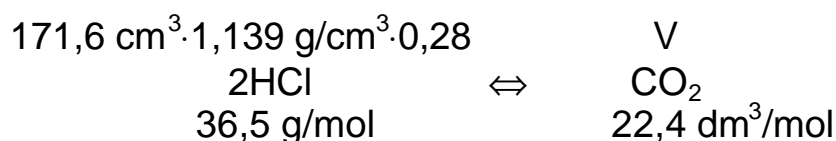
II Arvutame soolhappele vastava $CaCO_3$ massi

$$m \quad 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28$$



$$m(CaCO_3) = \frac{1}{2} \cdot 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 100 \text{ g/mol} = 75 \text{ g}$$

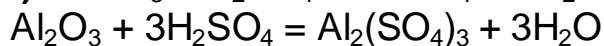
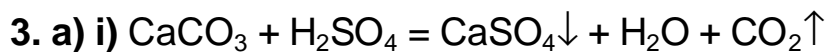
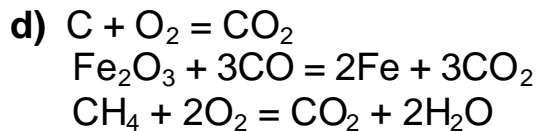
$CaCO_3$ on liias. Arvutused tuleb teha HCl järgi.



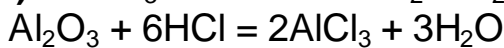
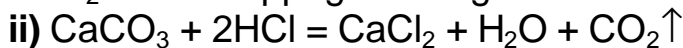
$$V(\text{CO}_2) = \frac{1}{2} \cdot 171,6 \text{ cm}^3 \cdot 1,139 \text{ g/cm}^3 \cdot 0,28 \cdot \frac{1 \text{ mol}}{36,5 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} = 16,79 \text{ dm}^3 \approx \mathbf{17 \text{ dm}^3}$$

c) I **%(saagis)** = $\frac{277 \text{ g}}{396 \text{ g}} \cdot 100 = 69,9 \approx \mathbf{70}$

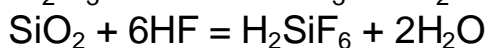
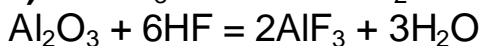
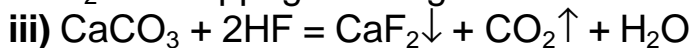
II **%(saagis)** = $\frac{13,44 \text{ dm}^3}{16,79 \text{ dm}^3} \cdot 100 = \mathbf{80}$



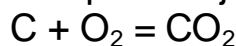
SiO_2 väävelhappega ei reageeri.



SiO_2 soolhappega ei reageeri.



b) Ahi läks põlema ja hunt põgenes.



4. a) A – NaNO_3 , tšiili salpeeter, põllumajandus.

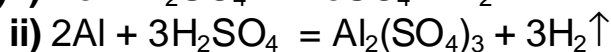
B – KNO_3 , india salpeeter, musta püssirohu põhikomponent.

C – AgNO_3 , pörgukivi (?????), fotograafia - meditsiin

b) X – $^{56}_{26}\text{Fe}$, raud

Y – $^{27}_{13}\text{Al}$, alumiinium

Z – $^{137}_{56}\text{Ba}$, baarium



d) Kontsentreeritud väävel- ja lämmastikhappega reageerimisel moodustub raua ja alumiiniumi pinnale mittelahustuv hapetega mittereageeriv kaitsekile.

5. a) A – O_2 , hapnik

B – H_2 , vesinik

D – CO_2 , süsinikdioksiid

E – CO , süsinikmonooksiid

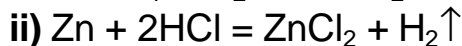
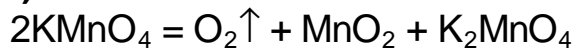
X – K_2MnO_4 , kaaliummanganaat

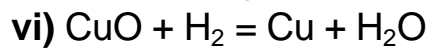
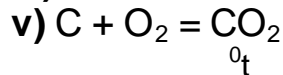
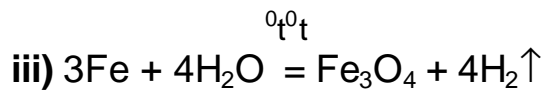
Y – H_2O , vesi

Z – Fe_3O_4 , raud(II,III)oksiid

Q – C, süsi, grafiit

b) i) ^0t





$$\text{6. I } 10^\circ\text{C i) } \%(\text{KNO}_3) = \frac{21,5}{121,5} \cdot 100 = 17,7$$

$$20^\circ\text{C ii) } L(\text{KNO}_3) = \frac{24,1}{75,9} \cdot 100 \text{ g} = 31,8 \text{ g}$$

$$30^\circ\text{C i) } \%(\text{KNO}_3) = \frac{115}{365} \cdot 100 = 31,5$$

$$\text{ii) } L(\text{KNO}_3) = \frac{115}{250} \cdot 100 \text{ g} = 46,0 \text{ g}$$

$$40^\circ\text{C i) } \%(\text{KNO}_3) = \frac{25,8}{65,8} \cdot 100 = 39,2 \text{ g}$$

$$\text{ii) } L(\text{KNO}_3) = \frac{25,8}{40,0} \cdot 100 \text{ g} = 64,5 \text{ g}$$

$$50^\circ\text{C i) } \%(\text{KNO}_3) = \frac{344}{744} \cdot 100 = 46,2 \text{ g}$$

$$\text{ii) } L(\text{KNO}_3) = \frac{344}{400} \cdot 100 \text{ g} = 86,0 \text{ g}$$

$$\text{II } m(\text{KNO}_3, \text{kuumas}) - m(\text{KNO}_3, \text{jahedas}) = m(\text{KNO}_3, \text{puhas})$$

Ümberkristalliseerimisel vee mass ei muutu.

$$100 \text{ g (H}_2\text{O)} \Leftrightarrow 110 \text{ g (KNO}_3)$$

Kuumas lahuses

$$m(\text{H}_2\text{O}) = 100 \text{ g (KNO}_3) \cdot \frac{100 \text{ g}}{110 \text{ g (KNO}_3)} = 90,9 \text{ g}$$

$$\begin{aligned} m(\text{KNO}_3, \text{puhas}) &= \frac{110 \text{ g}}{100 \text{ g (H}_2\text{O)}} \cdot 90,9 \text{ g (H}_2\text{O)} - \frac{21,5 \text{ g}}{100 \text{ g (H}_2\text{O)}} \cdot 90,9 \text{ g (H}_2\text{O)} = \\ &= 100 \text{ g} - 19,5 \text{ g} = 80,5 \text{ g} \approx \mathbf{81 \text{ g}} \end{aligned}$$