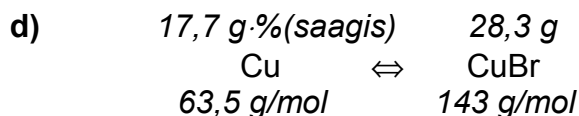


**1998/99 õa keemiaolümpiaadi piirkondliku vooru
ülesannete lahendused
11. klass**

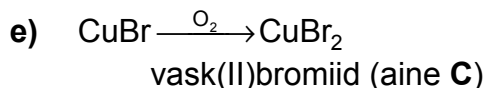
1. a) $2\text{Ca}_3(\text{PO}_4)_2 + 3\text{SiO}_2 + 10\text{C} = 3\text{Ca}_2\text{SiO}_4 + 10\text{CO} + \text{P}_4$
- b) $\text{Ca}_3(\text{PO}_4)_2$ - kaltsiumfosfaat
 SiO_2 - ränidioksiid
 C - süsinik
 aine **A** - fosfor
 aine **B** - kaltsiumortosilikaat Ca_2SiO_4 või kaltsiummetasilikaat CaSiO_3
 aine **C** - süsinikmonooksiid
- c) $100\text{ g} \cdot 0,25 \quad m$
 $2\text{Ca}_3(\text{PO}_4)_2 \Leftrightarrow \text{P}_4$
 $310\text{ g/mol} \quad 124\text{ g/mol}$
 $m(\text{P}_4) = \frac{1}{2} \cdot 100\text{g} \cdot 0,25 \cdot \frac{1\text{mol}}{310\text{g}} \cdot 124\text{g/mol} = 5,0\text{ g}$
2. a) $3\text{I}_2 + \text{NH}_3 = \text{NI}_3 + 3\text{HI}$
 jood ammoniaak joodnitriid vesinikjodiid
 (aine **A**) (aine **B**)
- b) $n(\text{NI}_3) = 20 \cdot 0,003\text{mol} = 0,06\text{ mol}$
 lahus **A**: $m(\text{I}_2\text{lahus}) = \frac{3}{1} \cdot 0,06\text{mol} \cdot 254\text{g/mol} \cdot \frac{1}{0,05} \cdot \frac{1}{0,76} = 1,2\text{ kg}$
 lahus **B**: $m(\text{NH}_3\text{lahus}) = \frac{1}{1} \cdot 0,06\text{mol} \cdot 17\text{g/mol} \cdot \frac{1}{0,1} = 10,2\text{ g}$
- c) $m(\text{NI}_3) = 0,003\text{mol} \cdot 395\text{ g/mol} = 1,2\text{ g}$
3. a) 1) $2\text{KI} + \text{Cl}_2 = 2\text{KCl} + \text{I}_2$
 2) $3\text{I}_2 + 2\text{Al} \xrightarrow{\text{H}_2\text{O}} 2\text{AlI}_3$
- b) Kaaliumi ühendid annavad leegile lillakas-violetse värvi. Kloor oksüdeerib ühendis oleva passiivsema halogeeni lihtaineks. Tahke halogeeninäe esineb ainult jood.
- c) $m(\text{I}_2) = 13,5\text{g} \cdot \frac{1}{6,617\%} \cdot 93,383\% = 191\text{g}$
- $18,1\text{ dm}^3 \quad m$
 $\text{Cl}_2 \Leftrightarrow \text{I}_2$
 $22,4\text{dm}^3/\text{mol} \cdot \frac{293}{273} \quad 254\text{ g/mol}$
 $m(\text{I}_2) = \frac{1}{1} \cdot 18,1\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot \frac{273}{293} \cdot 254\text{g/mol} = 191\text{ g}$
4. a) $\text{Cu} + 2\text{H}_2\text{SO}_4 = \text{CuSO}_4 + \text{SO}_2 + 2\text{H}_2\text{O}$ Metall **A** on vask.
 $\text{Cu} + 4\text{HNO}_3(\text{konts.}) = \text{Cu}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$
 $3\text{Cu} + 8\text{HNO}_3(\text{lahj.}) = 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$
- b) $2\text{CuSO}_4 + 2\text{KBr} + \text{SO}_2 + 2\text{H}_2\text{O} = 2\text{CuBr} \downarrow + \text{K}_2\text{SO}_4 + 2\text{H}_2\text{SO}_4$
 vask(I)bromiid
 (aine **B**)
- c) $2\text{Cu} \Leftrightarrow 2\text{CuBr} \Leftrightarrow \text{SO}_2$
 $n(\text{Cu}) = 17,7\text{g} \cdot \frac{1\text{mol}}{63,5\text{g}} = 0,279\text{mol}$

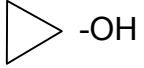
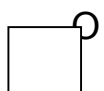
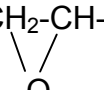
$$n(\text{SO}_2) = 7,35\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} = 0,328\text{mol}$$

SO₂ on rohkem kui kahekordses ülehulgas.

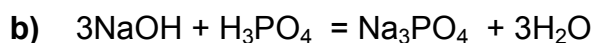


$$\%(\text{saagis}) = \frac{1}{1} \cdot 28,3\text{g} \cdot \frac{1\text{mol}}{143\text{g}} \cdot 63,5\text{g/mol} \cdot \frac{1}{17,7\text{g}} \cdot 100 = \mathbf{71,0\%}$$



5. a) Alkoholid: $\text{CH}_2=\text{CH}-\text{CH}_2\text{OH}$ – propeen-3-ool
 – tsüklopropanool
 $\text{CH}_2=\text{C}-\text{CH}_3$ – propeen-2-ool
 $\begin{array}{c} | \\ \text{OH} \end{array}$
 $\text{CH}_3-\text{CH}=\text{CH}-\text{OH}$ – propenool
 Ketoon: $\text{CH}_3-\text{C}-\text{CH}_3$ – propanoon
 $\begin{array}{c} || \\ \text{O} \end{array}$
 Aldehüüd: $\text{CH}_3-\text{CH}_2-\text{C}$
 $\begin{array}{l} // \text{O} \\ \backslash \text{H} \end{array}$ – propanaal
 Eetrid: $\text{CH}_2=\text{CH}-\text{O}-\text{CH}_3$ –(metoksüeteen)
 –(1,3-epoksüpropan)
 $\text{CH}_2-\text{CH}-\text{CH}_3$ –(1,2-epoksüpropan)


6. a) $n(\text{NaOH}) = 3,54\text{dm}^3 \cdot 1000\text{g/dm}^3 \cdot 0,00026 \cdot \frac{1\text{mol}}{40\text{g}} = 0,023\text{mol}$
 $n(\text{H}_3\text{PO}_4) = 1,46\text{dm}^3 \cdot 1000\text{g/dm}^3 \cdot 0,000403 \cdot \frac{1\text{mol}}{98,0\text{g}} = 0,00600\text{mol}$
 $C(\text{NaOH}) = \frac{0,023\text{mol}}{3,54\text{dm}^3} = \mathbf{0,0065\text{mol/dm}^3}$
 $c(\text{H}_3\text{PO}_4) = \frac{0,00600\text{mol}}{1,46\text{dm}^3} = \mathbf{0,00411\text{mol/dm}^3}$



c) H₃PO₄ täielikuks neutraliseerimiseks kulub (3/1)·0,006 mol = 0,018 mol.
Lahuses on **0,00600 mol Na₃PO₄** ja 0,023 - 0,018 = **0,005 mol NaOH**.

d) $C(\text{NaOH}) = \frac{0,005\text{mol}}{5,00\text{dm}^3} = 0,001\text{mol/dm}^3$
 $C(\text{H}^+) = \frac{10^{-14}}{10^{-3}} = 10^{-11}$ $\text{pH} = -\log 10^{-11} = \mathbf{11}$