

1997/98 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused
9. klass

1. Lähtume ühest moolist

a) $M(\text{FeS}_2) = 120 \text{ g/mol}$

$$m(\text{S}) = 2 \text{ mol} \cdot 32,1 \text{ g/mol} = 64,2 \text{ g}$$

$$m(\text{püriit}) = 120 \text{ g (FeS}_2) \cdot \frac{100 \text{ (püriit)}}{80,0 \text{ (FeS}_2)} = 150 \text{ g}$$

$$\%(\text{S}) = \frac{64,2 \text{ g (S)}}{150 \text{ g (püriit)}} \cdot 100 = \mathbf{42,8}$$

b) $M(\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}) = 248 \text{ g/mol}$ $m(\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}) = 1 \text{ mol} \cdot 248 \text{ g/mol} = 248 \text{ g}$

$$m(\text{S}) = 2 \text{ mol} \cdot 32,1 \text{ g/mol} = 64,2 \text{ g}$$

$$\%(\text{S}) = \frac{64,2}{248} \cdot 100 = \mathbf{25,9\%}$$

c) $m(\text{lahus}) = 25,0 + 100 = 125 \text{ g}$

$$\%(\text{S}) = \frac{25,0 \text{ g (Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O})}{125 \text{ g (lahus)}} \cdot \frac{25,9 \text{ g (S)}}{100 \text{ g (Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O})} \cdot 100 = \mathbf{5,18}$$

2. a) $\text{H}_2\text{SO}_4 + 2\text{NH}_3 = (\text{NH}_4)_2\text{SO}_4$

b) $m(\text{H}_2\text{SO}_4) = V(\text{lahus}) \text{ cm}^3 \cdot 1,34 \text{ g/cm}^3 \cdot 0,440$

$$m(\text{NH}_3) = 0,220 \text{ dm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot 0,935 \text{ g/cm}^3 \cdot 0,170$$

c) $M(\text{H}_2\text{SO}_4) = \mathbf{98,1 \text{ g/mol}}$

$M(\text{NH}_3) = \mathbf{17,0 \text{ g/mol}}$

d) $V \text{ cm}^3 \cdot 1,34 \text{ g/cm}^3 \cdot 0,440$ $220 \text{ cm}^3 \cdot 0,935 \text{ g/cm}^3 \cdot 0,170$

H_2SO_4	\Leftrightarrow	2NH_3
$98,1 \text{ g/mol}$		$17,0 \text{ g/mol}$

$$1,34 \cdot 0,440 V = \frac{1}{2} \cdot 220 \cdot 0,935 \cdot 0,170 \cdot \frac{1}{17,0} \cdot 98,1$$

$$V(\text{H}_2\text{SO}_4 \text{ lahus}) = \frac{1}{2} \cdot 220 \text{ cm}^3 \cdot 0,935 \text{ g/cm}^3 \cdot 0,170 \cdot \frac{1 \text{ mol}}{17,0 \text{ g}} \cdot 98,1 \text{ g/mol} \cdot \frac{1}{0,440} \cdot \frac{1 \text{ cm}^3}{1,34 \text{ g}} = \mathbf{171 \text{ cm}^3}$$

3. a) Lähtume 100-st grammist

$$n(\text{Cu}) = 100 \text{ g} \cdot 0,254 \cdot \frac{1 \text{ mol}}{63,5 \text{ g}} = 0,40 \text{ mol}$$

$$n(\text{S}) = 100 \text{ g} \cdot 0,129 \cdot \frac{1 \text{ mol}}{32,1 \text{ g}} = 0,40 \text{ mol}$$

$$n(\text{O}) = 100 \text{ g} \cdot 0,256 \cdot \frac{1 \text{ mol}}{16,0 \text{ g}} = 1,6 \text{ mol}$$

$$n(\text{H}_2\text{O}) = 100 \text{ g} \cdot 0,361 \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 2,0 \text{ mol}$$

$n(\text{Cu}) : n(\text{S}) : n(\text{O}) : n(\text{H}_2\text{O})$

$\mathbf{0,4 : 0,4 : 1,6 : 2}$

b) Valemis peavad aatomid suhtuma nagu täisarvud. Lihtsaima täisarvudega suhte saame olemasolevate moolide arvu korrutamisel 2,5-ga - $\mathbf{Cu_1S_1O_4 \cdot 5H_2O}$

c) Vaadeldud soolaks on **vasksulfaat-5-vesi**, mille rahvapärane nimetus on vasevitriol - $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

4. Tähistame anuma ruumala sümboliga V_a .

a) $V_M = 1 \text{ mol} \cdot 0,0820 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot \text{K}} \cdot 277 \text{ K} \cdot \frac{1}{5,00 \text{ atm}} = \mathbf{4,54 \text{ dm}^3/\text{mol}}$

$$\text{b) } n(\text{HCl}) = \frac{4}{5} V_a (\text{dm}^3) \cdot \frac{1 \text{ mol}}{4,54 \text{ dm}^3} = \mathbf{0,1762 \cdot V_a \text{ (mol)}}$$

$$m(\text{HCl}) = 0,1762 \cdot V_a (\text{mol}) \cdot 36,5 \text{ g/mol} = \mathbf{6,43 V_a \text{ (g)}}$$

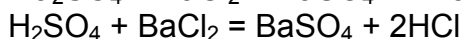
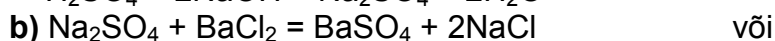
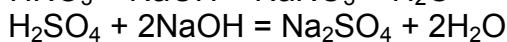
$$\text{c) } m(\text{lahus}) = m(\text{H}_2\text{O}) + m(\text{HCl})$$

$$m(\text{H}_2\text{O}) = V_a (\text{dm}^3) \cdot 1000 \text{ g/dm}^3 = 1000 V_a (\text{g})$$

$$m(\text{lahus}) = \mathbf{1006,43 V_a \text{ (g)}}$$

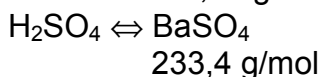
$$\text{d) } \%(\text{HCl}) = \frac{6,43 V_a (\text{g})}{1006,43 V_a (\text{g})} \cdot 100 = 0,63889 \approx \mathbf{0,639}$$

Märkus: 4 °C juures ei ole vee tihedus neljast tüvenumbrist täpsem. Kui lahuse massi tüvenumbrite arv on ümardatud neljani, siis lugeda see õigeks.



$$\text{c) } \Sigma n(\text{NaOH}) = 36,0 \text{ g} \cdot 0,300 \cdot \frac{1 \text{ mol}}{40,0 \text{ g}} = \mathbf{0,270 \text{ mol}}$$

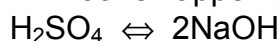
$$\text{d) } \quad \quad \quad 7,00 \text{ g}$$



$$233,4 \text{ g/mol}$$

$$n(\text{H}_2\text{SO}_4) = \frac{1}{1} \cdot 7,00 \text{ g} \cdot \frac{1 \text{ mol}}{233,4 \text{ g}} = 0,02999 \text{ mol} \approx \mathbf{0,0300 \text{ mol}}$$

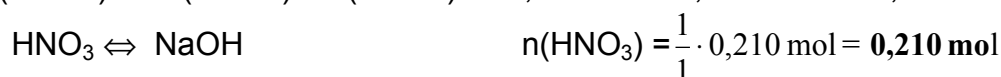
e) Vävelhappe neutraliseerimiseks kulub n' mooli NaOH



$$n'(\text{NaOH}) = \frac{2}{1} \cdot 0,0300 \text{ mol} = 0,0600 \text{ mol}$$

HNO₃ neutraliseerimiseks jääb:

$$n(\text{NaOH}) = \Sigma n(\text{NaOH}) - n'(\text{NaOH}) \Rightarrow 0,270 \text{ mol} - 0,0600 \text{ mol} = 0,210 \text{ mol}$$



$$\text{6. a) } m(\text{etanool}) = 1 \text{ L(lahus)} \cdot \frac{1000 \text{ cm}^3}{1 \text{ L}} \cdot \frac{40,0 (\text{etanool})}{100 (\text{lahus})} \cdot 0,794 \text{ g/cm}^3 = 317,6 \text{ g} \approx \mathbf{318 \text{ g}}$$

$$\text{b) } m(\text{etanool } 40,0 \% \text{ Vol.}) = 1 \text{ L (lahus)} \cdot \frac{1000 \text{ cm}^3}{1 \text{ L}} \cdot 0,950 \text{ g/cm}^3 = \mathbf{950 \text{ g}}$$

$$\%(\text{etanool}) = \frac{317,6}{950} \cdot 100 = 33,43 \approx \mathbf{33,4}$$

$$\text{c) } m(\text{etanool } 40,0 \% \text{ Vol.}) = 1 \text{ L(etanool)} \cdot \frac{1000 \text{ cm}^3}{1 \text{ L}} \cdot \frac{100 (\text{lahus})}{40,0 (\text{etanool})} \cdot 0,950 \text{ g/cm}^3 = 2375 \text{ g} \approx \mathbf{2380 \text{ g}}$$

$$\text{d) } V(\text{etanool } 40,0 \% \text{ Vol}) = 1 \text{ kg (etanool)} \cdot \frac{1000 \text{ g}}{1 \text{ kg}} \cdot \frac{1 \text{ cm}^3}{0,794 \text{ g}} \cdot \frac{1 \text{ L}}{1000 \text{ cm}^3} \cdot \frac{100 (\text{lahus})}{40,0 (\text{etanool})} = 3,149 \text{ L} \approx \mathbf{3,15 \text{ L}}$$

e) Ühest liitrist etanoolist sai valmistada 2375 g lahust (punkt c)

$$m(\text{etanool}) = 1 \text{ L (etanool)} \cdot \frac{1000 \text{ cm}^3}{1 \text{ L}} \cdot 0,794 \text{ g/cm}^3 = 794 \text{ g}$$

$$m(\text{H}_2\text{O}) = 2375 \text{ g} - 794 \text{ g} = 1581 \text{ g}$$

$$V(\text{H}_2\text{O}) = 1581 \text{ g (H}_2\text{O)} \cdot \frac{1 \text{ cm}^3}{1,00 \text{ g}} \cdot \frac{1 \text{ L}}{1000 \text{ cm}^3} = 1,581 \text{ L} \approx \mathbf{1,58 \text{ L}}$$