

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

1. $3,600 \text{ M} = 3,600 \text{ mol/dm}^3$

$$\rho(\text{H}_2\text{SO}_4 \text{ lahuse}) = \frac{\text{lahuse mass (grammides)}}{\text{lahuse ruumala (kuupsentimeetrites)}}$$

Täpselt ühes kuupdetsimeetris lahuses on 3,600 mol H_2SO_4 .
Seega lahuse ruumala on täpselt 1000 kuupsentimeetrit.

$$m(\text{H}_2\text{SO}_4) = 3,600 \text{ mol} \cdot 98,08 \text{ g/mol} = 353,09 \text{ g}$$

$$m(\text{H}_2\text{SO}_4 \text{ lahuse}) = 353,09 \text{ g} \cdot \frac{1}{0,2900} = 1218 \text{ g}$$

$$\rho(\text{H}_2\text{SO}_4 \text{ lahuse}) = \frac{1218 \text{ g}}{1000 \text{ cm}^3} = \mathbf{1,218 \text{ g/cm}^3}$$

2. a) $n(\text{H}_3\text{PO}_4) = 0,50 \text{ dm}^3 \cdot 0,10 \text{ mol/dm}^3 = 0,050 \text{ mol}$

$$n(\text{NaOH}) = 3,0 \text{ g} \cdot \frac{1 \text{ mol}}{40 \text{ g}} = \mathbf{0,075 \text{ mol}}$$

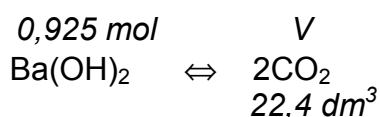
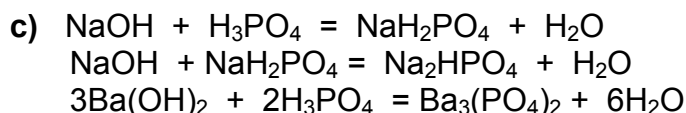
b) H_3PO_4 esimese prootoni neutraliseerimiseks kulub $\frac{1}{1} \cdot 0,050 \text{ mol NaOH}$.

Järelejäänud NaOH hulgast piisab moodustunud NaH_2PO_4 poole koguse üleviimiseks Na_2HPO_4 -ks. Peale lahuse kuivaksaurutamist on tahkete ainete segus **0,025 mol NaH_2PO_4** ja **0,025 mol Na_2HPO_4** .

$$\text{Ba}_3(\text{PO}_4)_2 \text{ moodustumiseks kulub } \frac{3}{2} \cdot 0,050 \text{ mol Ba(OH)}_2 \text{ ja järele jääb}$$

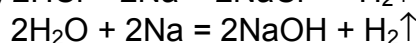
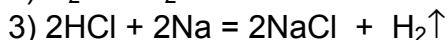
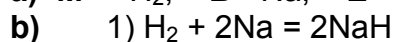
$$1,000 \text{ mol} - 0,075 \text{ mol} = 0,925 \text{ mol Ba(OH)}_2.$$

Peale lahuse kuivaksaurutamist on tahkete ainete segus **0,025 mol $\text{Ba}_3(\text{PO}_4)_2$** ja **0,925 mol Ba(OH)_2** .



$$V(\text{CO}_2) = \frac{2}{1} \cdot 0,925 \text{ mol} \cdot 22,4 \text{ dm}^3 = \mathbf{41,4 \text{ dm}^3}$$

3. a) **M** - H_2 ; **B** - Na; **E** - Cl_2 ; **G** - HCl; **L** - NaH.



c) Na asemel võiks olla **Li** või **K**.

Cl_2 asemel võiks olla **Br_2** või **I_2** (gaasilises olekus).

d) oksüdeerub: $\text{H}_2 + \text{Cl}_2 = 2\text{HCl}$ - vesinikkloriid

redutseerub: $\text{H}_2 + 2\text{Na} = 2\text{NaH}$ - naatriumhüdriid.

4. a) $\%(\text{Na}_2\text{SO}_4) = \frac{4,40}{220 \text{ g}} \cdot 100 = \mathbf{2,00}$

$$\text{b) } V(\text{Na}_2\text{SO}_4 \text{ lahus}) = 220\text{g} \cdot \frac{1\text{cm}^3}{1,016\text{g}} = \mathbf{216,5 \text{ cm}^3}$$

$$n(\text{Na}_2\text{SO}_4) = 4,40\text{g} \cdot \frac{1\text{mol}}{142\text{g}} = 0,03099 \text{ mol}$$

$$c(\text{Na}_2\text{SO}_4) = \frac{0,03099\text{mol}}{0,2165\text{dm}^3} = \mathbf{0,143 \text{ mol/dm}^3}$$

Märkus: vahetehete vastustes on üks lisanumber.

$$\text{c) } m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}) = 4,40\text{g} \cdot \frac{322\text{g/mol}}{142\text{g/mol}} = \mathbf{9,98 \text{ g}}$$

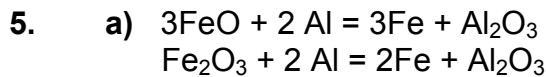
d) Tähistame $m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O})$ sümboliga $m(\text{kr.s})$

$$\frac{10,0\%}{100\%} = \frac{4,40\text{g} + m(\text{kr.s}) \cdot \frac{142}{322}}{220 + m(\text{kr.s})}$$

$$22,0 + 0,100 m(\text{kr.s}) = 4,40 + 0,441 m(\text{kr.s})$$

$$0,341m(\text{kr.s}) = 17,6 \text{ g};$$

$$m(\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}) = \mathbf{51,6 \text{ g}}$$



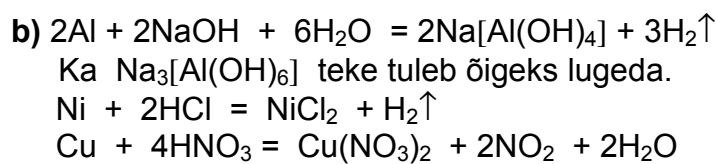
b) $\Delta H_{\text{red}}(\text{FeO}) \cdot 3\text{mol} = 1\text{mol} \cdot (-1675\text{kJ/mol}) - 3\text{mol} \cdot (-264\text{kJ/mol}) = -883 \text{ kJ/mol}$
 $\Delta H_{\text{red}}(\text{FeO}) = -883 \text{ kJ/mol} \cdot (1/3\text{mol}) = \mathbf{-294 \text{ kJ/mol}}$

$$\Delta H_{\text{red}}(\text{Fe}_2\text{O}_3) \cdot 1\text{mol} = 1\text{mol} \cdot (-1675\text{kJ/mol}) - 1\text{mol} \cdot (-821\text{kJ/mol}) = -854 \text{ kJ/mol}$$

$$\Delta H_{\text{red}}(\text{Fe}_2\text{O}_3) = -854 \text{ kJ/mol} \cdot (1/1\text{mol}) = \mathbf{-854 \text{ kJ/mol}}$$

c) 1) $\Delta H_{\text{saamine}}(\text{Fe}) \cdot 3\text{mol} = -883 \text{ kJ}$
 $\Delta H_{\text{saamine}}(\text{Fe}) = -883 \text{ kJ/mol} \cdot (1/3\text{mol}) = \mathbf{-294 \text{ kJ/mol}}$
2) $\Delta H_{\text{saamine}}(\text{Fe}) \cdot 2\text{mol} = -854 \text{ kJ}$
 $\Delta H_{\text{saamine}}(\text{Fe}) = -854 \text{ kJ/mol} \cdot (1/2\text{mol}) = \mathbf{-427 \text{ kJ/mol}}$

6. a) Tundmatu aine on **vask**.



c)

$$\begin{array}{ccc} m & & 1,87 \text{ dm}^3 \\ 2\text{Al} & \Leftrightarrow & 3\text{H}_2 \\ 27,0 \text{ g/mol} & & 22,4 \text{ dm}^3/\text{mol} \end{array}$$

$$m(\text{Al}) = \frac{2}{3} \cdot 1,87\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot 27,0\text{g/mol} = \mathbf{1,50 \text{ g}}$$

$$\begin{array}{ccc} m & & 1,50 \text{ dm}^3 \\ \text{Ni} & \Leftrightarrow & \text{H}_2 \\ 58,7 \text{ g/mol} & & 22,4 \text{ dm}^3/\text{mol} \end{array}$$

$$m(\text{Ni}) = \frac{1}{1} \cdot 1,50\text{dm}^3 \cdot \frac{1\text{mol}}{22,4\text{dm}^3} \cdot 58,7\text{g/mol} = \mathbf{3,93 \text{ g}}$$

$$m(\text{Cu}) = 30,00 - 1,50 \text{ g} - 3,93 \text{ g} = \mathbf{24,57 \text{ g}}$$