

# 1999/2000 õa keemiaolümpiaadi piirkondliku vooru ülesannete lahendused

## 9. klass

1. a) Mg – magneesium –  
MgO – magneesiumoksiid 0,5  
MgSO<sub>4</sub> – magneesiumsulfaat 0,5  
Mg(OH)<sub>2</sub> – magneesiumhüdroksiid 0,5  
MgCl<sub>2</sub> – magneesiumkloriid 0,5  
MgCO<sub>3</sub> – magneesiumkarbonaat 0,5  
Mg(HCO<sub>3</sub>)<sub>2</sub> – magneesiumvesinikkarbonaat 0,5
- b) 1)  $2\text{Mg} + \text{O}_2 = 2\text{MgO}$  1  
metall mittemetall aluseline oksiid
- 2)  $\text{MgO} + \text{H}_2\text{SO}_4 = \text{MgSO}_4 + \text{H}_2\text{O}$  1  
hape sool
- 3)  $\text{MgSO}_4 + 2\text{NaOH} = \text{Mg(OH)}_2\downarrow + \text{Na}_2\text{SO}_4$  1  
alus alus sool
- 4)  $\text{Mg(OH)}_2 + 2\text{HCl} = \text{MgCl}_2 + 2\text{H}_2\text{O}$  1  
hape sool
- 5)  $\text{MgCl}_2 + \text{Na}_2\text{CO}_3 = \text{MgCO}_3\downarrow + 2\text{NaCl}$  1  
sool sool sool
- 6)  $\text{MgCO}_3 + \text{H}_2\text{O} + \text{CO}_2 = \text{Mg(HCO}_3)_2$  1  
happeline oksiid vesiniksool
- 7)  $\text{Mg(HCO}_3)_2 = \text{MgO} + 2\text{CO}_2\uparrow + \text{H}_2\text{O}$   $\frac{1}{10}$   
**10 p**

2. a) Molekulide alljärgneva vastavuse korral on mõlemas aines võrdne mass lämmastikku:

$$V \cdot 0,958 \text{ g/cm}^3 \cdot 0,100 \cdot 5000 \text{ g} \quad 2\text{NH}_3 \Leftrightarrow (\text{NH}_2)_2\text{CO} \quad 1^*$$

$$17 \text{ g/mol} \quad 60,1 \text{ g/mol}$$

$$V(\text{NH}_3) = \frac{2}{1} \cdot \frac{5000 \text{ g}}{60,1 \text{ g/mol}} \cdot 17 \text{ g/mol} \cdot \frac{1}{0,100} \cdot \frac{1 \text{ cm}^3}{0,958 \text{ g}} = 29530 \text{ cm}^3 \approx \mathbf{29,5 \text{ l}} \quad 3$$

b)  $m \cdot 0,850 \quad 5,00 \text{ kg} \quad 2\text{NaNO}_3 \Leftrightarrow (\text{NH}_2)_2\text{CO} \quad 1^*$   
85,0 kg/kmol  $60,1 \text{ kg/kmol}$

$$m(\text{NaNO}_3) = \frac{2}{1} \cdot 5,00 \text{ kg} \cdot \frac{1 \text{ kmol}}{60,1 \text{ kg}} \cdot \frac{85,0 \text{ kg}}{1 \text{ kmol}} \cdot \frac{1}{0,850} = \mathbf{16,6 \text{ kg}} \quad \underline{3}$$

**8 p**

3. a) 1)  $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} = 4\text{H}_3\text{PO}_4$  1\*  
2)  $3\text{CrO}_3 + \text{Al}_2\text{O}_3 = \text{Al}_2(\text{CrO}_4)_3$  1\*  
3)  $\text{FeSO}_4 + 6\text{KCN} = \text{K}_4[\text{Fe(CN)}_6] + \text{K}_2\text{SO}_4$  1\*  
4)  $3\text{Cr}_2\text{O}_3 + \text{Fe}_2\text{O}_3 = 2\text{Fe(CrO}_2)_3$  1\*

- b) Antud reaktsioonides on happelisteks oksiidideks:

P<sub>4</sub>O<sub>10</sub> – tetrafosfordekaoksiid ehk fosfor(V)oksiid; 1  
CrO<sub>3</sub> – (mono)kroomtrioksiid ehk kroom(VI)oksiid; 1  
Cr<sub>2</sub>O<sub>3</sub> – dikroomtrioksiid ehk kroom(III)oksiid 1

- c)  $6\text{H}_2\text{O} \Leftrightarrow 4\text{H}_3\text{PO}_4$  0,5

$$n(\text{H}_2\text{O}) = \frac{6}{4} \cdot 20 = \mathbf{30 \text{ mol}} \quad 1$$

- d)  $6\text{KCN} \Leftrightarrow \text{K}_4[\text{Fe(CN)}_6]$  0,5

$$n\{\text{K}_4[\text{Fe(CN)}_6]\} = \frac{1}{6} \cdot 1,5 = \mathbf{0,25 \text{ mol}} \quad \underline{1}$$

**10 p**

4. a) i)  $\text{MgCO}_3 + 2\text{HCl} = \text{MgCl}_2 + \text{H}_2\text{O} + \text{CO}_2$  1\*
- ii)  $\text{Al}(\text{OH})_3 + 3\text{HCl} = \text{AlCl}_3 + 3\text{H}_2\text{O}$  1\*
- b)  $M(\text{MgCO}_3) = 84,0 \text{ g/mol}$  1
- $M[\text{Al}(\text{OH})_3] = 78,0 \text{ g/mol}$  1
- c) Olgu  $m(\text{MgCO}_3) = x$ , siis  $m[\text{Al}(\text{OH})_3] = 0,700 \text{ g} - x$
- $\text{MgCO}_3 \Leftrightarrow 2\text{HCl}$   $n'(\text{HCl}) = \frac{2}{1}x \cdot \frac{1 \text{ mol}}{84,0 \text{ g}}$  1\*
- $\text{Al}(\text{OH})_3 \Leftrightarrow 3\text{HCl}$   $n''(\text{HCl}) = \frac{3}{1}(0,700 \text{ g} - x) \cdot \frac{1 \text{ mol}}{78,0 \text{ g}}$  1\*
- d)  $n' + n'' = 0,0200 \text{ mol}$  0,5
- $2x \cdot \frac{1 \text{ mol}}{84,0 \text{ g}} + 3(0,700 \text{ g} - x) \cdot \frac{1 \text{ mol}}{78,0 \text{ g}} = 0,0200 \text{ mol}$  }
- Ühik mol taandub } 3,5
- $0,0238x \cdot \frac{1}{\text{g}} + 0,0269 - 0,0385x \cdot \frac{1}{\text{g}} = 0,0200$
- $0,0147x = 0,0069 \text{ g}$
- $m(\text{MgCO}_3) = 0,47 \text{ g}$**  0,5
- $m[\text{Al}(\text{OH})_3] = 0,23 \text{ g}$**  0,5
- Märkus:** Vastused on kahe tüvenumbri täpsusega, sest vahe 0,0269 - 0,0200 annab täpsuseks kaks tüvenumbrit. 11 p
5. 1) a)  $2\text{H}_3\text{PO}_4 + 3\text{Ca}(\text{OH})_2 = \text{Ca}_3\text{PO}_4 + 6\text{H}_2\text{O}$  1\*
- b)  $\text{Ca}(\text{OH})_2 + 2\text{HCl} = \text{CaCl}_2 + 2\text{H}_2\text{O}$  1\*
- c)  $\text{H}_3\text{PO}_4 + 3\text{NaOH} = \text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$  1\*
- d)  $\text{Ca}(\text{OH})_2 + \text{H}_2\text{CO}_3 = \text{CaCO}_3 + 2\text{H}_2\text{O}$  1\*
- 2) Esimest lähteainet peaks täielikuks neutraliseerimiseks olema
- a)  $n_1 = \frac{2}{3} \cdot 12 = 8 \text{ mol}$ ; on ekvivalentselt 1
- b)  $n_1 = \frac{1}{2} \cdot 6 = 3 \text{ mol}$ ; liias on HCl 1
- c)  $n_1 = \frac{1}{3} \cdot 3 = 1 \text{ mol}$ ; liias on  $\text{H}_3\text{PO}_4$  1
- d)  $n_1 = \frac{1}{1} \cdot 5 = 5 \text{ mol}$ ; liias on  $\text{H}_2\text{CO}_3$  1
- 3) a) sama, mis 1)a) 0,5
- b) sama, mis 1)b) 0,5
- c)  $\text{H}_3\text{PO}_4 + \text{NaOH} = \text{NaH}_2\text{PO}_4 + 3\text{H}_2\text{O}$  1\*
- d)  $\text{Ca}(\text{OH})_2 + 2\text{H}_2\text{CO}_3 = \text{Ca}(\text{HCO}_3)_2 + 2\text{H}_2\text{O}$  1\*
- 4) a) ei jäänud 0,5
- b) 2 mol HCl  $n(\text{HCl}) = 6 \text{ mol} - \frac{2}{1} \cdot 2 \text{ mol} = 2 \text{ mol}$  0,5
- c) ei jäänud 0,5
- d) ei jäänud. 0,5
- 13 p**
6.  $m(\text{HCl, alguses}) = 125,0 \text{ cm}^3 \cdot 1,198 \text{ g/cm}^3 \cdot 0,400 = 59,9 \text{ g}$  2
- $m(\text{H}_2\text{O, alguses}) = 125,0 \text{ cm}^3 \cdot 1,198 \text{ g/cm}^3 \cdot 0,600 = 89,9 \text{ g}$  1
- $V(\text{lahus, lõpus}) = 125,0 \text{ cm}^3 - 25,0 \text{ cm}^3 = 100,0 \text{ cm}^3$  1
- $m(\text{HCl, lõpus}) = 100,0 \text{ cm}^3 \cdot 1,147 \text{ g/cm}^3 \cdot 0,305 = 35,0 \text{ g}$  1
- $m(\text{H}_2\text{O, lõpus}) = 100,0 \text{ cm}^3 \cdot 1,147 \text{ g/cm}^3 \cdot 0,695 = 79,7 \text{ g}$  1
- $\Delta m(\text{HCl}) = 59,9 \text{ g} - 35,0 \text{ g} = 24,9 \text{ g}$**  1
- $\Delta m(\text{H}_2\text{O}) = 89,9 \text{ g} - 79,7 \text{ g} = 10,2 \text{ g}$**  1
- 8 p**