

**2000/2001 õa keemiaolümpiaadi piirkondliku vooru
ülesannete lahendused
8. klass**

1. a) **1** - keeduklaas, **2** - klaaspulk, **3** - lehter, **4** - kooniline (Erlenmeyeri) kolb,
5 - jaotuslehter, **6** - portselankauss, **7** - asbestvõrk, **8** - statiiv,
9 - gaasipõleti, **10** – seisukolb, **11** – jahuti, **12** – termomeeter. 6

b) **A. i)** filtrimine, **ii)** tahkete ainete vedelikest eraldamine, **iii)** lahustuvus;
B. i) eraldamine jaotuslehtriga, **ii)** mittesegunevad vedelikud,
iii) tihedus, lahustuvus;
C. i) aurustamine, **ii)** lahustunud tahke aine ja lahusti,
iii) keemistemperatuur;
D. i) destilleerimine, **ii)** segunevad vedelikud, **iii)** keemistemperatuur. 3

c) **i)** kuumutamiseks, **ii)** keeduklaasi ei või ja portselankaussi pole soovitatav lahtisel leegil kuumutada.
Asbestvõrk ühtlustab väga suurt temperatuuride erinevust. 2.
11 p

2. a) **i)** Kolmest osast.

ii) Ülemine kiht (benseeni ja heksaani lahus – tihedus $\approx 0,77 \text{ g/cm}^3$);
keskmine kiht (NaCl vesilahuse tihedus $> 1 \text{ g/cm}^3$);
alumine kiht (liiv – tihedus $2,6 \text{ g/cm}^3$). 4

b) i) Filtreerimisseadme **A** abil eraldatakse **liiv** vedelikust, pestakse veega ja kuivatatakse.
ii) Jaotuslehtri (seade **B**) abil lastakse *NaCl* vesilahus keeduklaasi. *Heksaani* ja *benseeni* lahus jääb jaotuslehtrisse.
iii) Portselankaussis (seade **C**) aurutatakse **NaCl** vesilahus kuivaks. Ka heksaani ja benseeni jäägid lenduvad.
iv) *Heksaani* ja *benseeni* lahus viiakse destillatsiooniseadmesse **D**. Destillatsioonil eraldub esmalt **heksaan**.
Benseen eraldub pärast **heksaani**. 5

c) **i)** $m(\text{liiv}) = 25 \text{ cm}^3 \cdot 2,3 \text{ g/cm}^3 \approx 58 \text{ g}$
ii) $m(\text{benseen}) = 25 \text{ cm}^3 \cdot 0,88 \text{ g/cm}^3 = 22 \text{ g}$ 1.
10 p

3. a) **i)**
$$N(\text{C}) = 342 \frac{\text{amü}}{\text{molekul}} \cdot 0,42 \cdot \frac{1 \text{ aatom}}{12 \text{ amü}} = 11,97 \frac{\text{aatom}}{\text{molekul}} \approx 12 \frac{\text{aatom}}{\text{molekul}}$$

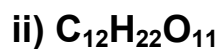
Sahharoosi molekulmassist moodustab hapniku ja vesiniku aatommasside summa $100\% - 42\% = 58\%$

$$m(\text{O+H}) = 342 \frac{\text{amü}}{\text{molekul}} \cdot 0,58 = 198,36 \frac{\text{amü}}{\text{molekul}}$$

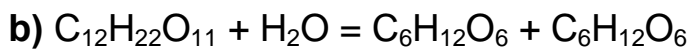
Sellest massist moodustab vesiniku aatomite mass $1/9$ ja hapniku aatomite mass $8/9$.

$$N(\text{H}) = 342 \frac{\text{amü}}{\text{molekul}} \cdot 0,58 \cdot \frac{1}{9} \cdot \frac{1 \text{ aatom}}{1,0 \text{ amü}} = 22,04 \frac{\text{aatom}}{\text{molekul}} \approx 22 \frac{\text{aatom}}{\text{molekul}}$$

$$N(O) = 342 \frac{\text{amü}}{\text{molekul}} \cdot 0,58 \cdot \frac{8}{9} \cdot \frac{1 \text{ aatom}}{16 \text{ amü}} = 11,02 \frac{\text{aatom}}{\text{molekul}} \approx 11 \frac{\text{aatom}}{\text{molekul}}$$



4,5



glükoos fruktoos

Aatomite arv on mõlemal pool võrdne.

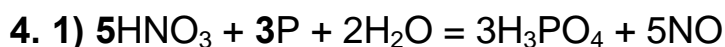
Glükoosi ja fruktoosi bruto-valemid on ühesugused.

2

c) Süsivesikud sisaldavad kõik süsinikku;

vesiniku ja hapniku aatomite suhe nende molekulides on sama, mis vees 0,5.

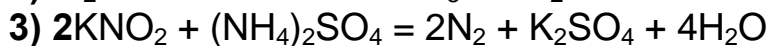
7 p



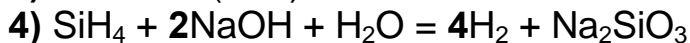
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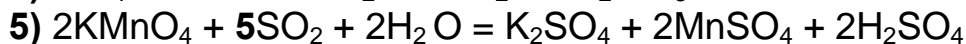
2,5



1,5



3



2
12 p

5. Olgu kergema isotoobi aatomi mass a ja raskema isotoobi mass b. Et nende isotoopide aatommasside jagatis on ühest väiksem, siis see jagatis on a/b.

a) $\frac{a}{b} \Rightarrow \frac{b - 2,00 \text{ amü}}{b} = 0,9692$

$0,0308b = 2,00 \text{ amü}$

b = 64,9 amü

a = 64,9 amü - 2,00 amü = 62,9 amü

5

b) $A_r(X) = 64,9 - 1,4 = 63,5$

Metall X on **Cu – vask**

2

c) Kergem isotoop koosneb 29 prootonist, 29 elektronist ja 34 neutronist.

Raskem isotoop – 29 prootonist, 29 elektronist ja 36 neutronist.

2
9 p

6. a) $m(C) = 55 \text{ aat} \cdot 12,01 \text{ amü/aatom} = 660,55 \text{ amü}$

$m(H) = 72 \text{ aat} \cdot 1,01 \text{ amü/aatom} = 72,72 \text{ amü}$

$m(N) = 4 \text{ aat} \cdot 14,0 \text{ amü/aatom} = 56,0 \text{ amü}$

$m(O) = 5 \text{ aat} \cdot 16,0 \text{ amü/aatom} = 80,0 \text{ amü}$

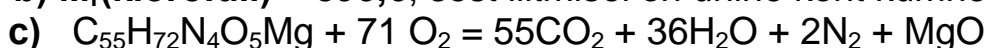
$m(Mg) = 1 \text{ aat} \cdot 24,3 \text{ amü/aat} = 24,3 \text{ amü}$

$M_r(\text{klorofüll}) = 893,57 \approx 894$

6

b) $M_r(\text{klorofüll}) = 893,6$, sest liitmisel on ühine koht kümnendikud.

1



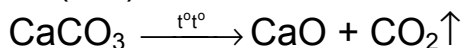
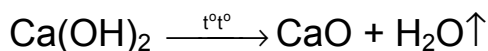
4
11 p

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9. klass**

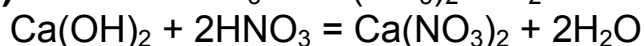
1. a) $\Sigma \$ = 4,50 \cdot 10^9 \text{ aastat} \cdot \frac{365,25 \text{ päeva}}{\text{aastas}} \cdot \frac{24 \text{ tundi}}{\text{päevas}} \cdot \frac{3,6 \cdot 10^3 \text{ sekundit}}{\text{tunnis}} \cdot \frac{10^6 \$}{\text{sekundis}} = 1,42 \cdot 10^{23} \text{ 4}$
- b) $\%(\text{kulutamata}) = \frac{6,02 \cdot 10^{23} - 1,42 \cdot 10^{23}}{6,02 \cdot 10^{23}} \cdot 100 = 76,4 \quad 2$
- c) $\Sigma \$ = 1 \text{ aasta} \cdot \frac{365,25 \text{ päeva}}{\text{aastas}} \cdot \frac{24 \text{ tundi}}{\text{päevas}} \cdot \frac{3,6 \cdot 10^3 \text{ sekundit}}{\text{tunnis}} \cdot \frac{1 \$}{\text{sekundis}} = 31\,558\,000 \quad \underline{4}$
- 10 p**
2. a) $0,33 = \frac{5,7 \text{ dm}^3 \cdot 1052 \text{ g/dm}^3 \cdot 0,080 + V \cdot 1834 \text{ g/dm}^3 \cdot 0,95}{5,7 \text{ dm}^3 \cdot 1052 \text{ g/dm}^3 + V \cdot 1834 \text{ g/dm}^3}$
 $0,33 \cdot (5996 \text{ g} + V \cdot 1834 \text{ g/dm}^3) = 479,7 \text{ g} + V \cdot 1742 \text{ g/dm}^3$
 $1499 = V \cdot 1137 \cdot 1/\text{dm}^3$
V(95% H₂SO₄) = 1,32 dm³ ≈ 1,3 dm³ 5
- b) $m(8,0\% \text{ H}_2\text{SO}_4) = 5,7 \text{ dm}^3 \cdot 1052 \text{ g/dm}^3 = 5996 \text{ g}$
 $m(95\% \text{ H}_2\text{SO}_4) = 1,32 \text{ dm}^3 \cdot 1834 \text{ g/dm}^3 = 2421 \text{ g}$
 $m(\text{akuhape}) = 8417 \text{ g}$
V(akuhape) = 8417 g · $\frac{1 \text{ dm}^3}{1243 \text{ g}}$ = 6,77 dm³ ≈ 6,8 dm³ 4,5
- c) Kontsentreeritud hape tuleb peenikese joana valada lahjendatud happesse. Lahust segada ja jahutada. 1,5
- 11 p**
3. a) **A** – Fe₂O₃, raud(III)oksiid; **B** – Al₂O₃, alumiiniumoksiid; **C** – FeO, raud(II)oksiid;
D – Fe₃O₄, raud(II)diraud(III)oksiid; **E** – Fe(OH)₂, raud(II)hüdroksoid;
F – Fe(OH)₃, raud(III)hüdroksoid; **G** – Al(OH)₃, alumiiniumhüdroksoid;
H – AlCl₃, alumiiniumkloriid; **I** – FeCl₂, raud(II)kloriid; **J** – FeCl₃, raud(III)kloriid. 5
- b) x -II
Fe₃O₄ 3x + 4·(-2) = 0 x = 8/3 1
- c) i) 4Fe + 3O₂ = 2Fe₂O₃
A 0,5
- ii) Fe₂O₃ + 2Al = Al₂O₃ + 2Fe
A **B** 0,5
- iii) 4Fe(OH)₂ + O₂ + 2H₂O = 4Fe(OH)₃
E **F** 1,5
- iv) 12HCl + 3O₂ + 4Fe = 4FeCl₃ + 6H₂O
J 1,5
- d) i) 6HCl + 2Al = 2AlCl₃ + 3H₂
H 1
- ii) AlCl₃ + 3NaOH = Al(OH)₃↓ + 3NaCl
H **G** 0,5
- iii) 2Al(OH)₃ $\xrightarrow{\text{t}^\circ}$ Al₂O₃ + 3H₂O
G **B** 0,5

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1. a) i) CaO kuumutamisel ei muutu



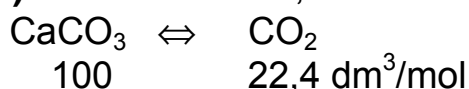
ii) $\text{CaO} + 2\text{HNO}_3 = \text{Ca(NO}_3)_2 + \text{H}_2\text{O}$



5

b) $\Delta m[\text{Ca(OH)}_2 + \text{CaCO}_3] = 7,1 \text{ g}$

i) ja ii) m 2,24 dm³



$$n(\text{CaCO}_3) = n(\text{CO}_2) = 2,24 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = \mathbf{0,100 \text{ mol}}$$

$$m(\text{CaCO}_3) = 0,100 \text{ mol} \cdot \frac{100 \text{ g}}{1 \text{ mol}} = \mathbf{10,0 \text{ g}}$$

$$m(\text{CO}_2) = 0,100 \text{ mol} \cdot 44,0 \text{ g/mol} = 4,40 \text{ g}$$

$$m(\text{H}_2\text{O, kaltsiumhüdroksiidist}) = 7,1 \text{ g} - 4,40 \text{ g} = 2,7 \text{ g}$$

$$n[\text{Ca(OH)}_2] = n(\text{H}_2\text{O}) = 2,7 \text{ g} \cdot \frac{1 \text{ mol}}{18,0 \text{ g}} = \mathbf{0,15 \text{ mol}}$$

$$m[\text{Ca(OH)}_2] = 0,15 \text{ mol} \cdot 74,1 \text{ g/mol} = 11,1 \text{ g} \approx \mathbf{11 \text{ g}}$$

$$m(\text{CaO}) = 23,9 \text{ g} - 10,0 \text{ g} - 11,1 \text{ g} = \mathbf{2,8 \text{ g}}$$

$$n(\text{CaO}) = 2,8 \text{ g} \cdot \frac{1 \text{ mol}}{56,1 \text{ g}} \approx \mathbf{0,050 \text{ mol}}$$

iii) $\text{CaO} : \text{Ca(OH)}_2 : \text{CaCO}_3 = 0,050 : 0,15 : 0,100 \Rightarrow \mathbf{1 : 3 : 2}$

6.
11 p

2. a) **A** – FeSO₄, raud(II)sulfaat;

B – Fe(OH)₂, raud(II)hüdroksiid;

C – Na₂SO₄, naatriumsulfaat;

D – BaCl₂, baariumkloriid;

E – BaSO₄, baariumsulfaat;

F – Fe₃O₄, raud(II)diraud(III)oksiid;

G – FeCl₂, raud(II)kloriid;

H – FeCl₃, raud(III)kloriid.

4

b) i) $\text{FeSO}_4 + 2\text{NaOH} = \text{Fe(OH)}_2\downarrow + \text{Na}_2\text{SO}_4$

A

B

C

ii) $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 = \text{BaSO}_4\downarrow + 2\text{NaCl}$

C

D

E

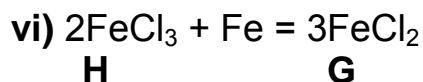
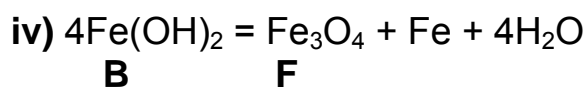
iii) $\text{FeSO}_4 + \text{BaCl}_2 = \text{BaSO}_4\downarrow + \text{FeCl}_2$

A

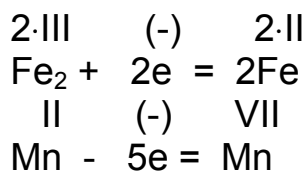
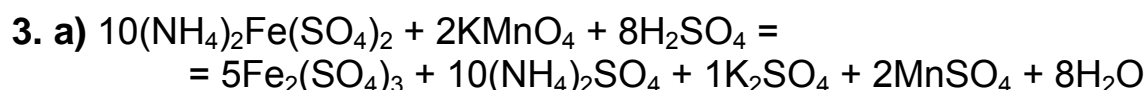
D

E

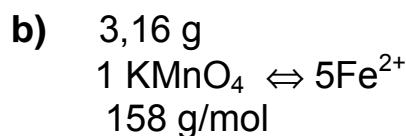
G



6.
10 p



4



$$n(\text{Fe}^{2+}) = \frac{5}{1} \cdot 3,16 \text{ g} \cdot \frac{1 \text{ mol}}{158 \text{ g}} = \mathbf{0,100 \text{ mol}}$$

2

c) $M[(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2] = 392 \text{ g/mol} - 6 \cdot 18,0 \text{ g/mol} = 284 \text{ g/mol}$
 $m[(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2] = 0,100 \text{ mol} \cdot 284 \text{ g/mol} = \mathbf{28,4 \text{ g}}$

2

d) $m(\text{Mohri sool}) = 0,100 \text{ mol} \cdot 392 \text{ g/mol} = 39,2 \text{ g}$
 $m(\text{H}_2\text{O, Mohri soola lahustamiseks}) = 958 \text{ g} - 39,2 \text{ g} \approx \mathbf{919 \text{ g}}$

2.
10 p

4. a) i) $\%(\text{HCl, A}) = \frac{1,00 \text{ mol} \cdot 36,5 \text{ g/mol}}{36,5 \text{ g} + 100 \text{ g}} \cdot 100 = \mathbf{26,7}$

ii) $\%(\text{HCl, B}) = \frac{36,08 \text{ cm}^3 \cdot 1,133 \text{ g/cm}^3 \cdot 0,267}{200,0 \text{ cm}^3 \cdot 1,036 \text{ g/cm}^3} \cdot 100 = \mathbf{5,27}$

4

b) i) $m(\text{H}_2\text{O}) = 200,0 \text{ cm}^3 \cdot 1,036 \text{ g/cm}^3 - 36,08 \text{ cm}^3 \cdot 1,133 \text{ g/cm}^3 =$
 $= 207,2 \text{ g} - 40,88 \text{ g} = \mathbf{166,3 \text{ g}}$

ii) $\Sigma V = 166,3 \text{ g} \cdot 1 \text{ cm}^3 / 0,9962 \text{ g} + 36,08 \text{ cm}^3 = 203,0 \text{ cm}^3$
 $\Delta V = 200,0 \text{ cm}^3 - 203,0 \text{ cm}^3 = \mathbf{-3,0 \text{ cm}^3}$

4.
8 p

5. a) i) Väga väikene tihedus ($0,0900 \text{ g/dm}^3$) saab olla ainult gaasilisel ainel

$$M(\text{aine B}) = 0,0900 \text{ g/dm}^3 \cdot 22,4 \text{ dm}^3/\text{mol} \approx \mathbf{2,02 \text{ g/mol}}$$

ii) Aine B on vesinik (H_2)

2

b) i) Aine C molekulis on kaks liitiumi aatomit,
mis moodustab molekulmassist (molaarmassist) 13,62%.

$$M(\text{aine C}) = 2 \cdot 6,94 \text{ g} \cdot \frac{100}{13,62} \cdot \frac{1}{\text{mol}} = 101,9 \text{ g/mol} \approx \mathbf{102 \text{ g/mol}}$$

ii) Aines A, võrreldes ainega B, puuduvad liitiumi aatomid.
Nende asemel on vesiniku aatomid.

$$M(\text{aine A}) = (101,9 \text{ g} - 2 \cdot 6,94 \text{ g} + 2,02 \text{ g}) \cdot \frac{1}{\text{mol}} \approx \mathbf{90,0 \text{ g/mol}}$$

3

c)

$$\text{CO}_2 \Leftrightarrow \text{C}$$
$$n(\text{C}) = \frac{1}{1} \cdot \frac{90,0}{9,0} \cdot 4,48 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = 2,0 \text{ mol}$$

$$\text{H}_2\text{O} \Leftrightarrow 2\text{H}$$
$$n(\text{H}) = \frac{2}{1} \cdot \frac{90,0}{9,0} \cdot 1,8 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 2,0 \text{ mol}$$

$$\text{CO}_2 \Leftrightarrow 2\text{O} \quad \text{H}_2\text{O} \Leftrightarrow \text{O} \quad \text{O}_2 \Leftrightarrow 2\text{O}$$
$$n(\text{O}) = \frac{2}{1} \cdot 2,0 \text{ mol} + \frac{1}{1} \cdot 1,0 \text{ mol} - \frac{2}{1} \cdot 0,50 \text{ mol} = 4,0 \text{ mol}$$

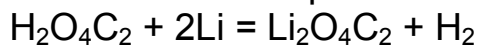
lisatud hapnik

i) $\text{H}_2\text{O}_4\text{C}_2$

4

d) i) Et liitium tõrjub aimest A vesiniku välja ja moodustub sool,
siis on tegemist happega.

See on etaandihape ehk oblikhape (COOH)₂.



2
11 p

6. a) i) $\text{Ca}^{2+} + \text{SO}_4^{2-} = \text{CaSO}_4$ (ei reageeri hapetega)

ii) Kollane leegi värvus viitab naatriumi olemasolule.

Na_2SO_4 (kolm elementi)

$$M(\text{Na}_2\text{SO}_4) = \mathbf{142 \text{ g/mol}}$$

4

b) i) $m(\text{B}) \cdot 0,441 \Leftrightarrow m(\text{A})$

$$M(\text{aine B}) = 142 \text{ g/mol} \cdot \frac{100}{44,1} = \mathbf{322 \text{ g/mol}}$$

ii) $m(\text{B}) \cdot (1 - 0,559) \Leftrightarrow m(\text{A})$

$$M(\text{aine B}) = 142 \text{ g/mol} \cdot \frac{100}{100 - 55,9} = 322 \text{ g/mol}$$

3

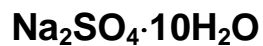
Märkus: 100% on tervik. Arv 100 on lõpmatult täpne.

c) i) Aine **B** on kristallhüdraat.

Vees sisalduv vesinik on veevaba soolaga võrreldes neljandaks elemendiks.

$$m(\text{H}_2\text{O}) = 322 \text{ g} \cdot 0,559 = 180 \text{ g}$$

$$n(\text{H}_2\text{O}) = 180 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 10 \text{ mol}$$



ii) Naatriumsulfaat-vesi(1/10).

Десятиводный кристаллогидрат сульфата натрия.

3
10 p

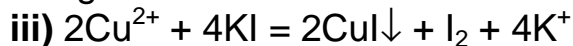
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11. klass**

1. a) CH_3COOH – etaanhape, äädikhape 1
- b) $\text{NaOH} + \text{CH}_3\text{COOH} = \text{CH}_3\text{COONa} + \text{H}_2\text{O}$ 1
- c) i) $n(\text{NaOH}) = 1,00 \text{ dm}^3 \cdot 1109 \text{ g/dm}^3 \cdot 0,100 \cdot \frac{1 \text{ mol}}{40,0 \text{ g}} \approx 2,77 \text{ mol}$
 $n(\text{CH}_3\text{COOH}) = 2,00 \text{ dm}^3 \cdot 1019,5 \text{ g/dm}^3 \cdot 0,100 \cdot \frac{1 \text{ mol}}{60,0 \text{ g}} \approx 3,40 \text{ mol}$
 ii) $n(\text{NaOH}) = 0$
 $n(\text{CH}_3\text{COOH}) = 3,40 - 2,77 \text{ mol} = 0,63 \text{ mol}$
 $n(\text{CH}_3\text{COONa}) = 2,77 \text{ mol}$ 3
- d) i) $\text{CH}_3\text{COOH} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}^+$
 ii) $K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}^+]}{[\text{CH}_3\text{COOH}]}$ 2
- e) i) $[\text{H}^+] = \frac{K_a \cdot c_{\text{hape}}}{c_{\text{sool}}}$, sest saadi puhverlahus
 ii) $[\text{H}^+] = 1,85 \cdot 10^{-5} \text{ mol/dm}^3 \cdot \frac{0,63}{2,77} \approx 4,2 \cdot 10^{-6} \text{ mol/dm}^3$
Märkus: Molaarseid kontsentratsioone pole vaja välja arvutada, sest ruumalad on samad ja taanduvad avaldisest välja. 2
- f) $\text{pH} = -\lg 4,2 \cdot 10^{-6} = 5,376 \approx 5,4$ $\frac{1}{10} \text{ p}$
2. a) No 1 – $\text{Al}_2(\text{SO}_4)_3$
 No 2 – FeCl_2
 No 3 – Na_2CO_3
 No 4 – NaOH 2
- b) 1 ja 3 – $\text{Al}_2(\text{SO}_4)_3 + 3\text{Na}_2\text{CO}_3 + 3\text{H}_2\text{O} = 2\text{Al}(\text{OH})_3\downarrow + 3\text{Na}_2\text{SO}_4 + 3\text{CO}_2\uparrow$ 2
- 1 ja 4 – $\text{Al}_2(\text{SO}_4)_3 + 6\text{NaOH} = 2\text{Al}(\text{OH})_3\downarrow + 3\text{Na}_2\text{SO}_4$ 0,5
 $\text{Al}(\text{OH})_3 + 3\text{NaOH} = \text{Na}_3[\text{Al}(\text{OH})_6]$; ka $\text{Na}[\text{Al}(\text{OH})_4]$ on õige. 0,5
- 2 ja 3 – $\text{FeCl}_2 + \text{Na}_2\text{CO}_3 = \text{FeCO}_3\downarrow + 2\text{NaCl}$ 1,5
- 2 ja 4 – $\text{FeCl}_2 + 2\text{NaOH} = \text{Fe}(\text{OH})_2\downarrow + 2\text{NaCl}$ $\frac{0,5}{7} \text{ p}$

3. a) i) Element **X** on ühendis **A** maksimaalselt oksüdeerunud olekus. 0,5

ii) Aine **A** vesilahus on stabiilne. Oksüdeerunud olekus aine **A** ei saa vees lahustunud hapnikuga reageerida, küll aga reageerib redutseerunud olekus.

Seega redutseerunud olek on välistatud. 0,5



B C

b) i) $n(\text{O}) = 40 \text{ g} \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 2,5 \text{ mol}$

$$n(\text{C}) = 24 \text{ g} \cdot \frac{1 \text{ mol}}{12 \text{ g}} = 2 \text{ mol}$$

$$n(\text{H}) = 4 \text{ g} \cdot \frac{1 \text{ mol}}{1 \text{ g}} = 4 \text{ mol}$$

Suhte $n(\text{O}) : n(\text{C}) : n(\text{H}) = 5 : 4 : 8$ põhjal peab elementi **X** olema 64 g, millest

$$M(\text{X}) = \frac{64 \text{ g}}{1 \text{ mol}} = 64 \text{ g/mol, so Cu, millel on ioonid Cu}^+ \text{ ja Cu}^{2+}.$$

Brutovalem on **CuC₄H₈O₅** 3,5

ii) Kristalne olek ja vesilahuse väiksem protsendiline sisaldus viitab kristallhüdraadile. Paaritu arvulise hapniku aatomite arvu järgi võiks oletada üht vee molekuli, jääb brutovalem **CuC₄H₆O₄**.

Vase ioon viitab soolale **(CH₃COO)₂Cu**

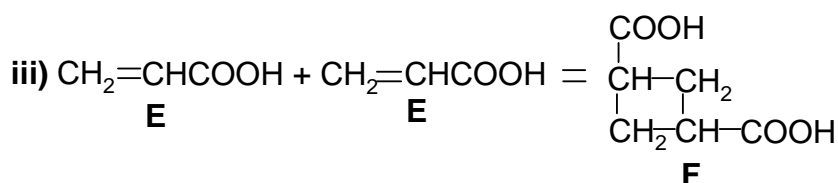
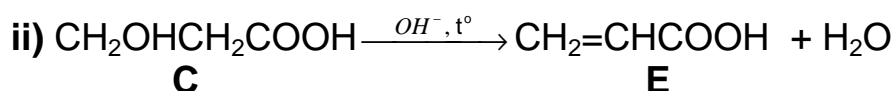
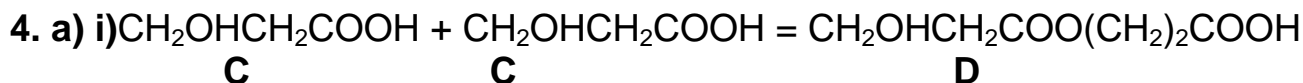
Seega aine **A** valem on:

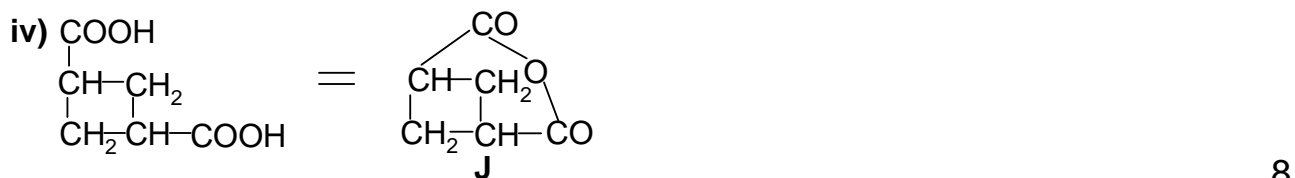


c) Aine **Y** on **etaanhape (CH₃COOH)**.

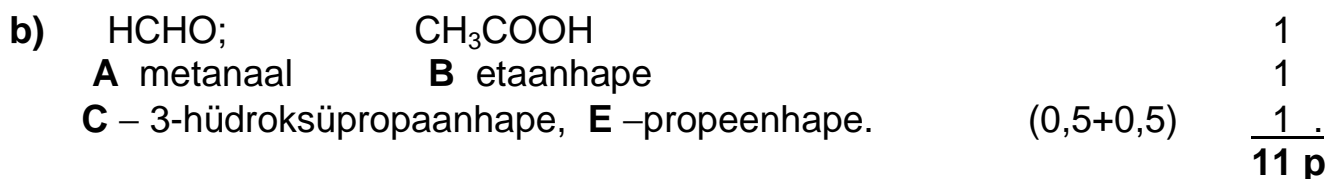
Aine **A** täielikule hüdrolyüsile aitavad kaasa merevees olevad jodiidioonid, mis tekitavad rasklahustuva **CuI**.

$\frac{1}{9}$ p

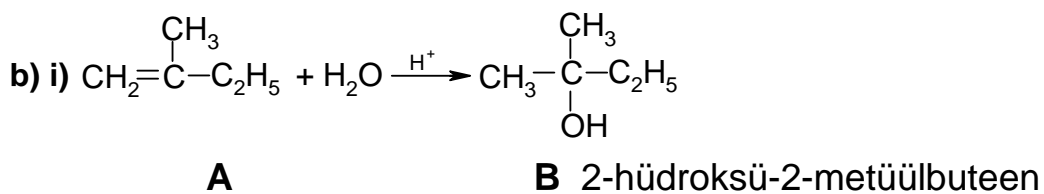
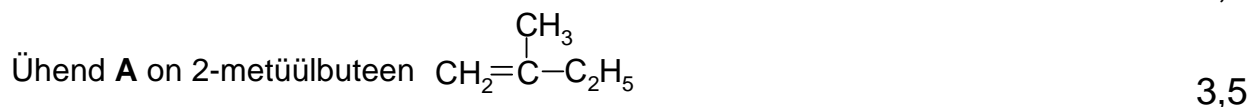




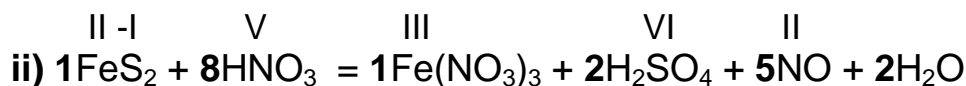
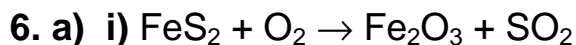
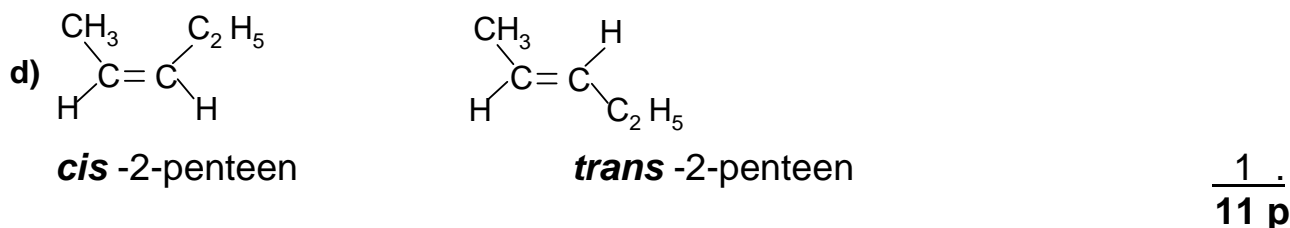
8

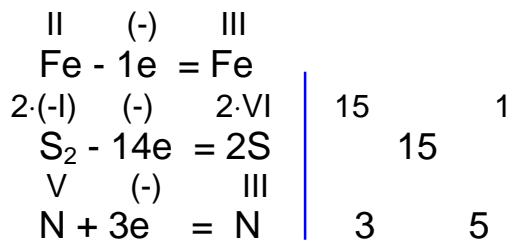


5. a) Aine **B** ja moodustunud polümeer jälgivad aine **A** struktuuri. Kui tertsiaarses alkoholis kõik alküülrühmad oleks metüülrühmad, siis peaks tema molaarmass olema 74 g/mol. Molaarmassist 88 g/mol tuleneb, et üks rühmadest on etüülrühm. 0,5

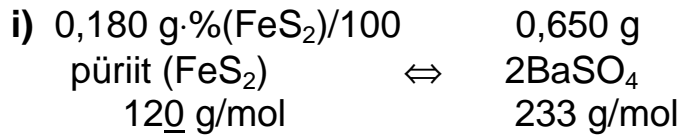


c) aine **C** on 2-metüülbutaan CH₃C(CH₃)C₂H₅
 aine **D** on 2-metüül-2-klorobutaan CH₃CCl(CH₃)C₂H₅
 aine **E** on 1,2-dibromo-2-metüülbutaan CH₂BrCBr(CH₃)C₂H₅ 2

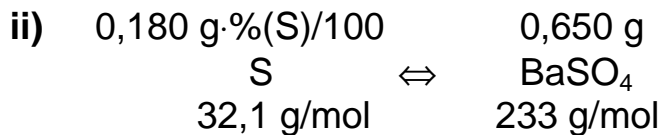




4

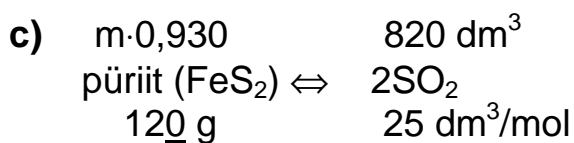


$$\%(\text{FeS}_2) = \frac{1}{2} \cdot 0,650 \text{ g} \cdot \frac{1 \text{ mol}}{233 \text{ g}} \cdot 120 \text{ g/mol} \cdot 100 \cdot \frac{1}{0,180 \text{ g}} \approx \mathbf{93,0}$$



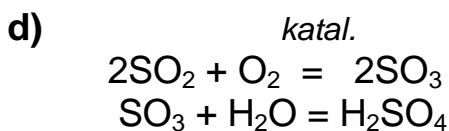
$$\%(\text{S}) = 0,650 \text{ g} \cdot \frac{1 \text{ mol}}{233 \text{ g}} \cdot 32,1 \text{ g/mol} \cdot 100 \cdot \frac{1}{0,180 \text{ g}} \approx \mathbf{49,7}$$

3



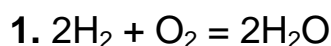
$$m(\text{püriit}) = \frac{1}{2} \cdot 820 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{25 \text{ dm}^3} \cdot 120 \text{ g/mol} \cdot \frac{1}{0,930} = 2116 \text{ g} \approx \mathbf{2,1 \text{ kg}}$$

3



2.
12 p

**2000/2001 õa keemiaolümpiaadi piirkondliku vooru
ülesannete lahendused
12. klass**



Temperatuuril 120 °C on nii lähte- kui saadusaine(d) gaasid. Reaktsiooni käigus toimunud ruumala muutus vastab reageerinud hapniku ruumalale

$$\Delta V = 2V(\text{H}_2\text{O}) - V(\text{O}_2) - 2V(\text{H}_2) = -V(\text{O}_2)$$

$$\Delta V = 800 \text{ cm}^3 - 1000 \text{ cm}^3 = -200 \text{ cm}^3$$

Kolm võimalikku varianti on:

- a) mõlemat lähteainet on ekvivalentne kogus,
- b) kogu hapnik reageerib ära ja vesinikku on liias,
- c) kogu vesinik reageerib ära ja hapnikku on liias.

a) $V(\text{H}_2) = 1000 \text{ cm}^3 \cdot \frac{2}{3} = 666,7 \text{ cm}^3$

$$V(\text{O}_2) = 1000 \text{ cm}^3 \cdot \frac{1}{3} = 333,3 \text{ cm}^3$$

Ekvivalentsete hulkade korral kogu vesinik ja kogu hapnik reageerivad täielikult.

$\Delta V = -V(\text{O}_2) = -333,3 \text{ cm}^3$, mis pole ülesande tingimustega ($\Delta V = -200 \text{ cm}^3$) kooskõlas.

b) $\Delta V = -V(\text{O}_2) = -200 \text{ cm}^3$ $V(\text{O}_2) = 200 \text{ cm}^3$

$$V(\text{H}_2) = 1000 \text{ cm}^3 - 200 \text{ cm}^3 = 800 \text{ cm}^3$$

$$\% \text{vol}(\text{O}_2) = 200 \cdot \frac{100}{1000} = 20,0$$

$$\% \text{vol}(\text{H}_2) = 100 - 20,0 = 80,0$$

c) $V(\text{H}_2) = 2(-\Delta V) = 2 \cdot [-(-200 \text{ cm}^3)] = 400 \text{ cm}^3$

$$V(\text{O}_2) = 1000 \text{ cm}^3 - 400 \text{ cm}^3 = 600 \text{ cm}^3$$

$$\% \text{vol}(\text{H}_2) = 400 \cdot \frac{100}{1000} = 40,0$$

$$\% \text{vol}(\text{O}_2) = 100 - 40,0 = 60,0$$

Lähteandmeid rahuldab kaks erinevat lähteainete koostist: **b)** ja **c)**

_____.
9 p

2. a) $m(\text{kuum lahus}) = 118,8 \text{ g} + 25,7 \text{ g} = 144,5 \text{ g}$

$$m(\text{A, kuum lahus}) = 144,5 \text{ g} \cdot 0,422 = 61,0 \text{ g}$$

$$m(\text{jahe lahus}) = 144,5 \text{ g} - 100,0 \text{ g} = 44,5 \text{ g}$$

$$m(\text{A, jahe lahus}) = 44,5 \text{ g} \cdot 0,215 = 9,568 \text{ g} \approx \mathbf{9,6 \text{ g}}$$

4

b) $m(\text{A, 100 g-s aines B}) = 61,0 \text{ g} - 9,6 \text{ g} = 51,4 \text{ g}$

$$m(\text{H}_2\text{O, 100 g-s aines B}) = 100,0 - 51,4 \text{ g} = 48,6 \text{ g}$$

$$m(\Sigma \text{H}_2\text{O, aines B}) = 1 \text{ mol} \cdot \frac{48,6 \text{ g}}{0,150 \text{ mol}} = 324 \text{ g}$$

$$n(\text{H}_2\text{O, moolis B}) = 324 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} = \mathbf{18 \text{ mol}}$$

$$N(\text{H}_2\text{O, molekulis B}) = \mathbf{18 \text{ molekuli}}$$

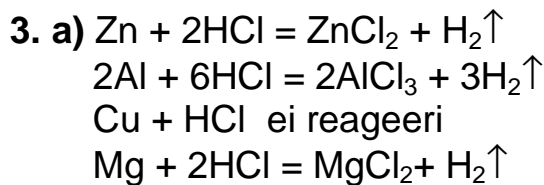
4

$$\text{c) } m(\mathbf{A}) = \frac{51,4 \text{ g}}{0,150 \text{ mol}} = 342,7 \text{ g/mol} \approx \mathbf{343 \text{ g/mol}}$$

$$m(\mathbf{B}) = \frac{100,0 \text{ g}}{0,150 \text{ mol}} = 666,7 \text{ g/mol} \approx \mathbf{667 \text{ g/mol}}$$

$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ – alumiiniumsulfaat-vesi (1/18)

3
11 p



2

$$\text{b) } \frac{2}{5}\text{Zn} \Leftrightarrow V(\text{H}_2) = \frac{1}{1} \cdot 7,00 \text{ g} \cdot \frac{2}{5} \cdot \frac{1 \text{ mol}}{65,3 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} = 0,960 \text{ dm}^3$$

$$\frac{3}{5}\text{Al} \Leftrightarrow V(\text{H}_2) = \frac{3}{2} \cdot 7,00 \text{ g} \cdot \frac{3}{5} \cdot \frac{1 \text{ mol}}{27,0 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} = 5,23 \text{ dm}^3$$

$$\frac{3}{5}\text{Mg} \Leftrightarrow V(\text{H}_2) = \frac{1}{1} \cdot 7,00 \text{ g} \cdot \frac{3}{5} \cdot \frac{1 \text{ mol}}{24,3 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} = 3,87 \text{ dm}^3$$

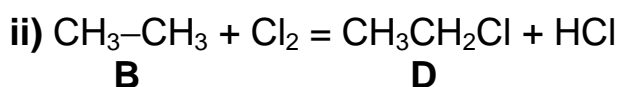
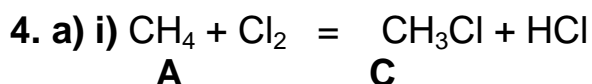
Sulam Zn–Al ei sobi, kuna juba alumiinium tõrjub välja rohkem vesinikku;

Cu–Zn ei sobi, sest isegi 7 g tsingi tõrjub välja vähem vesinikku;

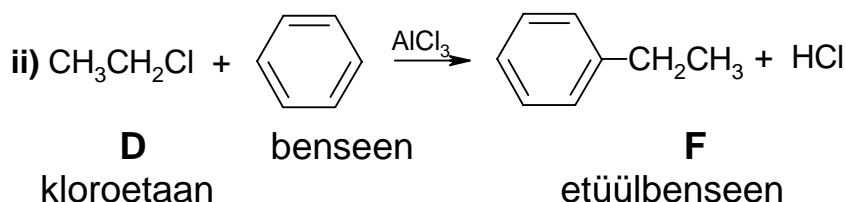
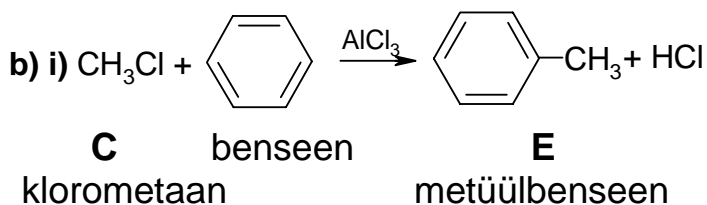
Zn–Mg $V(\text{H}_2) = 0,96 \text{ l} + 3,87 \text{ l} = \mathbf{4,83 \text{ l}}$ sobib;

Mg–Al ei sobi, sest juba alumiinium tõrjub välja rohkem vesinikku.

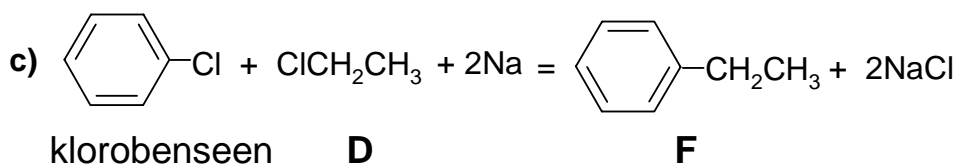
9
11 p



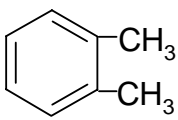
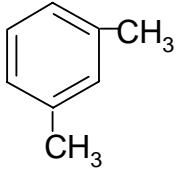
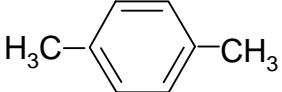
1



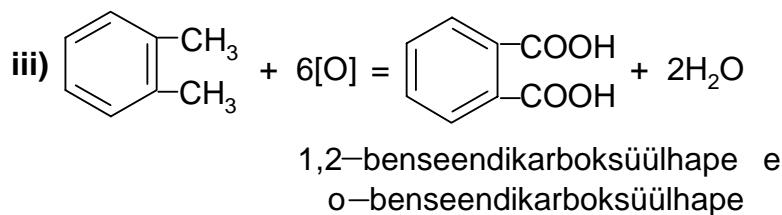
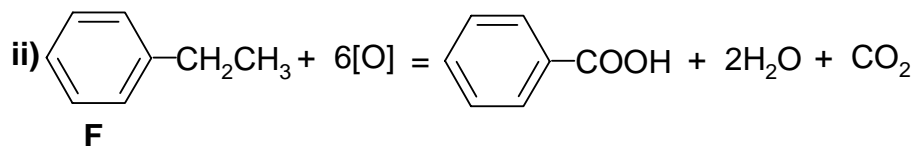
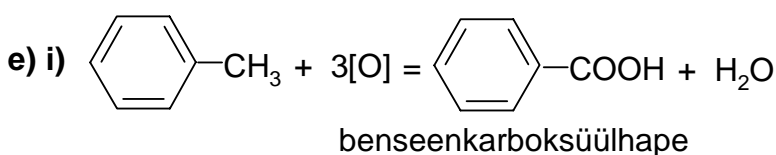
2



1,5

- d) i)  **G** 1,2-dimetüülbenseen
o-ksüleen e ortodimetüülbenseen
- ii)  **H** 1,3-dimetüülbenseen
m-ksüleen e metadimetüülbenseen
- iii)  **I** 1,4-dimetüülbenseen
p-ksüleen e paradimetüülbenseen

1,5

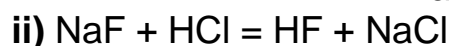


(1+1+2) 4
10 p



A kaaliummetasilikaat

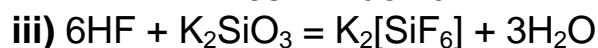
1,5



B

vesinikfluoriid

0,5



C kaaliumheksafluorosilikaat

2



D kaaliumfluoriid

B

E ortoränihape

2

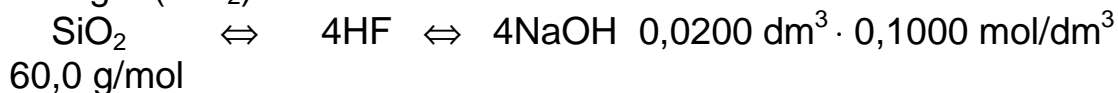


0,5

b) KCl vähendab vähelahustuva kompleksühendi **C** lahustumist.

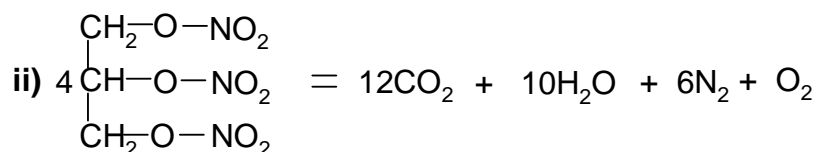
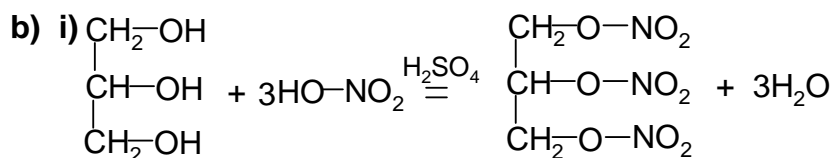
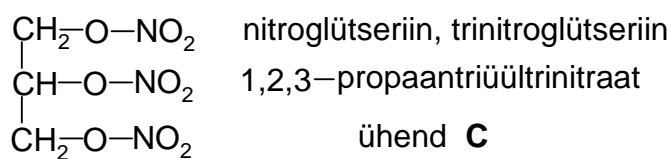
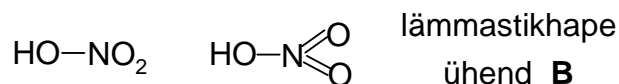
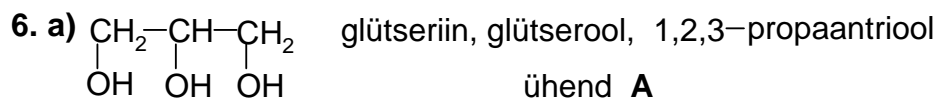
1

c) $0,0600 \text{ g} \cdot \%(\text{SiO}_2)/100$



$$\%(\text{SiO}_2) = \frac{1}{4} \cdot 0,0200 \text{ dm}^3 \cdot 0,1000 \text{ mol/dm}^3 \cdot 60,0 \text{ g/mol} \cdot 100 \cdot \frac{1}{0,0600 \text{ g}} = \mathbf{50,0}$$

2,5

10 p

c) Ühe mooli ühendi **C** oksüdeerimisel tekib 1,5 mooli lämmastikku ja 0,25 mooli hapnikku.

a) (2+1+2) 5
b) (1+1,5) 2,5
c) (1+ 0,5) 1,5
9 p