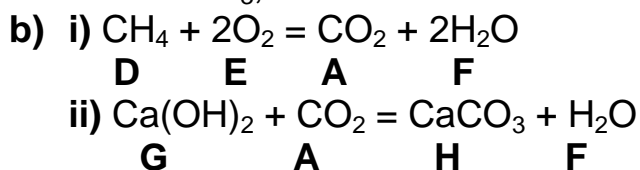
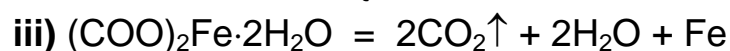
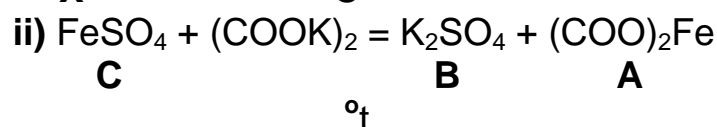
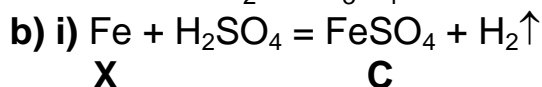
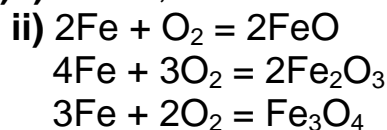


**2001/2002 õa keemiaolümpiaadi piirkonnavooru
ülesannete lahendused
10. klass**

1. a) **A** – CO₂, süsinikdioksiid, *atmosfääris*¹.
B – N₂, lämmastik, *atmosfääris*.
C – (C₆H₁₀O₅)_n, tselluloos; *ei lahustu vees, tekib fotosünteesil*.
D – CH₄, metaan, *kõige kergem orgaaniline gaas, mis tekib seedimisel*.
E – O₂, hapnik
F – H₂O, vesi, *esineb atmosfääris veeauruna, rahena, vihmepiiskadena*.
G – Ca(OH)₂, kaltsiumhüdroksiid, kustutatud lubi.
H – CaCO₃, kaltsiumkarbonaat



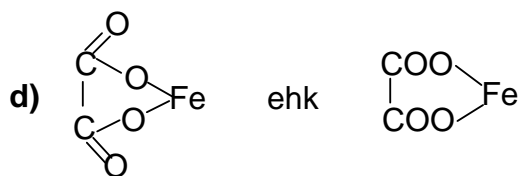
2. a) i) **X** - Fe, raud



- c) i) (COO)₂Fe·2H₂O, raud(II)oksalaat-kaks-vesi
 ehk raud(II)oksalaat-kaks-hüdraat

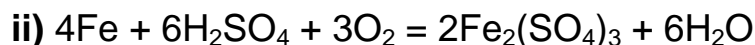
- ii) FeSO₄·7H₂O, raud(II)sulfaat-seitse-vesi ehk raud(II)sulfaat-hepta-hüdraat
 ehk raud(II)vitriol; *raud(II)ioon annab turnbulli sinise*.

- iii) K₂SO₄, kaaliumsulfaat



¹ - kursiivis antud seletust pole õpilastelt nõutud.

e) i) Rauapulbri reageerimisel lahjendatud happe lahusega, mis küllastatakse hapnikuga.



D Raud(III) ioon annab berliini sinise.

iii) Raudoksalaadi kuumutamisel saadakse tolmpreen (suure eripinnaga – pindala/mass) pulber.

3. a) i) $n(\text{karbonaat}) \Leftrightarrow n(\text{CO}_2)$

$$n(\text{karbonaat}) = \frac{1}{1} \cdot 2,62 \text{ dm}^3 \cdot \frac{1 \text{ mol}}{22,4 \text{ dm}^3} = \mathbf{0,117 \text{ mol}}$$

ii) $n(\text{hüdroksiid}) \Leftrightarrow n(\text{H}_2\text{O})$

$$n(\text{H}_2\text{O}) \cdot 18,0 \text{ g/mol} + n(\text{CO}_2) \cdot 44,0 \text{ g/mol} = 7,25 \text{ g}$$

$$m(\text{H}_2\text{O}) = 7,25 \text{ g} - 0,117 \text{ mol} \cdot 44,0 \text{ g/mol} = 2,10 \text{ g}$$

$$n(\text{hüdroksiid}) = \frac{1}{1} \cdot 2,10 \text{ g} \cdot \frac{1 \text{ mol}}{18,0 \text{ g}} = \mathbf{0,117 \text{ mol}}$$

$$\text{iii) } n(\text{oksiid}) = 0,351 \text{ mol} - 0,117 \text{ mol} - 0,117 \text{ mol} = \mathbf{0,117 \text{ mol}}$$

b) $M(\text{oksiid}) = \frac{17,9 \text{ g}}{0,117 \text{ mol}} = 153 \text{ g/mol}$

$$M(\text{X}) = 153 \text{ g/mol} - 16 \text{ g/mol} = 137 \text{ g/mol}$$

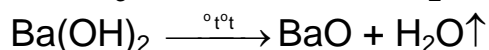
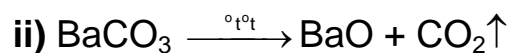
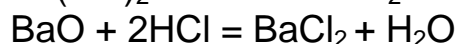
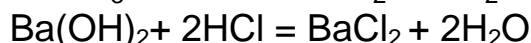
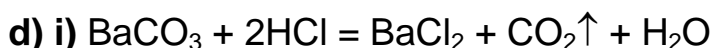
X – Ba, baarium

c) $M[\text{Ba}(\text{OH})_2] = 171 \text{ g/mol}$

$$M(\text{BaCO}_3) = 197 \text{ g/mol}$$

i) $m[\text{Ba}(\text{OH})_2] = 0,117 \text{ mol} \cdot 171 \text{ g/mol} = \mathbf{20,0 \text{ g}}$

ii) $m(\text{BaCO}_3) = 0,117 \text{ mol} \cdot 197 \text{ g/mol} = \mathbf{23,0 \text{ g}}$



4. a) $M(\text{A}) = 29,0 \text{ g/mol} \cdot 9,79 = 283,9 \text{ g/mol} \approx 284 \text{ g/mol}$

$$m(\text{X}) = 283,9 \text{ g} \cdot 0,4366 = 123,95 \text{ g} \approx 124 \text{ g}$$

$$m(\text{O}) = 284 \text{ g} - 124 \text{ g} = 160 \text{ g}$$

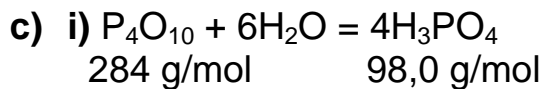
$$n(\text{O}) = 160 \text{ g} \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 10 \text{ mol}$$

$n(\text{X}) \Leftrightarrow 1 \quad 2$ ja 3 ei sobi, sest elemendi oksüdatsiooniaste ei saa olla 20 ega 10 ja tavaliselt pole see ka murdarv.

$$\text{Kui } n(\mathbf{X}) = 4, \text{ siis } M(\mathbf{X}) = \frac{124 \text{ g}}{4 \text{ mol}} = 31 \text{ g/mol},$$

mis vastab **fosforile**.

b) P₄O₁₀ – tetrafosfordekaoksiid

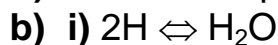


ii) $m(\text{H}_3\text{PO}_4) = \frac{4}{1} \cdot 5,00 \text{ g} \cdot \frac{1 \text{ mol}}{284 \text{ g}} \cdot 98,0 \text{ g/mol} = 6,90 \text{ g}$

$$\%(\text{H}_3\text{PO}_4) = \frac{6,90 \text{ g}}{5,00 \text{ g} + 100 \text{ g}} \cdot 100 = \mathbf{6,57}$$

iii) ortofosforhappe lahus

5. a) Peamisteks põlemise saadusaineteks on CO₂, H₂O, N₂ ja oksiidid.



$$m(\text{H}_2\text{O}) = 16,8 \text{ g} - 6,0 \text{ g} = 10,8 \text{ g}$$

$$n(\text{H}) = \frac{2}{1} \cdot 10,8 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} = 1,2 \text{ mol}$$

Et kõikides ainetes vesiniku hulgad olid võrdsed, siis iga aine 0,1 moolis oli

$$\frac{1,2 \text{ mol}}{3} = 0,4 \text{ mol. Seega iga aine molekulis on } \mathbf{4 \text{ vesiniku aatomit.}}$$

ii) M(X;Y;Z) = 4 \cdot \frac{1,0 \text{ g}}{\text{mol}} \cdot \frac{1}{0,125} = \mathbf{32 \text{ g/mol}}

c) i) Aine **A** on vees lahustumatu oksiid.

$$M(\mathbf{A}) = \frac{6,0 \text{ g}}{0,1 \text{ mol}} = 60 \text{ g/mol. Selleks oksiidiks on } \mathbf{\text{SiO}_2} \text{ - ränidioksiid}$$

$$M(\text{Si}) = 32 \text{ g/mol} - 4 \cdot 1 \text{ g/mol} = 28 \text{ g/mol}$$

ii) Aine **A** saadakse aine **X** põlemisel, sest aine **X** on gaas (SiH₄).

d) i) $M(\text{gaasid}) = 1,6 \text{ g/dm}^3 \cdot 22,4 \text{ dm}^3/\text{mol} = 35,8 \text{ g/mol} \approx 36 \text{ g/mol}$

Kui oletada, et üheks gaasiks on CO₂ [M(CH₃OH) = 32 g/mol], siis
0,5 mol · 44 g/mol + 0,5 mol [M(teine gaas)] = 36 g

$$M(\text{teine gaas}) = \frac{36 \text{ g} - 22 \text{ g}}{0,5 \text{ mol}} = 28 \text{ g/mol}$$

Selline molaarmass on **lämmastikul (N₂)**

ii) Aine **Y** põlemisel tekib CO₂ (CH₃OH on vedelik).

Aine **Z** põlemisel tekib N₂ (NH₂-NH₂ on madalal temperatuuril tahke aine).

e) X – SiH₄, silaan (gaas)

Y – CH₃OH, metanool (vedelik) M(C+O) = 32 g/mol - 4 · 1 g/mol = 28 g/mol

Z – NH₂-NH₂, hüdrasiin (tahke) M(N+N) = 32 g/mol - 4 · 1 g/mol = 28 g/mol

6. a) °t



b) i) Taigas sisalduvas vees dissotsieeruvad mõlemad soolad. Sool **B** peab andma happelise keskkonna, mille toimel soolast **A** moodustub süsihape, mis laguneb veeks ja gaasiks.

ii) Eraldub CO_2 (süsihappe gaas ehk süsinikdioksiid)

c) $m(\mathbf{A}) = 20,0 \text{ g} \cdot 0,35 = 7,00 \text{ g}$

$$m(\mathbf{B}) = 20,0 \text{ g} \cdot 0,25 = 5,00 \text{ g}$$

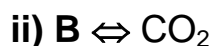
$$n(\text{CO}_2) = 0,200 \text{ dm}^3 \cdot \frac{100\%}{10\%} \cdot \frac{1 \text{ mol}}{24,0 \text{ dm}^3} = 0,0833 \text{ mol}$$



$$n(\mathbf{A}) = \frac{1}{1} \cdot n(\text{CO}_2) = 0,0833 \text{ mol}$$

$$M(\mathbf{A}) = \frac{7,00 \text{ g}}{0,0833 \text{ mol}} = 84,0 \text{ g/mol} = M(\text{NaHCO}_3)$$

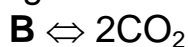
A – NaHCO_3 , naatriumvesinikkarbonaat



$$M(\mathbf{B}) = \frac{5,00 \text{ g}}{0,0833 \text{ mol}} = 60,0 \text{ g/mol} \text{ (ei sobi, sest pole kahelaengulist aniooni,}$$

mille molaarmass oleks

$$60 \text{ g/mol} - 23 \text{ g/mol} - 1 \text{ g/mol} = 36 \text{ g/mol}).$$

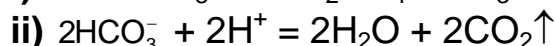
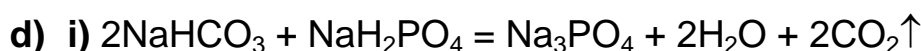


$$n(\mathbf{B}) = \frac{1}{2} \cdot 0,0833 \text{ mol}$$

$$M(\mathbf{B}) = \frac{5,00 \text{ g} \cdot 2}{0,0833 \text{ mol}} = 120 \text{ g/mol} = M(\text{NaH}_2\text{PO}_4)$$

$$M(\text{PO}_4^{3-}) = 120 \text{ g/mol} - 23 \text{ g/mol} - 2 \cdot 1 \text{ g/mol} = 95 \text{ g/mol}$$

B – NaH_2PO_4 (naatriumdivesinikfosfaat)



e) i) Reaktsioon toimub ionide vahel, mis moodustuvad soolade dissotsieerumisel vesilahuses. ii) Tähtsiks imab niiskust, mis takistab soolade dissotsiatsiooni.