

2001/2002 õa keemiaolümpiaadi lõppvooru ülesannete lahendused
12. klass

1. a) $\Delta H^\circ = \sum \Delta H_f^\circ (\text{saadused}) - \sum \Delta H_f^\circ (\text{lähiteained})$

$$\Delta H^\circ = 1 \text{ mol} \cdot (-110 \text{ kJ/mol}) - 1 \text{ mol} \cdot (-242 \text{ kJ/mol}) - 1 \text{ mol} \cdot (-75 \text{ kJ/mol}) = \\ = 207 \text{ kJ}$$

b) i) $\Delta G^\circ = \Delta H^\circ - T \cdot \Delta S^\circ$

$$\Delta S^\circ = \sum S_f^\circ (\text{saadused}) - \sum S_f^\circ (\text{lähiteained})$$

$$\Delta S^\circ = 3 \text{ mol} \cdot 131 \text{ J/(mol}\cdot\text{K)} + 1 \text{ mol} \cdot 197 \text{ J/(mol}\cdot\text{K)} - 1 \text{ mol} \cdot 189 \text{ J/(mol}\cdot\text{K)} - \\ - 1 \text{ mol} \cdot 186 \text{ J/(mol}\cdot\text{K)} = 215 \text{ J/K} = 0,215 \text{ kJ/K}$$

$$\Delta G^\circ = 207 \text{ kJ} - 298 \text{ K} \cdot 0,215 \text{ kJ/K} = 207 \text{ kJ} - 64 \text{ kJ} = 143 \text{ kJ}$$

ii) Otsesuunaline reaktsioon ei saa toimuda.

c) $K_t = e^{-\frac{\Delta G}{RT}}$

$$K_t = e^{-\frac{143000}{8,314 \cdot 298}} = e^{-57,7} = 8,73 \times 10^{-26}$$

d) i) Tasakaalu korral $\Delta G = 0$

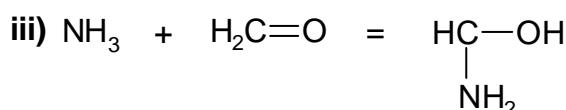
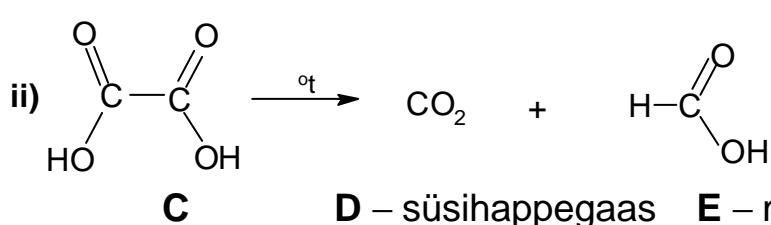
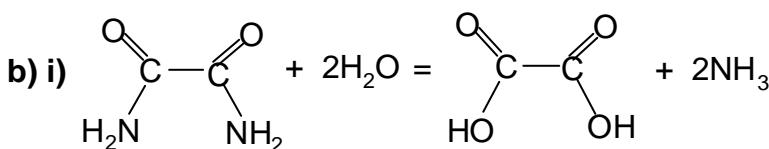
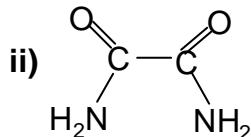
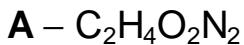
ii) $0 = \Delta H - T \cdot \Delta S$

$$T = 207 \text{ kJ} \cdot \frac{K}{0,215 \text{ kJ}} = 963 \text{ K}$$

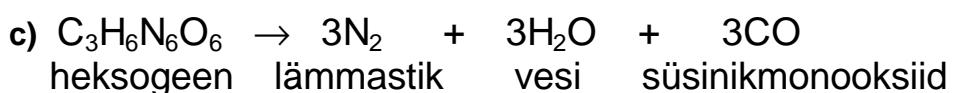
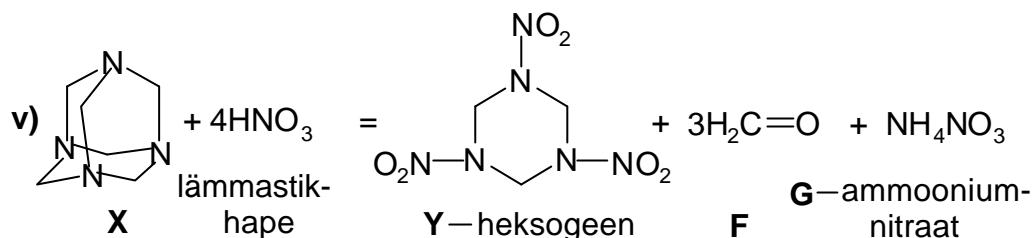
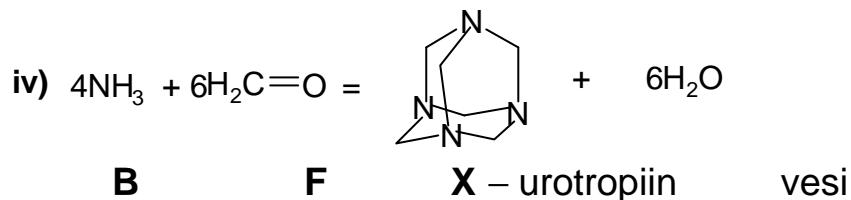
$$^{\circ}t = T - 273 = 963 - 273 = 690 \text{ }^{\circ}\text{C}$$

2. a) i) Elementide aatomite arv ei saa olla üks, sest siis oleks neid kõiki võrdselt ($3 \cdot 1 \cdot 2 = 1$). Kui süsiniku, hapniku ja lämmastiku aatomite arv on kaks, siis vesiniku aatomeid peab olema neli ($3 \cdot 2 \cdot 2 = 4$).

$$M_r(A) = 2 \cdot 12 + 4 \cdot 1 + 2 \cdot 16 + 2 \cdot 14 = 88$$



B **F** – metanaal aminometanool



3. a) Sooladel **Y** ja **Z** on kompleksanioon(id), mille tsentraalaatom on Fe^{3+} .
 Ligandideks on anioon(id), mille molaarmass on
 $2,0 \text{ g/mol} \cdot 13,5 - 1,0 \text{ g/mol} = 26 \text{ g/mol}$
 $n(\text{ligandid}) = 56,0 \text{ g} \cdot \frac{0,736}{0,264} \cdot \frac{1 \text{ mol}}{26 \text{ g}} = 6 \text{ mol}$

Mürgine, lenduv üheprootoniline nõrk hape on HCN (27 g/mol)
 Kompleksanioon on $[\text{Fe}(\text{CN})_6]^{3-}$

b) **X** – $(\text{NH}_4)_3\text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}$

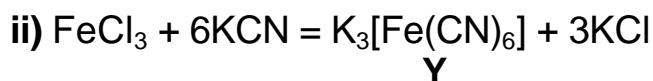
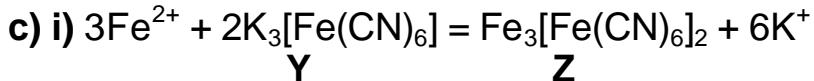
Q – $(\text{NH}_4)_2\text{Fe}(\text{C}_2\text{O}_4)_2 \cdot 2\text{H}_2\text{O}$

Y – $\text{K}_3[\text{Fe}(\text{CN})_6]$

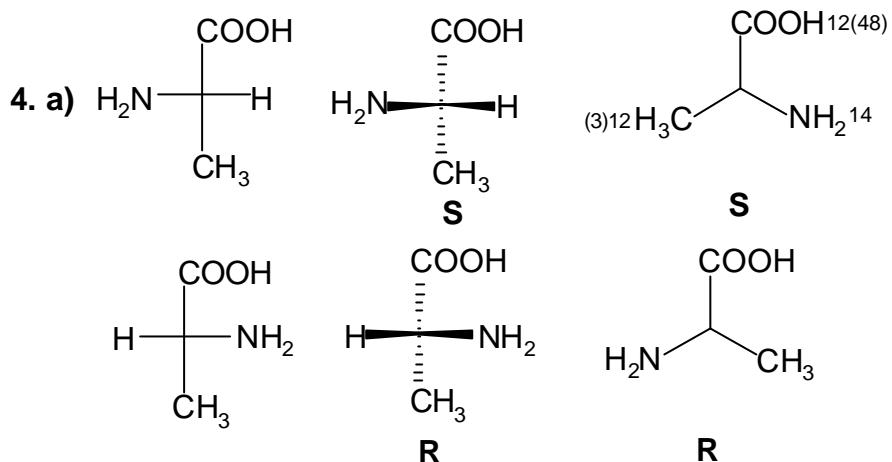
Z – $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$

A – KCN

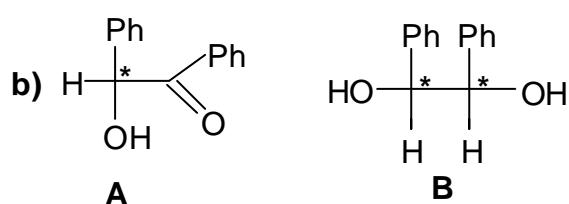
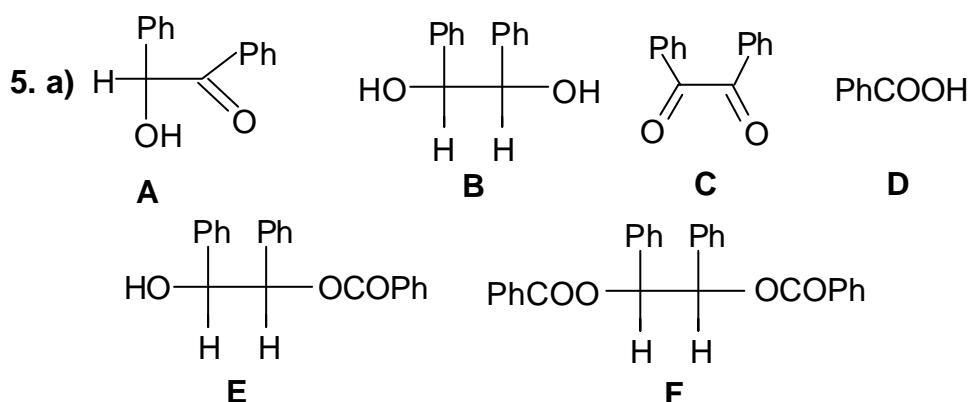
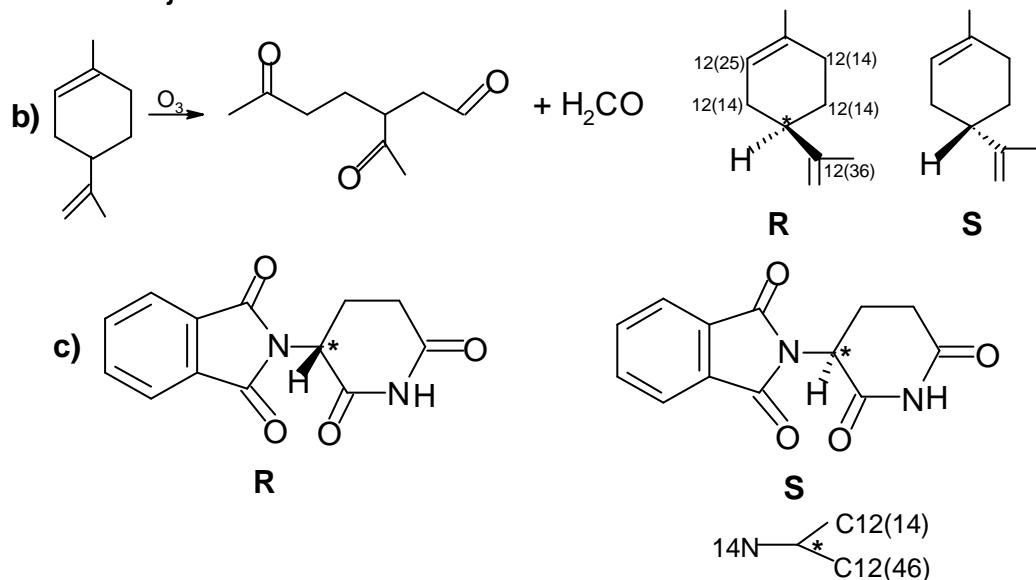
B – HCN

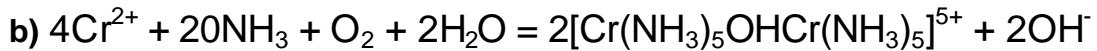
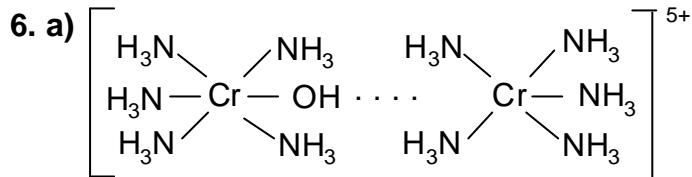
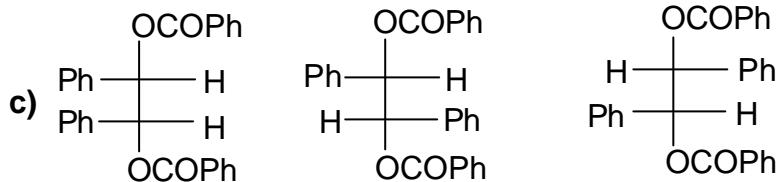


iii) $2[(\text{NH}_4)_3\text{Fe}(\text{C}_2\text{O}_4)_3 \cdot 3\text{H}_2\text{O}] = 2[(\text{NH}_4)_2\text{Fe}(\text{C}_2\text{O}_4)_2 \cdot 2\text{H}_2\text{O}] + (\text{NH}_4)_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O} + 2\text{CO}_2 \uparrow$

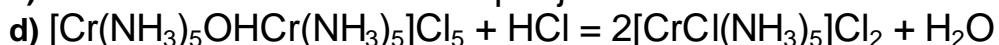


Kui on märkimata, millised rühmitused on ees, siis Fischeri projekt-sioonis ei saa **S** ja **R** enantiomeere määrata





c) Kloriidioonide suur ülehulk põhjustab hüdroksiidi asemel kloriidi moodustumise.



X

Z

e) Pentaammiinklorokroom(2+)kloriid.



$$V(\text{AgNO}_3) = \frac{2}{1} \cdot \frac{10 \text{ cm}^3 \cdot 0,05 \text{ mol / dm}^3}{0,1 \text{ mol / dm}^3} = \mathbf{10 \text{ cm}^3}$$

Komplekskatsoon ei dissotsieeru.