

**2002/2003 õa keemiaolümpiaadi piirkonnavooru
ülesannete lahendused
11. klass**

1. a) $M(\text{SCl}_2) = 103 \text{ g/mol}$

$$n(\text{SCl}_2) = 15,5 \text{ g} \cdot \frac{1 \text{ mol}}{103 \text{ g}} \approx \mathbf{0,150 \text{ mol}}$$

b) $n(\text{Cl}) = 15,5 \text{ g} \cdot \frac{1 \text{ mol}}{103 \text{ g}} \cdot 2 \approx \mathbf{0,301 \text{ mol}}$

c) $N(\text{S}) = 15,5 \text{ g} \cdot \frac{1 \text{ mol}}{103 \text{ g}} \cdot 1 \cdot 6,02 \cdot 10^{23} \text{ aatomit / mol} = \mathbf{9,06 \cdot 10^{22} \text{ aatomit}}$

d) II

e) $V_M = 22,4 \text{ dm}^3 / \text{mol} \cdot \frac{300 \text{ K}}{273 \text{ K}} \cdot \frac{1 \text{ atm}}{0,100 \text{ atm}} = 246,15 \text{ dm}^3 / \text{mol}$

$$\rho(\text{SCl}_2) = 103 \text{ g/mol} \cdot \frac{1 \text{ mol}}{246,15 \text{ dm}^3} \approx \mathbf{0,418 \text{ g/dm}^3}$$

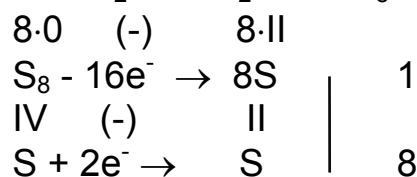
f) $\text{SCl}_2 \Leftrightarrow \text{Cl}_2$

$$V(\text{Cl}_2) = 15,5 \text{ g} \cdot \frac{1 \text{ mol}}{103 \text{ g}} \cdot 22,4 \text{ dm}^3 / \text{mol} \approx \mathbf{3,37 \text{ liitrit}}$$

g) $4\text{HCl} + \text{MnO}_2 = \text{MnCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O}$

h) $m(\text{MnO}_2) = \frac{1}{1} \cdot 0,150 \text{ mol} \cdot \frac{100\%}{92,0\%} \cdot 86,9 \text{ g/mol} \approx \mathbf{14,2 \text{ g}}$

i) $16\text{SCl}_2 + 24\text{H}_2\text{O} = 1\text{S}_8 + 8\text{H}_2\text{SO}_3 + 32\text{HCl}$



2. a) **A** – HF, vesinikfluoriid, gaas

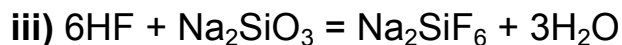
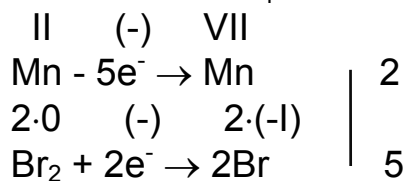
B – HCl, vesinikkloriid, gaas

C – HBr, vesinikbromiid, gaas

D – HI, vesinikjodiid, gaas

E – KMnO_4 , kaaliumpermanganaat, tahke

F – Br_2 , broom, vedelik



3. a) i) **X** – N, lämmastik

Y – H, vesinik

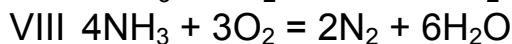
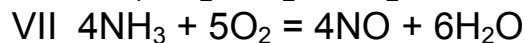
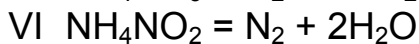
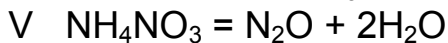
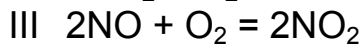
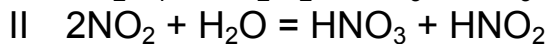
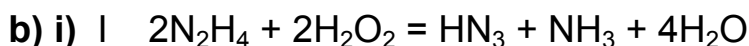
Z – O, hapnik

ii) **X₂Y₄** – NH₂–NH₂, hüdrasiin

Y₂Z₂ – H–O–O–H, vesinikperoksiid

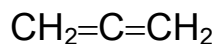
X₃H – HN₃, vesiniklämmastikhape, азотистоводородная кислота

X₂Z – N₂O, naerugaas, dilämmastikmonooksiid



ii) Reaktsioon VII toimub Pt katalüsaatoril.

4. a) propadieen



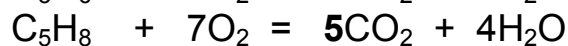
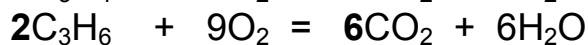
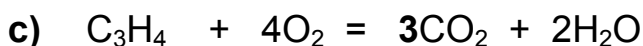
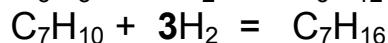
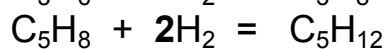
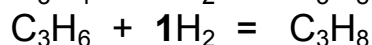
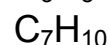
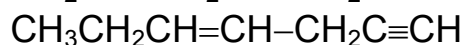
propeen

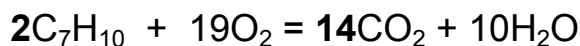


1,4-pentadieen



4-hepteen-1-üün





d) 4-hepteen-1-üünis on kolmiksideme juures olevad süsiniku aatomid sp-hübriidses olekus.

e) Olgu $n(\text{C}_3\text{H}_4) = a$ mooli
 $n(\text{C}_3\text{H}_6) = b$ mooli
 $n(\text{C}_5\text{H}_8) = c$ mooli
 $n(\text{C}_7\text{H}_{10}) = d$ mooli, siis

$$n(\text{H}_2) = 2a + 1b + 2c + 3d$$

$$n(\text{CO}_2) = 3a + 3b + 5c + 7d$$

Et $2n(\text{H}_2) = n(\text{CO}_2)$, siis

$$2(2a + 1b + 2c + 3d) = 3a + 3b + 5c + 7d, \text{ millest}$$

$$a = b + c + d \text{ (võrrand I)}$$

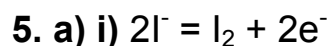
$$a + b + c + d = 100\% \text{ vol, siis}$$

$$100\% \text{ vol} - a = b + c + d \text{ (võrrand II)}$$

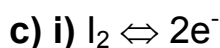
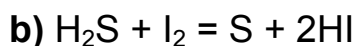
Võrranditest I ja II

$$a = 100\% \text{ vol} - a$$

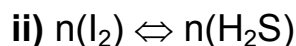
$$a = 50\% \text{ vol}$$



ii) anoodil



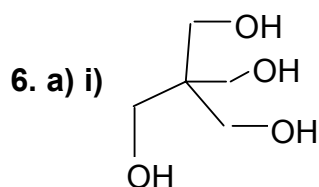
$$n(\text{I}_2) = \frac{1}{2} \cdot (2 \cdot 60 \text{ s} + 50 \text{ s}) \cdot 0,018 \text{ A} \cdot \frac{1 \text{ mol}}{96500 \text{ A} \cdot \text{s}} = 1,59 \cdot 10^{-5} \text{ mol} \approx 1,6 \cdot 10^{-5} \text{ mol}$$

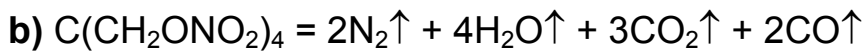
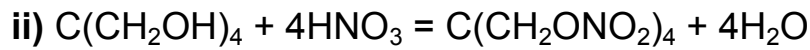


$$m(\text{H}_2\text{S}) = 1,58 \cdot 10^{-5} \text{ mol} \cdot 34 \text{ g/mol} = 5,39 \cdot 10^{-4} \text{ g} \approx 5,4 \cdot 10^{-4} \text{ g}$$

d) sisaldus $(\text{H}_2\text{S}) = 5,4 \cdot 10^{-4} \text{ g} \cdot \frac{1000 \text{ mg}}{1 \text{ g}} \cdot \frac{1}{2 \text{ l}} = 0,27 \text{ mg/l}$

sisaldus (H_2S) ületab lubatud normi $\frac{0,27 \text{ mg/l}}{0,01 \text{ mg/l}} = 27 \text{ korda}$





c) $n(\text{pentriit}) = 15 \text{ dm} \cdot 0,10 \cdot 0,10 \text{ dm}^2 \cdot 1,7 \text{ g/cm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{1 \text{ mol}}{316 \text{ g}} = 0,81 \text{ mol}$

$$n(\text{gaasid pentriidist}) = \frac{11}{1} \cdot 0,81 \text{ mol} = 8,91 \text{ mol} \approx 9 \text{ mol}$$

$$n(CO_2) = 15 \text{ dm} \cdot 0,90 \cdot 0,10 \text{ dm}^2 \cdot 1,5 \text{ g/cm}^3 \cdot \frac{1000 \text{ cm}^3}{1 \text{ dm}^3} \cdot \frac{1 \text{ mol}}{44 \text{ g}} = 46 \text{ mol}$$

$$\Sigma n(\text{gaasid}) = 46 \text{ mol} + 9 \text{ mol} = 55 \text{ mol}$$

$$p = 55 \text{ mol} \cdot 0,082 \frac{\text{atm} \cdot \text{dm}^3}{\text{mol} \cdot K} \cdot 833 \text{ K} \cdot \frac{1}{1,5 \text{ dm}^3} \approx \mathbf{2500 \text{ atm}}$$

d) $V = 55 \text{ mol} \cdot 22,4 \text{ dm}^3 / \text{mol} \cdot \frac{283}{273} = 1277 \text{ dm}^3 \approx \mathbf{1300 \text{ dm}^3}$