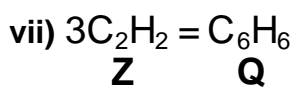
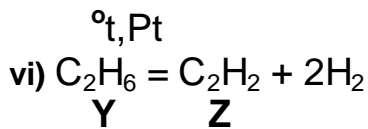
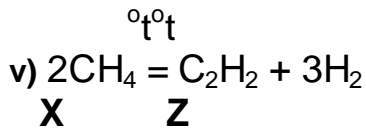
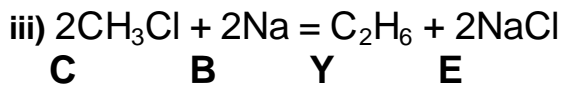
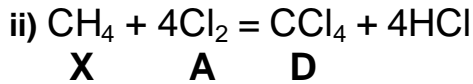
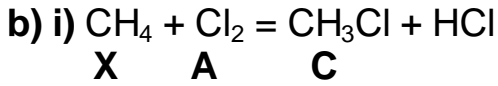


**2001/2002 õa keemiaolümpiaadi lõppvoorü ülesannete lahendused**  
**11. klass**

1. a) **X** – CH<sub>4</sub>, metaan                      **B** – Na, naatrium  
**Y** – C<sub>2</sub>H<sub>6</sub>, etaan                              **C** – CH<sub>3</sub>Cl, klorometaan e metüülkloriid  
**Z** – C<sub>2</sub>H<sub>2</sub>, etüün                              **D** – CCl<sub>4</sub>, tetraklorometaan  
**Q** – C<sub>6</sub>H<sub>6</sub>, benseen                          **E** – NaCl, naatriumkriid  
**A** – Cl<sub>2</sub>, kloor



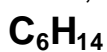
c) i) M<sub>r</sub>(CCl<sub>4</sub>) = 154  
M<sub>r</sub>(CH<sub>4</sub>) = 16  
D(CCl<sub>4</sub>)<sub>CH<sub>4</sub></sub> =  $\frac{154}{16} = 9,6$

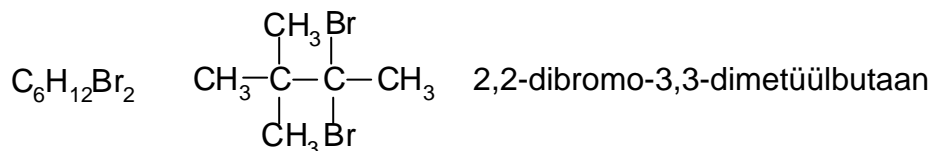
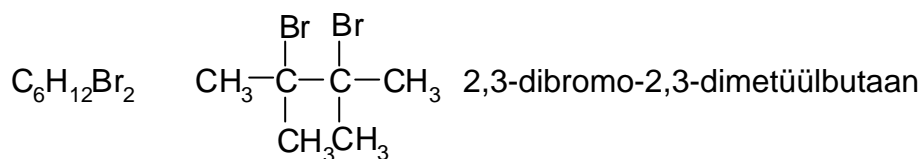
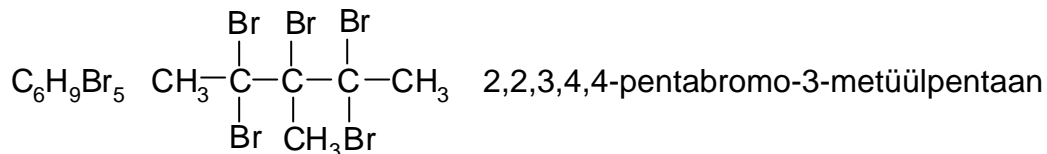
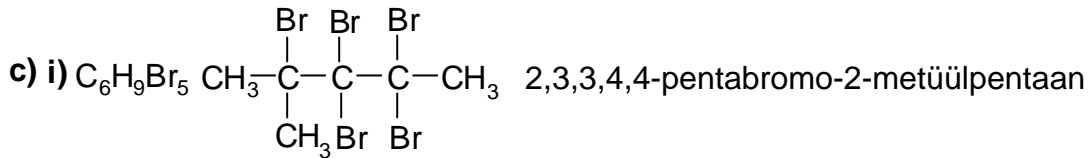
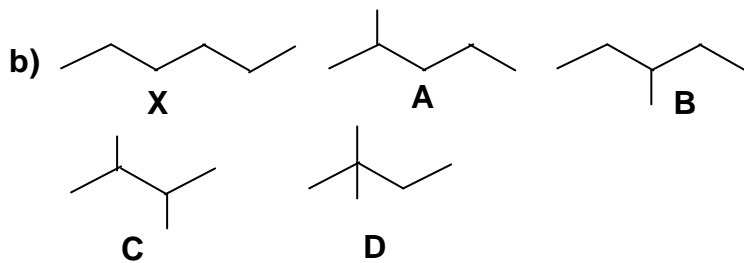
ii) M<sub>r</sub>(C<sub>2</sub>H<sub>2</sub>) = 26  
M<sub>r</sub>(C<sub>2</sub>H<sub>6</sub>) = 30  
D(C<sub>2</sub>H<sub>6</sub>)<sub>C<sub>2</sub>H<sub>2</sub></sub> =  $\frac{26}{30} = 0,867$

iii) M(C<sub>6</sub>H<sub>6</sub>) = 78 g/mol

2. a) i)  $\frac{n(H)}{n(C)} = \frac{2 \cdot 8,95 \text{ g}}{18,0 \text{ g/mol}} \cdot \frac{22,4 \text{ dm}^3 / \text{mol}}{9,55 \text{ dm}^3} = 2,333 \approx 2,33$

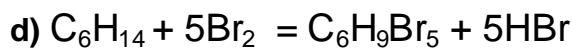
ii) 2,333n = 2n + 2  
 $n = \frac{2}{0,333} = 6,006 \approx 6$





$$\text{ii) } \frac{M(C_6H_9Br_5)}{M(C_6H_{14})} = \frac{81 + 5 \cdot 80}{86} = 5,59$$

$$\frac{M(C_6H_{12}Br_2)}{M(C_6H_{14})} = \frac{84 + 2 \cdot 80}{86} = 2,84$$



3. a) i)  $N(O) = \frac{47,1}{16} = 2,94$        $N(Al) = \frac{52,9}{27,0} = 1,96$

Kui  $N(Al) = 1$ , siis  $N(O) = \frac{2,94}{1,96} = 1,5$



ii)  $N(O) = \frac{50,4}{16} = 3,15$        $N(Al) = \frac{42,5}{27} = 1,57$

$N(Be) = \frac{7,1}{9,01} = 0,788$

Kui  $N(Be) = 1$ , siis  $N(Al) = \frac{1,57}{0,788} \approx 2$  ja  $N(O) = \frac{3,15}{0,788} = 4$



$$\text{iii) } N(\text{O}) = \frac{53,6}{16} = 3,35 \quad N(\text{Si}) = \frac{31,4}{28} = 1,12$$

$$N(\text{Al}) = \frac{10}{27} = 0,37 \quad N(\text{Be}) = \frac{5,0}{9,01} = 0,555$$

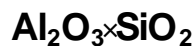
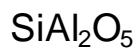
$$\text{Kui } N(\text{Al}) = 1, \text{ siis } N(\text{O}) = \frac{3,35}{0,37} \approx 9,$$

$$N(\text{Si}) = \frac{1,12}{0,37} \approx 3 \quad N(\text{Be}) = \frac{0,555}{0,37} \approx 1,5$$



$$\text{iv) } N(\text{O}) = \frac{49,4}{16} = 3,09 \quad N(\text{Si}) = \frac{17,3}{28} = 0,618 \quad N(\text{Al}) = \frac{33,3}{27} = 1,23$$

$$\text{Kui } N(\text{Si}) = 1, \text{ siis } N(\text{Al}) = \frac{1,23}{0,618} \approx 2 \quad \text{ja} \quad N(\text{O}) = \frac{3,09}{0,618} = 5$$

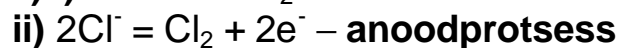
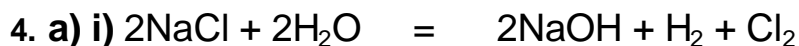


b) i) X - V, vanaadium                      Z - Mn, mangaan

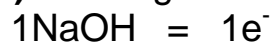
Y - Cr, kroom                                  Q - Fe, raud

ii) Otsitavateks metallideks ei saa olla ei Ti ega Co. Nende vahele jääb neli metalli, mis sobivad ülesande tingimustega, sest raual esinevad kahe- ja kolmevalentsed ioonid. Tuntud on pruunid mangaaniühendid ja rohelised kroomiühendid.

elektrolüüs



$$\text{b) i) } 1000 \text{ g} \quad I \cdot t = 0,9$$



$$40,0 \text{ g/mol} \quad 96500 \text{ A} \cdot \text{s/mol}$$

$$I \cdot t = \frac{1}{1} \cdot 1000 \frac{\text{g}}{\text{kg}} \cdot \frac{1 \text{ mol}}{40,0 \text{ g}} \cdot 96500 \frac{\text{A} \cdot \text{s}}{\text{mol}} \cdot \frac{1}{0,9} \cdot \frac{1 \text{ kA}}{1000 \text{ A}} \cdot \frac{1 \text{ h}}{3600 \text{ s}} = 0,745 \frac{\text{kA} \cdot \text{h}}{\text{kg}}$$

$$E = 0,745 \frac{\text{kA} \cdot \text{h}}{\text{kg}} \cdot 3,80 \text{ V} \cdot \frac{1 \text{ kW}}{\text{kA} \cdot \text{V}} = 2,829 \text{ kWh/kg}$$

$$\text{Hind}(\text{NaOH}) = 2,829 \frac{\text{kWh}}{\text{kg}} \cdot 80 \frac{\text{senti}}{\text{kWh}} = 226,4 \text{ senti/kg} \approx \mathbf{226 \text{ senti/kg}}$$

ii) 40,0 g NaOH  $\Leftrightarrow$  100 g 36,5% soolhape

$$\begin{aligned} \text{Hind}(36,5\% \text{ HCl}) &= 226,4 \text{ senti} \cdot \frac{1}{\text{kg}(\text{NaOH})} \cdot \frac{0,04 \text{ kg}(\text{NaOH})}{0,1 \text{ kg} (36,5\% \text{ soolhape})} = \\ &= 90,56 \text{ senti/kg} \approx \mathbf{90,6 \text{ senti/kg}} \end{aligned}$$

c) i)  $m(\text{NaOH}) = 100 \text{ krooni} \cdot \frac{1 \text{ kg}}{2,264 \text{ krooni}} = 44,2 \text{ kg}$

ii)  $m(36,5\% \text{ HCl}) = 100 \text{ krooni} \cdot \frac{1 \text{ kg}}{0,9056 \text{ krooni}} = 110 \text{ kg}$

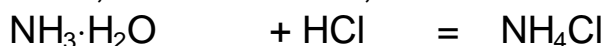
5. a)  $c(\text{NaCl}) = c(\text{Cl}^-) = \frac{1,56 \cdot 10^{-10} \text{ mol}^2 / (\text{dm}^3)^2}{1,56 \cdot 10^{-9} \text{ mol} / \text{dm}^3} = 1,00 \cdot 10^{-1} \text{ mol} / \text{dm}^3$

b)  $[\text{OH}^-] = 1,79 \cdot 10^{-5} \text{ mol} / \text{dm}^3 \cdot \frac{1,25 \cdot 10^{-1}}{1,00 \cdot 10^{-1}} = 2,238 \cdot 10^{-5}$

$\text{pOH} = -\lg 2,238 \cdot 10^{-5} = 4,65$

$\text{pH} = 14 - 4,65 = 9,35$

c) lähtehulk  $0,009375 \text{ mol}$   $0,1875 \text{ mol}$   $0,0750 \text{ mol}$



lõpp-hulk  $-$   $0,09375 \text{ mol}$   $0,169 \text{ mol}$

Lähtehulk:  $n(\text{NH}_3 \cdot \text{H}_2\text{O}) = 0,750 \text{ dm}^3 \cdot 0,125 \text{ mol} / \text{dm}^3 = 0,09375 \text{ mol}$

$n(\text{HCl}) = 1,50 \text{ dm}^3 \cdot 0,125 \text{ mol} / \text{dm}^3 = 0,1875 \text{ mol}$

Lõpp-hulk:  $n(\text{HCl}) = 0,1875 \text{ mol} - 0,09375 \text{ mol} = 0,09375 \text{ mol}$

Lahust **Z** on  $1,50 \text{ dm}^3 + 1,50 \text{ dm}^3 = 3,00 \text{ dm}^3$  ja selles sisaldub  $0,09375$  mooli tugevat hapet, mis nõrga aluse soolaga ei moodusta enam puhversüsteemi

$[\text{H}^+] = \frac{0,09375 \text{ mol}}{3,00 \text{ dm}^3} = 3,125 \cdot 10^{-2} \text{ mol} / \text{dm}^3$

$\text{pH} = -\lg 3,125 \cdot 10^{-2} \text{ mol} / \text{dm}^3 = 1,51$

