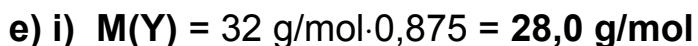
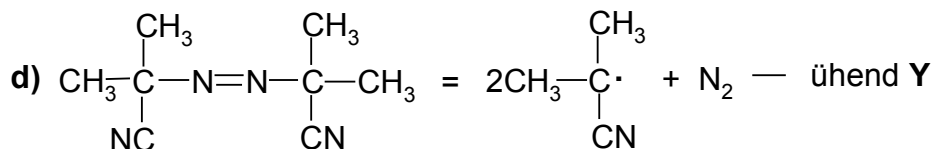
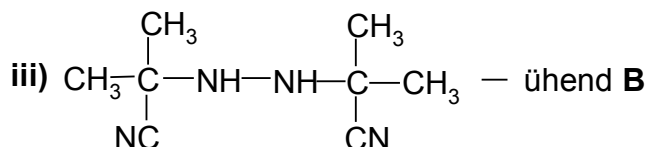
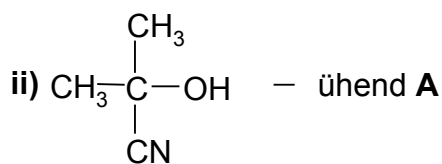
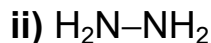
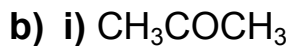


1999/2000 õa keemiaolümpiaadi III vooru ülesannete lahendused
12. klass



ii) Sama molaarmass on lämmastikul (N_2), süsinikmonooksiidil (CO) ja eteenil ($\text{CH}_2=\text{CH}_2$). CO ei saa tekkida, kuna ühendis 1,1'-ditsüano-1,1'-dimetüülasoetaanis puudub hapnik, etüülrühm ei lagune eteeniks.

2. a) i) $M(\text{X}) = \frac{1}{2} \left(\frac{32,1}{0,226} - 32,1 - 4 \cdot 16,0 \right) \text{ g/mol} = \mathbf{23,0 \text{ g/mol}}$

ii) $M(\text{Y}) = \frac{1}{2} \left(\frac{32,1}{0,254} - 32,1 - 4 \cdot 16,0 \right) \text{ g/mol} = \mathbf{15,1 \text{ g/mol}}$

b) **A** – Na_2SO_4 , naatriumsulfaat

B – $(\text{CH}_3)_2\text{SO}_4$, dimetüülsulfaat

C – NaOH , naatriumhüdroksiid

D – CH_3NaSO_4 , naatriummetüülsulfaat

E – CH_3OH , metanool

F – Na , naatrium

G – CH_3ONa , metoksünaatrium, naatriummetanolaat

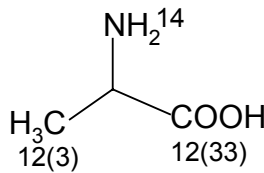
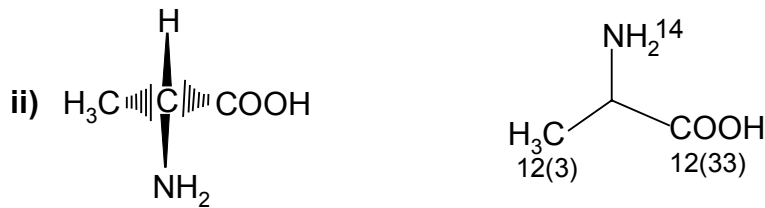
- c) i) $(\text{CH}_3)_2\text{SO}_4 + \text{NaOH} = \text{CH}_3\text{NaSO}_4 + \text{CH}_3\text{OH}$
 ii) $(\text{CH}_3)_2\text{SO}_4 + 2\text{NaOH} = \text{Na}_2\text{SO}_4 + 2\text{CH}_3\text{OH}$
 iii) $2\text{CH}_3\text{OH} + 2\text{Na} = 2\text{CH}_3\text{ONa} + \text{H}_2\uparrow$
 iv) $\text{CH}_3\text{ONa} + \text{H}_2\text{O} = \text{CH}_3\text{OH} + \text{NaOH}$

d) dimetüülsulfaat on ester $\text{CH}_3\text{-O-SO}_2\text{-O-CH}_3$

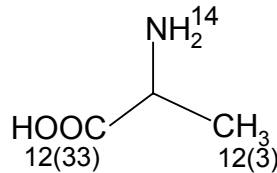
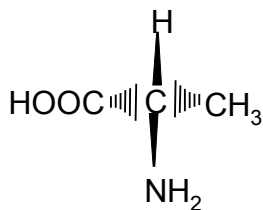
3. a) **A** – CH_3CHO
B – $\text{CH}_3\text{-CH=NH}$
C – $\text{CH}_3\text{CH}(\text{NH}_2)\text{-C}\equiv\text{N}$
X – $\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH}$

- b) i) $\text{CH}_3\text{CHO} + \text{NH}_3 = \text{CH}_3\text{CH=NH} + \text{H}_2\text{O}$
 ii) $\text{CH}_3\text{CH=NH} + \text{HCN} = \text{CH}_3\text{-CH}(\text{NH}_2)\text{-C}\equiv\text{N}$
 iii) $\text{CH}_3\text{-CH}(\text{NH}_2)\text{-C}\equiv\text{N} + 2\text{H}_2\text{O} = \text{CH}_3\text{-CH}(\text{NH}_2)\text{COOH} + \text{NH}_3$

c) i) α -aminopropaanhape,alaniin

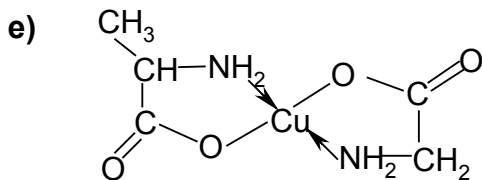


R



S

d) $2\text{CH}_3\text{CH}(\text{NH}_2)\text{COOH} + \text{Cu}^{2+} = [\text{CH}_3\text{CH}(\text{NH}_2)\text{COO}]_2\text{Cu} + 2\text{H}^+$



4. a) i) Et atsetoonis on ainult üks hapnik, siis saab ühendi **B** molaarmassi leida hapniku protsendilise sisalduse järgi

$$M(\text{B}) = \frac{16,0 \text{ g/mol}}{0,381} = 42,0 \text{ g/mol}$$

$$\text{Ühendis B: } n(\text{H}) = 42,0 \text{ g} \cdot 0,0476 \cdot \frac{1 \text{ mol}}{1 \text{ g}} = 2 \text{ mol}$$

$$n(\text{C}) = (42 - 16 - 2) \text{ g} \cdot \frac{1 \text{ mol}}{12 \text{ g}} = 2 \text{ mol}$$

Ühendi **B** empiiriline valem on $\text{C}_2\text{H}_2\text{O}$

ii) $M(\text{atsetoon}) = 58 \text{ g/mol}$

$$M(\text{A}) = M(\text{atsetoon}) - m(\text{B}) = 58 \text{ g/mol} - 42 \text{ g/mol} = 16 \text{ g/mol}$$

Ühendi **A** empiiriline valem on $\text{C}_3\text{H}_6\text{O} - \text{C}_2\text{H}_2\text{O} = \text{CH}_4$

b) **A** – CH_4 , metaan

B – $\text{CH}_2=\text{C}=\text{O}$, keteen

C – $\text{CH}_3\text{COOC}_2\text{H}_5$, etüülmetanaat

D – CH_3COOH , etaanhape

E – CH_3COONa , naatriumetanaat

c) i) $\text{CH}_2=\text{C}=\text{O} + \text{C}_2\text{H}_5\text{OH} = \text{CH}_3\text{COOC}_2\text{H}_5$ (**C**)

ii) $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O} = \text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH}$ (**D**)

iii) $\text{CH}_2=\text{C}=\text{O} + \text{H}_2\text{O} = \text{CH}_3\text{COOH}$ (**D**)

iv) $\text{CH}_3\text{COOH} + \text{NaOH} = \text{H}_2\text{O} + \text{CH}_3\text{COONa}$ (**E**)

v) $\text{CH}_3\text{COONa} + \text{NaOH} = \text{Na}_2\text{CO}_3 + \text{CH}_4$ (**A**)

d) $\text{CH}_2=\text{C}=\text{O} + \text{CH}_3\text{COOH} = \text{CH}_3\text{COOCOCH}_3$
etaanhappeanhüdriid

e) $2(\text{CH}_2=\text{C}=\text{O}) = \text{CH}_2=\text{C}(\text{O}-\text{C}=\text{O})-\text{CH}_2$
diketeen

$$5. \text{ a) } N(\text{prep}) = 1250 \text{ Ci/mmol} \cdot 3,700 \cdot 10^{10} \frac{\text{lagunemist}}{\text{sek}} \cdot \frac{60 \text{ sek}}{1 \text{ min}} = 2,775 \cdot 10^{15} \text{ dpm/mmol}$$

$$\text{b) } N(100\%) = 5,41 \cdot 10^{-6} \frac{\text{mmol}}{\text{mmol} \cdot \text{min}} \cdot 6,02 \cdot 10^{20} \frac{\text{lagunemist}}{\text{mmol}} = 3,26 \cdot 10^{15} \text{ dpm/mmol}$$

$$\text{c) } n(100\%) = 1 \text{ mmol} \cdot \frac{2,78 \cdot 10^{15}}{3,26 \cdot 10^{15}} = 0,853 \text{ mmol}$$

$$\text{d) } t = \frac{89,0 \text{ ööpäeva}}{\ln 2} \cdot \ln \frac{0,853}{0,853 - 0,100} \Rightarrow 128,4 \text{ ööpäeva} \cdot 0,1249 = 16,0 \text{ ööpäeva}$$

$$\text{e) eriaktiivsus (203 ööpäeva)} = 1,000 \text{ Ci/ml} \cdot e^{\frac{-\ln 2}{89,0 \text{ ööpäeva}} \cdot 203 \text{ ööpäeva}} = 0,205 \text{ Ci/ml}$$

6. a) i) $[\text{Cl}^-] = [\text{AgCl}] = \frac{1,81 \cdot 10^{-3} \text{ g/dm}^3}{143 \text{ g/mol}} = 1,26 \cdot 10^{-5} \text{ mol/dm}^3$

ii) $c(\text{Cl}^-) = c(\text{H}^+) = 10^{-\text{pH}} = 10^{-2,35} \text{ mol/dm}^3 = 4,47 \cdot 10^{-3} \text{ mol/dm}^3$

b) $LK(\text{AgCl}) = [\text{Ag}^+][\text{Cl}^-] = (1,26 \cdot 10^{-5} \text{ mol/dm}^3)^2 = 1,59 \cdot 10^{-10} \text{ mol}^2/\text{dm}^6$

c) HCl lahuses $[\text{AgCl}] = [\text{Ag}^+] = \frac{1,59 \cdot 10^{-10}}{4,47 \cdot 10^{-3}} = 3,56 \cdot 10^{-8} \text{ mol/dm}^3$

$L(\text{AgCl}) = 3,56 \cdot 10^{-8} \text{ mol/dm}^3 \cdot 143 \text{ g/mol} = 5,09 \cdot 10^{-6} \text{ g/dm}^3$

Lahustuvuste suhe on $\frac{1,81 \cdot 10^{-3}}{5,09 \cdot 10^{-6}} = 356$

d) i) $m(\text{NaCl}) = 1,0 \cdot 10^4 \text{ dm}^3 \cdot 1,0 \cdot 10^{-3} \text{ mol/dm}^3 \cdot 58,5 \text{ g/mol} = 585 \text{ g}$

ii) $m(\text{Ag}) = \frac{1,59 \cdot 10^{-10}}{1,0 \cdot 10^{-3}} \text{ mol/dm}^3 \cdot 1,0 \cdot 10^4 \text{ dm}^3 \cdot 108 \text{ g/mol} = 0,17 \text{ g}$