Ülesannete lahendused*

11. klass

Tallinna XX koolinoorte keemiaolümpiaadi koolivoor 2019/ 2020 õ. a

1. (10)

1. Iga õige süstemaatiline nimetus 0,5p. Kokku 5p.

A – **triklorometaan** 0,5

B – **etoksüetaan / dietüüleeter** 0,5

C – **etanool** 0,5

D – **propaan-2-ool** 0,5

E – 2-(difluorometoksü)-1,1,1,2-tetrafluoroetaan /
(1,2,2,2-tetrafluoroetüül) difluorometüüleeter 0,5

F – **2-bromo-1,1,1-trifluoro-2-kloroetaan** 0,5

G – **propaan-1,2,3-triool** 0,5

H – **naatriumetanolaat / naatriumetoksiid** 0,5

I – **tributüülamiin / N, N-dibutüülbutaan-1-amiin** 0,5

J – 2- (dietüülamino)etaan-1-ool / dietüülaminoetanool /
(2-hüdroksüetüül) dietüülamiin 0,5

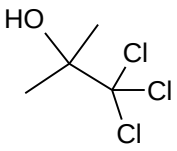
2. Iga õigesti valitud ühend 0,25p. Kokku 1p. Kui ühes alapunktis on märgitud enam kui kaks ühendit, siis iga valesti märgitud ühend - 0,25p. Min tulemus 0p.

2.1. **I** ja **J** 0,5

2.2. **B** ja **E** 0,5

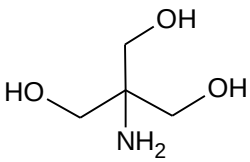
3. Iga õige struktuurivalem 1p. Kokku 4p.

K



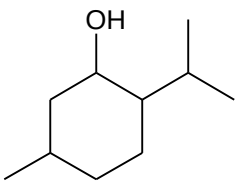
(1)

L



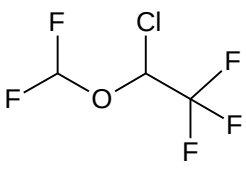
(1)

M



(1)

N



(1)

10p

2. (10)

1.

I $RCHO + Ag_2O \rightarrow RCOOH + 2Ag \downarrow$ 1

n(Ag) = $\frac{21,23\ \text{g}}{108\ \text{g}/\text{mol}} = 0,1966\text{mol}$, n(RCHO) = 0,0983 mol

m(RCHO) = 10 cm^3 · 1,042 g/cm^3 = 10,42 g

M(RCHO) = $\frac{10,42\ \text{g}}{0,0983\ \text{mol}}$ = 106 g/mol

Kuna aine **A** andis *hõbepeegli* reaktsiooni, siis kuulub ta aldehüüdide klassi.

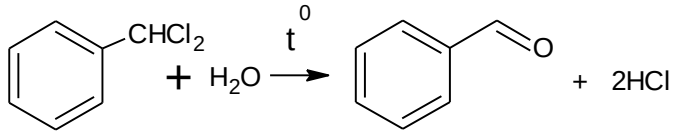
Ülesande tekstist võib aru saada, et tegemist on aromaatse aldehüüdiga.

Molaarmassga M=106 g/mol on kõige lihtsam aromaatne aldehüüd - **bensaldehüüd**,

1

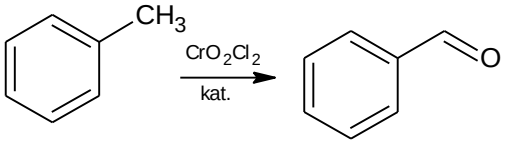
2.

II



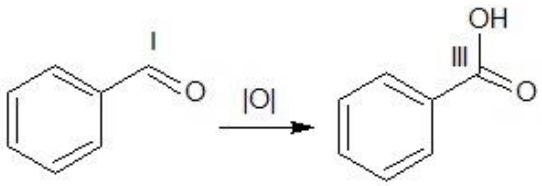
1

III



0,5

3.



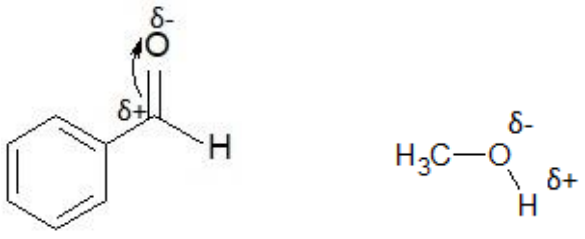
0,5

IV

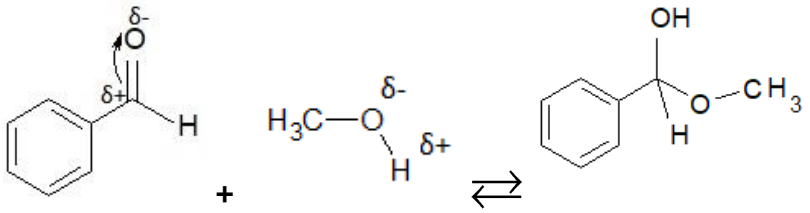
Süsiniku o.a karbonüülrühmas **I** ja karboksüülrühmas **III** 0,5

toimus **oksüdeerumine** 0,5

4.

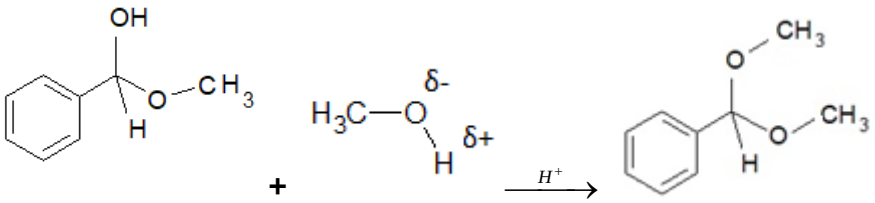


1

i) **V** 

1

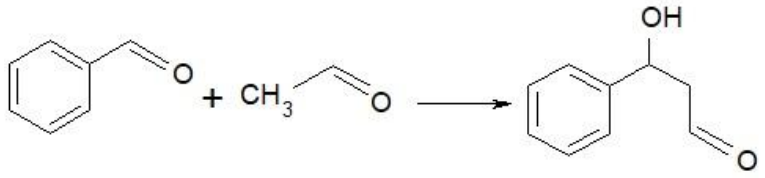
poolatsetaal

ii) **VI** 

+ H_2O 1

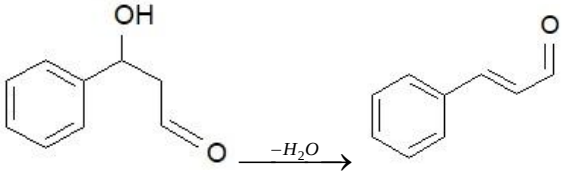
atsetaal

5.



iii) **VII**

aine C – etanaal 1

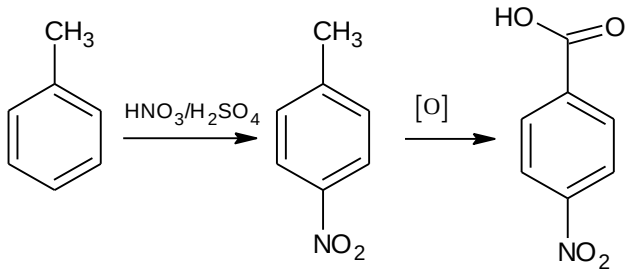
iv) **VIII** 

kaneelaldehüüd 1

10 p

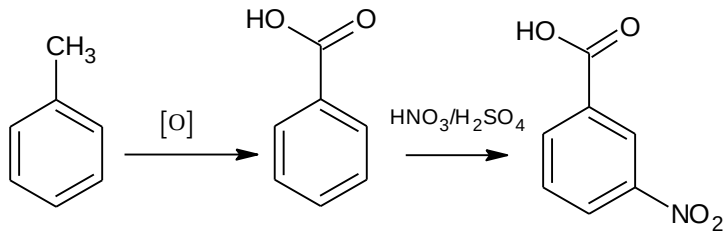
3. (10)

1.



i) 1

p - nitrobensoehape



ii) 1

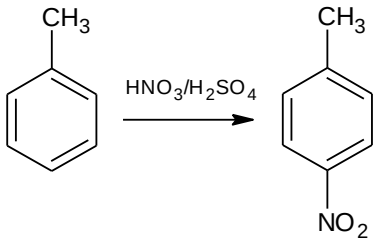
m - nitrobensoehape

2. NO_2^+ - nitrooniumioon 1

3. väävelhape protoneerib lämmastikhapet, eraldub vesi ja tekib nitrooniumioon NO_2^+, mis on hea elektrofiil 1

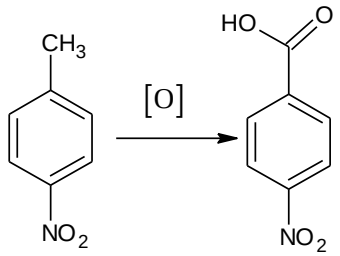
väävelhape seob nitreerimisprotsessis eralduva vee 1

4. i) 1.



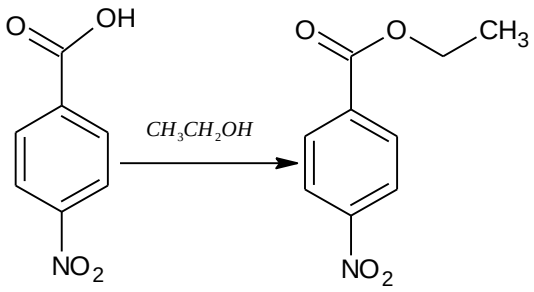
0,5

2.



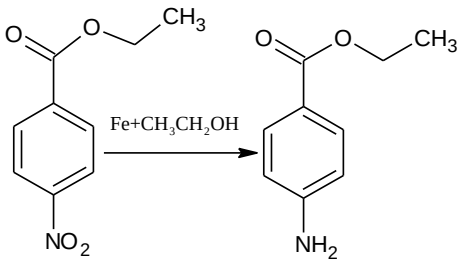
0,5

3.



0,5

4.



0,5

ii) 1. 4-nitrotolueen, 2. 4-nitrobensoehape, 3. etüül–4-nitrobensoaat,

4. etüül-4-aminobensoaat 2

iii) 1. nitreerimine, 2. oksüdeerimine,

3. esterdamine, 4. redutseerimine 1

10p

4. (10)

1. $HCl + NaOH = NaCl + H_2O$ 0,5

$HCl + NH_3 \cdot H_2O = NH_4Cl + H_2O$ 0,5

$NaOH + CH_3COOH = CH_3COONa + H_2O$ 0,5

$NH_3 \cdot H_2O + CH_3COOH = CH_3COONH_4 + H_2O$ 0,5

2. A – NaCl (soola lahus) 0,5

B – CH_3COOH ja HCl (hapete segu lahus) 0,5

C – $NH_3 \cdot H_2O$ ja NH_4Cl (puhverlahus) 0,5

D - CH_3COOH ja CH_3COONa (puhverlahus) 0,5

E – $NH_3 \cdot H_2O$ ja NaOH (aluste segu lahus) 0,5

F – CH_3COONH_4 (soola lahus) 0,5

3. Puhverlahus **C** – $NH_3 \cdot H_2O$ ja NH_4Cl

$n(NH_3 \cdot H_2O) = 0{,}2000\ M \cdot 0{,}1000\ l = 0{,}02000\ mol$

$n(HCl) = 0{,}1000\ M \cdot 0{,}1000\ l = 0{,}01000\ mol$

$c(NH_3 \cdot H_2O) = \frac{0{,}01000\ mol}{0{,}2000\ l} = 0{,}05000\ \frac{mol}{l}$

$c(NH_4Cl) = \frac{0{,}01000\ mol}{0{,}2000\ l} = 0{,}05000\ \frac{mol}{l}$

$$pOH = pK_b + \log\frac{BH^+}{B} = -\log\left(1{,}75 \cdot 10^{-5}\right) + \log\left(\frac{0{,}05000}{0{,}05000}\right) = \mathbf{4{,}76}$$

pH = 14,00 – 4,76 = **9,24** 2

4. Puhverlahus **D** - CH_3COOH ja CH_3COONa

$n(CH_3COOH) = 0{,}2000\ M \cdot 0{,}1000\ l = 0{,}02000\ mol$

$n(NaOH) = 0{,}1000\ M \cdot 0{,}1000\ l = 0{,}01000\ mol$

$c(CH_3COOH) = \frac{0{,}01000\ mol}{0{,}2000\ l} = 0{,}05000\ \frac{mol}{l}$

$c(CH_3COONa) = \frac{0{,}01000\ mol}{0{,}2000\ l} = 0{,}05000\ \frac{mol}{l}$

$$\mathbf{pH =}\ pK_a + \log\frac{A^-}{HA} = -\log\left(1{,}8 \cdot 10^{-5}\right) + \log\left(\frac{0{,}05000}{0{,}05000}\right) = \mathbf{4{,}74}$$ 2

5. **$CH_3COONH_4 + H_2O = CH_3COOH + NH_3 \cdot H_2O$** 1

10p

** Keemiaolümpiaadi koolivooru komisjon võib iseseisvalt hinnata võimalikke alternatiivseid lahendusvariante.*