Univerza *v Ljubljani*
Fakulteta *za kemijo in kemijsko tehnologijo*

Darko Dolenc

Organska kemija

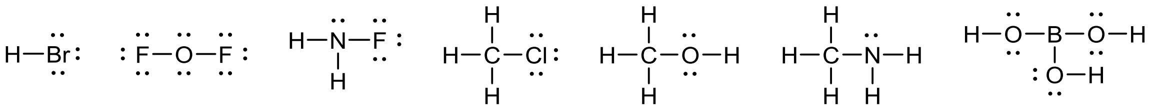
Rešitve nalog

Ljubljana, 2019

2. Vezi v molekulah organskih spojin

2.3.1

a)



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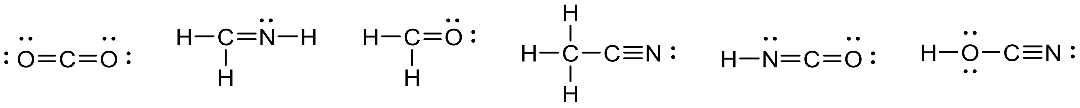

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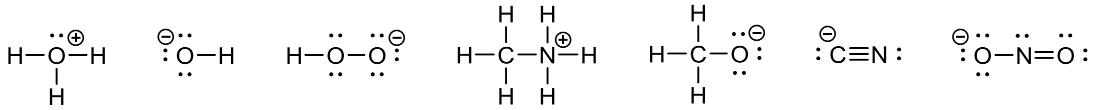
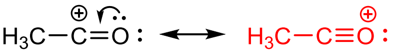
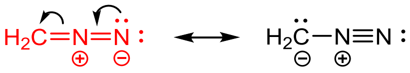
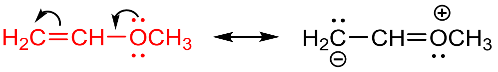
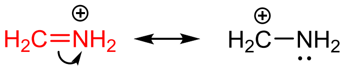


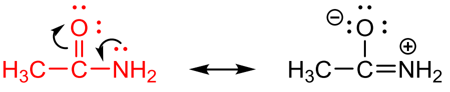
2.5. 1 Pomembnejša struktura je označena rdeče

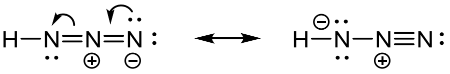
a)  (okteti)

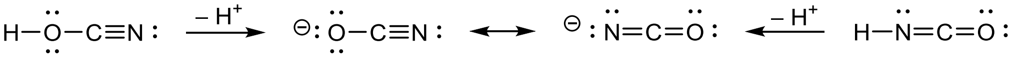
b)  (elektronegativnost)

c)  (naboji)

d)  (okteti)

e)  (naboji)

f) 

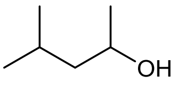
2.5.2 

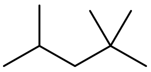
2.6.1 a) 109,5° b) 180° c) 120°

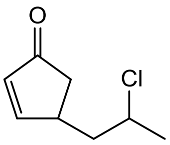
2.6.2 a) trikotno planarna b) piramidalna c) tetraedrična

3. Izomerija in imenovanje organskih spojin

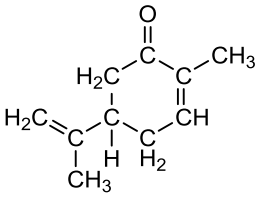
3.1.1

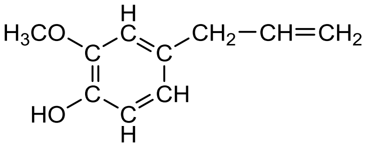
a) 

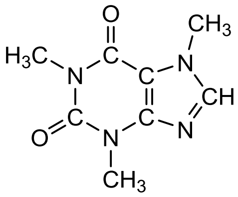
b) 

c) 

3.1.2

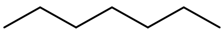
a) 

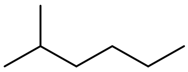
b) 

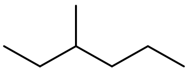
c) 

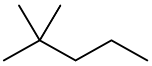
3.3.1 a) 2,2,4-trimetilheksan b) 3-metil-4-propilheptan c) 5-etil-4,4-dimetiloktan
d) 4-etil-2-metilheksan e) 1-etil-2-metilciklopentan f) 1,2,4-trimetilcikloheksan
g) 4-etil-2-metil-1-propilcikloheksan h) (1,2,3,3-tetrametilbutil)cikloheksan ali 4-cikloheksil-2,2,3-trimetilpentan

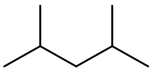
3.3.2

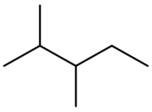

heptan

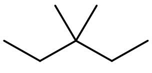

2-metilheksan

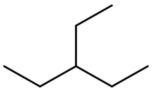

3-metilheksan

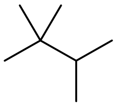

2,2-dimetilpentan


2,4-dimetilpentan

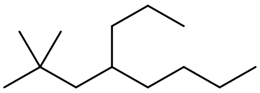

2,3-dimetilpentan


3,3-dimetilpentan


3-etilpentan


2,2,3-trimetilbutan

3.3.3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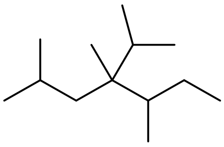
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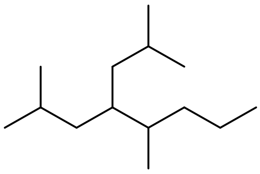
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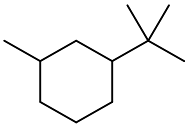

d

3.3.4 a) but-1-en b) 2-metilbut-1-en c) 2-metilbut-2-en d) 3-metilbut-1-en

e) 2-metilbuta-1,3-dien f) 1-metilciklopenten g) pent-1-in h) heks-2-in i) cikloheksa-1,3-dien
j) 3-metilcikloheksen k) 5-metilheks-4-en-1-in

3.3.5 a) 2-metilpropilbenzen b) 1-etil-2,4-dimetilbenzen c) 2-metilprop-1-enilbenzen
d) ciklopropilbenzen

3.4.1 a) pentan-2-ol b) 2-metilbutan-2-ol c) propan-1,2-diol d) ciklopentilmetanol

e) 1-feniletanol f) 2-hidroksietilcikloheksanol g) 2-bromoetanol h) 2-metoksietanol

i) 2-(metiletil)-5-metilcikloheksanol j) 3-etilfenol k) 2-metoksi-4-prop-2-enilfenol

3.4.2 a) 2-metilbutanal b) cikloheksankarbaldehid c) butandial d) propenal e) butanon

f) ciklopentanon g) cikloheksiletan-1-on h) heksan-2,5-dion i) 2-(1-oksoetil)cikloheksanon

j) 1,3-dihidroksipropanon

3.4.3 a) 2-metilbutanojska kislina b) ciklobutankarboksilna kislina

c) 2-metilpentandiojska kislina d) 2-amino-3-hidroksibutanojska kislina

e) 2-oksopentandiojska kislina f) 2,3-dikloropropanojska kislina

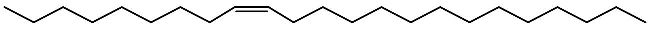
g) ciklohekseni-4,5-dikarboksilna kislina h) 2-(2-karboksietil)cikloheksankarboksilna kislina

i) etanoil klorid (acetil klorid) j) etil propanoat k) 4-hidroksibenzenkarboksamid

l) *N*-(4-hidroksifenil)etanamid

3.5.1 a) OH b) OCH_3 c) CH_2OCH_3 d) CH_2F e) $COCH_3$ f) Ph g) CN

3.5.2 a) E b) E c) E d) Z

3.5.3 

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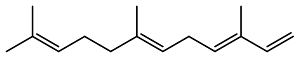
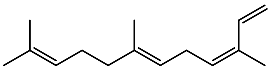
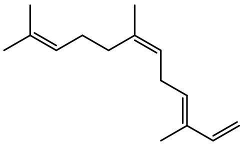


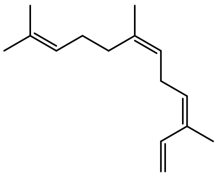
(3*E*,6*E*)-3,7,11-trimetildodeka-1,3,6,10-tetraen



(3*Z*,6*E*)

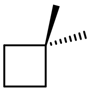


(3*E*,6*Z*)

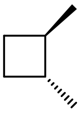


(3*Z*,6*Z*)

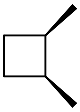
3.6.1



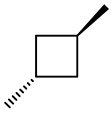
1,1-dimetilciklobutan



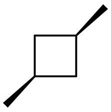
trans-1,2-dimetil...



cis-1,2...

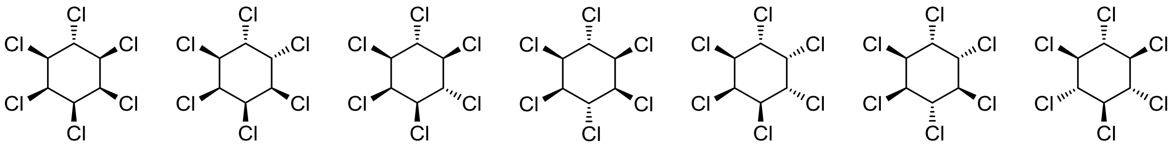


trans-1,3...



cis-1,3...

3.6.2.



4. Lastnosti organskih spojin

4.3.1 Najnižje 2,2,3-trimetilbutan, najvišje heptan.

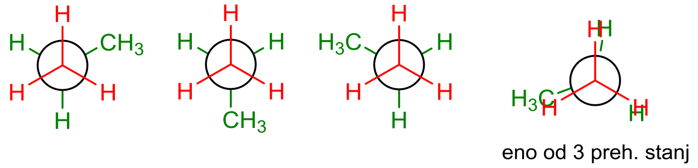
4.3.2 Molekula *p*-ksilena je pravilnejše oblike (ima več elementov simetrije) kot molekula *m*-ksilena. Zato lažje tvori urejeno kristalno mrežo.

4.3.3 Obe spojini sta akceptorja vodikove vezi in z vodo tvorita vodikove vezi. Amin je bolj bazičen in tvori močnejše vezi kot eter. Poleg tega je amin tudi šibek donor vodikove vezi.

4.3.4 Butan-1,4-diol > pentan-1-ol > heksan.

5. Konformacija in napetost

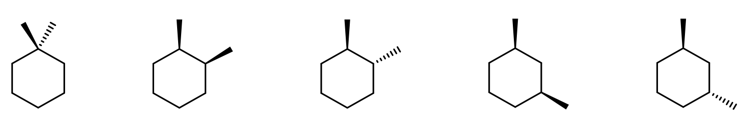
5.2.1



a) ne b) višja

5.2.2

a)



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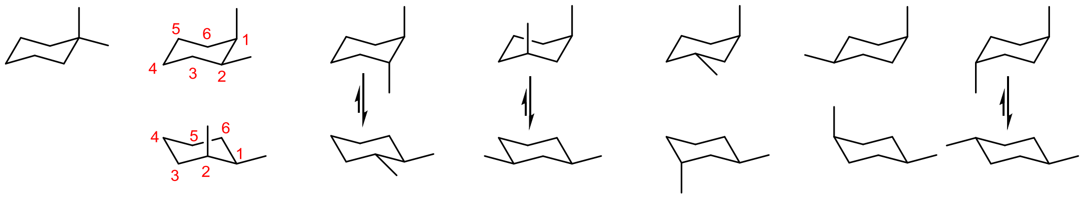

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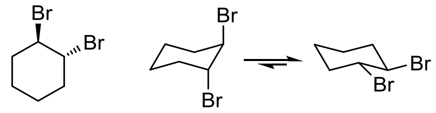
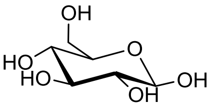
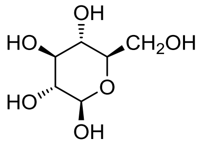


5.2.4

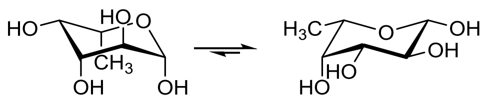
a)



b)



5.2.5



6. Kisline in baze

6.1.1 a) NO_3^-, b) OH^-, c) HCO_3^-, d) CH_3O^-, e) CO_3^{2-}, f) NH_3, g) NH_2^-, h) CH_3^-.

6.1.2 a) H_2O, b) H_2SO_4, c) H_3O^+, d) $CH_3NH_3^+$, e) NH_3, f) H_2O_2, g) $CH_3OH_2^+$

6.2. Ustrezne konstante kislin poiščite v priročnikih ali na spletu

a) $\overset{10,2}{HCO_3^-} + NH_3 \rightleftharpoons CO_3^{2-} + \overset{9,2}{NH_4^+}$

b) $HCO_3^- + \overset{4,7}{CH_3COOH} \rightleftharpoons \overset{6,4}{H_2CO_3} + CH_3COO^-$

c) $NH_2^- + \overset{15,7}{H_2O} \rightleftharpoons \overset{38}{NH_3} + OH^-$

d) $CN^- + \overset{4,7}{CH_3COOH} \rightleftharpoons \overset{9,2}{HCN} + CH_3COO^-$

e) $CO_3^{2-} + \overset{10,0}{PhOH} \rightleftharpoons \overset{10,2}{HCO_3-} + PhO^-$

6.2.2 Ustrezne konstante kislin poiščite v preglednici 6.1, v priročnikih ali na spletu

a) $CH_3COOH + EtNH_2 \rightleftharpoons CH_3COO^- + EtNH_3^+$

b) $Ph\text{–}OH + NaOH \rightleftharpoons PhONa + H_2O$

c) $Ph\text{–}OH + NaHCO_3 \rightleftharpoons PhONa + H_2CO_3$

d) $NaOH + HC\equiv CH \rightleftharpoons H_2O + HC\equiv CNa$

e) $NaNH_2 + HC\equiv CH \rightleftharpoons NH_3 + HC\equiv CNa$

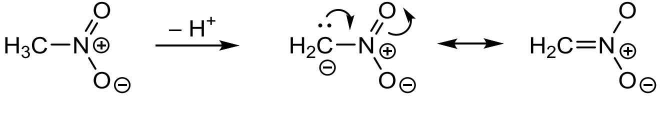
f) $PhNH_2 + CH_3COOH \rightleftharpoons PhNH_3^+ + CH_3COO^-$

g) $NaHCO_3 + NaH_2PO_4 \rightleftharpoons Na_2CO_3 + H_3PO_4$ ali $NaHCO_3 + NaH_2PO_4 \rightleftharpoons H_2CO_3 + Na_2HPO_4$

6.3.1 C < B < D < A < E

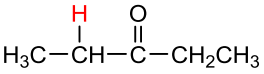
6.3.2 C

6.5.1 a) Nitrometan pri oddaji protona nastali negativni naboj v veliki meri porazdeli prek nitro skupine.



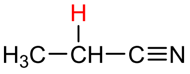
b) Toluen je bolj kisel zaradi porazdelitve naboja v nastalem anionu prek benzenovega obroča, analogno kot pri fenoksidnem anionu.

6.5.2 a) $H_3C-C\equiv C-H$ b)



$H_3C-\overset{H}{CH}-\overset{O}{\overset{\|}{C}}-CH_2CH_3$

c)



$H_3C-\overset{H}{CH}-C\equiv N$

6.5.3 Bolj bazična je skupina na stranski verigi

6.5.4 Malononitril je močneje kisel od acetonitrila

6.6.1 a) obe b) le benzojska kislina

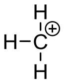
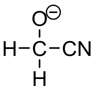
6.6.2 pK_a($AtrH^+$) = 9,7. To pomeni, da je pri pH = 5 v protonirani obliki, torej v obliki kationa $AtrH^+$ oziroma soli. Ta oblika je topna v vodi.
V obliki sulfata, torej soli, se uporablja zato, ker je v tej obliki topen v vodi in ima raztopina lahko pH, ki je blizu fiziološkemu (7,4). Atropin v obliki prostega amina ni dovolj topen v vodi in pH take raztopine bi moral biti nad pK_a($AtrH^+$) = 9,7, kar je za uporabo v očeh škodljivo.

6.6.3 Pri pH pod pK_a = 4,2 je kislina pretežno v protonirani obliki (-COOH). V obliki soli se uporablja zaradi topnosti, saj je natrijeva sol dobro topna in se v živilu hitro raztopi. Kislina je slabše topna in bi se lahko neraztopljena usedla.

7. Reakcije v organski kemiji

7.1.1 a) substitucija b) premestitev c) substitucija d) eliminacija e) substitucija f) adicija

7.2.1

	E	Nu
a	H^+	H_2O
b	 $H_2\overset{\oplus}{C}H$	$:\ddot{\underset{..}{O}}^{\ominus}-H$
c	H^+	$H_2C=CH_2$
d	H_3C-Cl	NH_3
e	$H_2C=O$	CN^-
f	H_2O	 $H_2C(O^{\ominus})-CN$

7.5.1 Krivulja A: $A = 10^{12}$ s^{-1} in E_a = 55 kJ/mol, krivulja B: $A = 10^8$ s^{-1} in E_a = 30 kJ/mol.

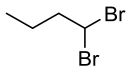
7.6.1. Razmerje bi bilo 2 (*orto*) : 2 (*meta*): 1 (*para*)

7.7.1 b > a > d > c

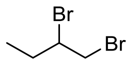
7.7.2 a > d > b > c

8. Alkani

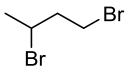
8.1.1



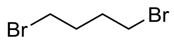
1,1-dibromobutan



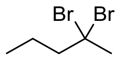
1,2-di...



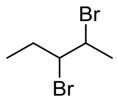
1,3-di...



1,4-di...



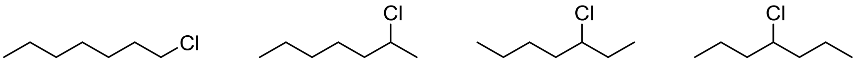
2,2-di...



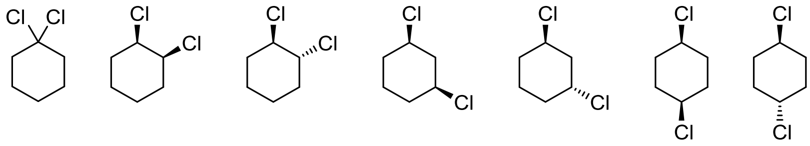
2,3-di..

8.1.2. Nastane zmes različnih produktov. V prvi fazi, ko imamo v reakcijski zmesi le cikloheksan, nastaja bromocikloheksan. Ko se ta nabira v reakcijski zmesi poteka nadaljnje bromiranje tudi te spojine, nastajajo dibromocikloheksani in naprej, tribromo itd. Atom broma v bromocikloheksanu ne vpliva močno na reaktivnost preostalih skupin CH_2 v molekuli. Reakcija poteka dokler ne zmanjka broma. Pri tem seveda ostane tudi nekaj nezreagiranega ogljikovodika.

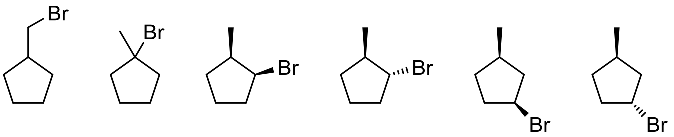
8.7.1



8.7.2



8.7.3



8.7.4

1. Fluoriranje

$H_3C\text{-}H \; + \; F\cdot \longrightarrow H_3C\cdot \; + \; H\text{–}F$ (1)

$\Delta H_r(1) = –[\Delta H_v(\text{H-F}) – \Delta H_v(\text{C-H})] = [\Delta H_v(\text{C-H}) – \Delta H_v(\text{H-F})] = 439 – 570 = –131 \text{ kJ mol}^{–1}$

$H_3C\cdot \; + \; F\text{–}F \longrightarrow CH_3F \; + \; F\cdot$ (2)

$\Delta H_r(2) = –[\Delta H_v(\text{C-F}) – \Delta H_v(\text{F-F})] = [\Delta H_v(\text{F-F}) – \Delta H_v(\text{C-F})] = 159 – 460 = –301 \text{ kJ mol}^{–1}$

$\Delta H_r = \Delta H_r(1) + \Delta H_r(2) = –131 + (–301) \text{ kJ mol}^{–1} = –432 \text{ kJ mol}^{–1}$

2. Jodiranje

$H_3C\text{-}H \; + \; Br\cdot \longrightarrow H_3C\cdot \; + \; H\text{–}Br$ (1)

$\Delta H_r(1) = –[\Delta H_v(\text{H-Br}) – \Delta H_v(\text{C-H})] = [\Delta H_v(\text{C-H}) – \Delta H_v(\text{H-Br})] = 439 – 366 = 73 \text{ kJ mol}^{–1}$

$$H_3C\cdot + Br{-}Br \longrightarrow CH_3{-}Br + Br\cdot \qquad (2)$$

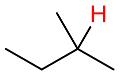
$\Delta H_r(2) = -[\Delta H_v(\text{C-Br}) - \Delta H_v(\text{Br-Br})] = [\Delta H_v(\text{Br-Br}) - \Delta H_v(\text{C-Br})] = 193 - 294 = -101\ \text{kJ mol}^{-1}$

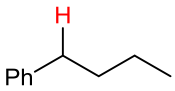
$\Delta H_r = \Delta H_r(1) + \Delta H_r(2) = 73 + (-101)\ \text{kJ mol}^{-1} = -28\ \text{kJ mol}^{-1}$

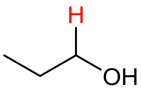
a) Bromiranje je eksotermno, torej lahko poteka. Reakcija (1) je sicer endotermna, kar pomeni, da leži ravnotežje na levi, vendar imamo v reakcijski zmesi kljub temu majhno koncentracijo metilnih radikalov. Ti v drugi stopnji reagirajo naprej in celoten proces poteka. Seveda počasneje kot kloriranje.

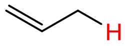
b) Fluoriranje je tako močno eksotermno, da sproščena toplota segreje reakcijsko zmes in reakcija zato poteka vse hitreje; sprošča se vse več toplote. Taka reakcija poteče eksplozivno.

8.7.5









8.7.6 $M(C_7H_{12}) = 96{,}17\ \text{g mol}^{-1}$. $n = 10{,}40$ mol.

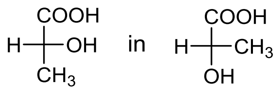
$$C_7H_{12} + 10\ O_2 \longrightarrow 7\ CO_2 + 3\ H_2O$$

$n(CO_2) = 7 \times 10{,}40\ \text{mol} = 72{,}79\ \text{mol}$ $\quad m(CO_2) = 72{,}79\ \text{mol} \times 44{,}00\ \text{g mol}^{-1} = 3{,}20\ \text{kg}$

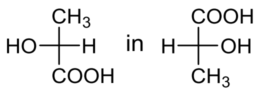
$V(CO_2) = 72{,}79\ \text{mol} \times 8{,}314\ \text{J mol}^{-1}\ \text{K}^{-1} \times 293\ \text{K} / 100 \times 10^3\ \text{Pa} = 1{,}77\ \text{m}^3$

9. Optična izomerija in kiralnost

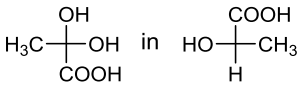
9.2.1



enantiomera

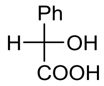


enaki molekuli

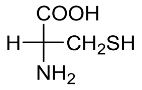


enantiomera

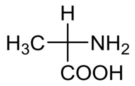
9.3.1



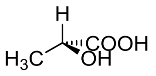
L



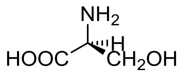
L



D



D



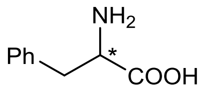
L

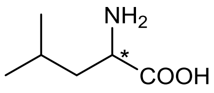
9.3.2 a) S, b) S, c) R, d) R, e) S, f) R

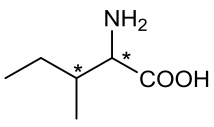
9.9.1 Kiralne so molekule pod a, b, e, f, in g

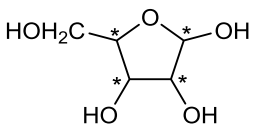
9.9.2 Kiralne so molekule pod b, d in f

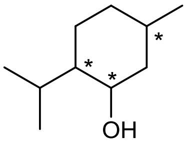
9.9.3

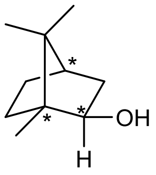


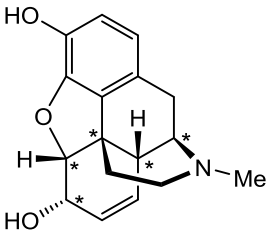










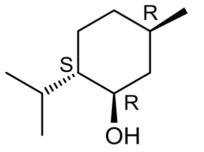


9.9.4 a) L, b) D, c) L, d) D, e) L, f) D, g) L, h) D

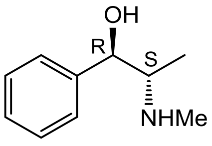
9.9.5 a) S, b) R, c) R, d) S, e) S, f) S, g) R, h) R

9.9.6 a) L-serin - S, L-cistein - R b) A - R, B - S c) C - R, D - S

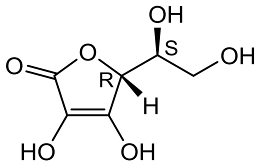
9.9.7



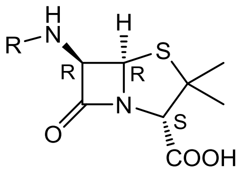
mentol



efedrin



L-askorbinska kislina



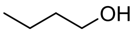
penicilin

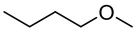
9.9.8 A = arabinoza, B = ksiloza

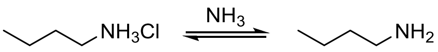
9.9.9 ee = 95,2 %

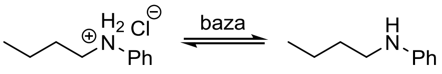
10. Organske halogenske spojine 1. Nukleofilna substitucija

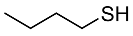
10.3.1

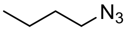
a) 

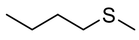
b) 

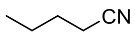
c) 

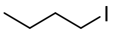
d) 

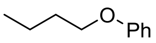
e) 

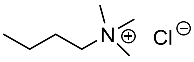
f) 

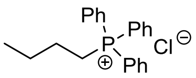
g) 

h) 

i) 

j) 

k) 

l) 

10.3.2

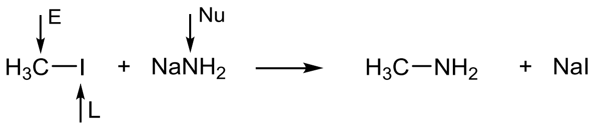
a) 1-bromopentan > 2-bromopentan > 2-bromo-2-metilbutan

b) 1-bromo-3-metilbutan > 3-bromo-2-metilbutan > 2-bromo-2-metilbutan

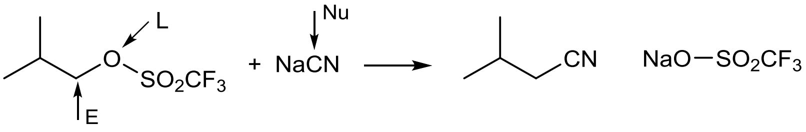
c) 1-bromobutan > 1-bromo-3-metilbutan > 1-bromo-2-metilbutan > 1-bromo-2,2-dimetilbutan

10.3.3

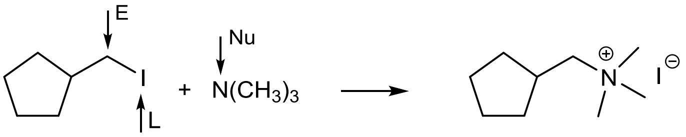
a)



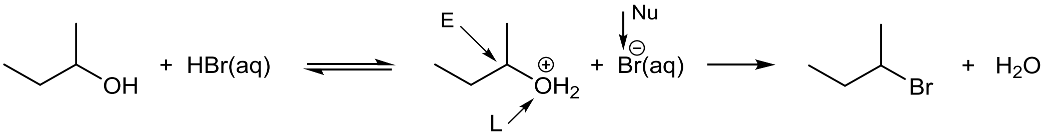
b)



c)



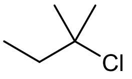
d)

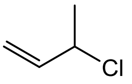


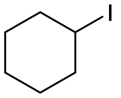
10.3.4 Produkta sta enantiomera – imata nasprotno konfiguracijo, kar pomeni, da je po eni poti prišlo do inverzije konfiguracije, po drugi pa se je ohranila. Po levi poti je najprej reakcija s kalijem, ki odtrga proton z OH skupine, kar ne vpliva na konfiguracijo. Naslednja reakcija je nukleofilna substitucija na etilni skupini. Konfiguracija na 1-fenilpropilni skupini se ohrani.

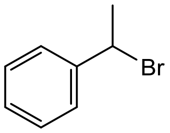
Reakcija po desni poti obrne konfiguracijo pri reakciji tozilata z etoksidom (S_N2).

10.7.1

a) 

b) 

c) 

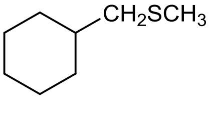
d) 

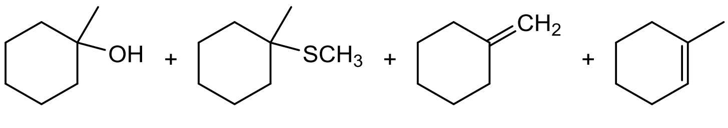
10.7.2 a) z NaSEt b) z jodidom

10.7.3 a) z bromidom b) ni razlike c) z bromidom

10.7.4 acetonitril

10.7.5

a) 

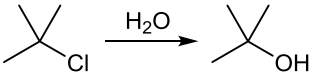
b) 

10.7.6 a) reakcija bo hitreje potekla v aprotičnem DMSO kot v protičnem EtOH

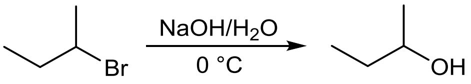
b) V DMSO bo produkt substitucije le alkohol, v etanolu pa tudi etoksimetilcikloheksan.

10.7.7 Prikazani so primeri sintez z nukleofilnimi substitucijami. Mogoče so tudi druge sintezne poti.

a)

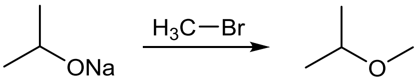


b)



c)

d)



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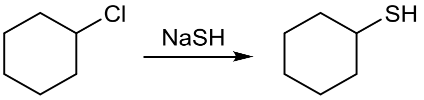
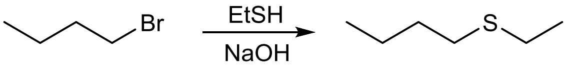
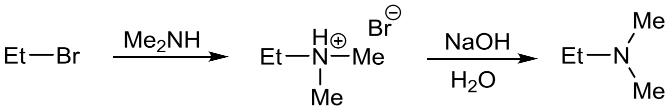


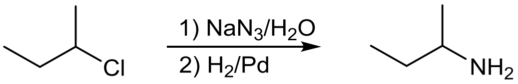
f)



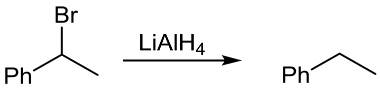
g)



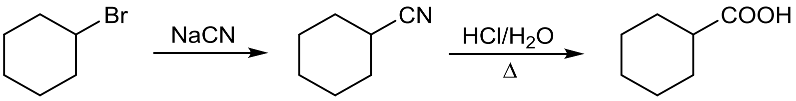
h)



i)

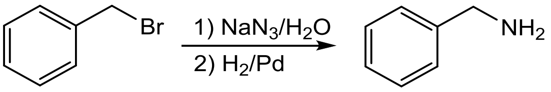


j)

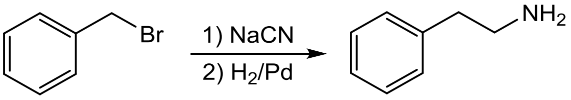


10.7.8

a)



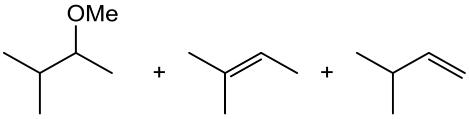
b)



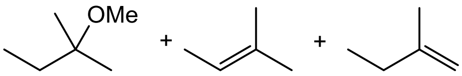
11. Organske halogenske spojine 2. Eliminacija

11.2.1

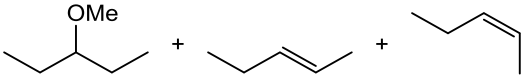
a)



b)



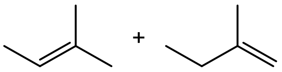
c)

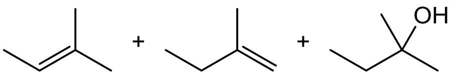


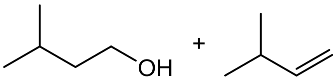
11.Vaje.1

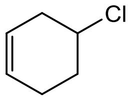
glavni z EtOK glavni s *t*-BuOK

11.Vaje.2

a) 

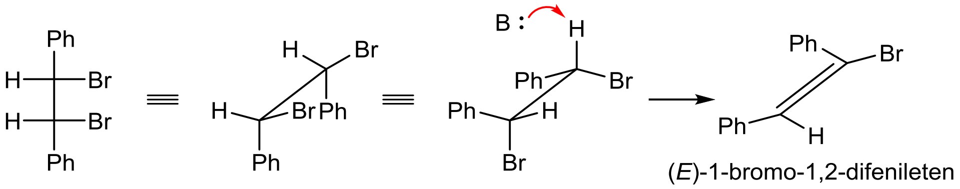
b) 

c) 

11.Vaje.3 

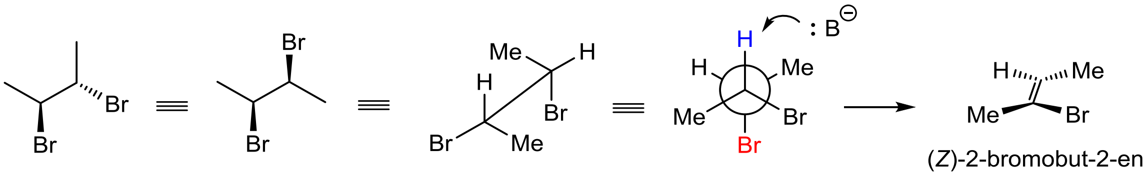
11.Vaje.4 a) Primernejša je kombinacija B. b) Pri kombinaciji A je glavni produkt propen in ne eter.

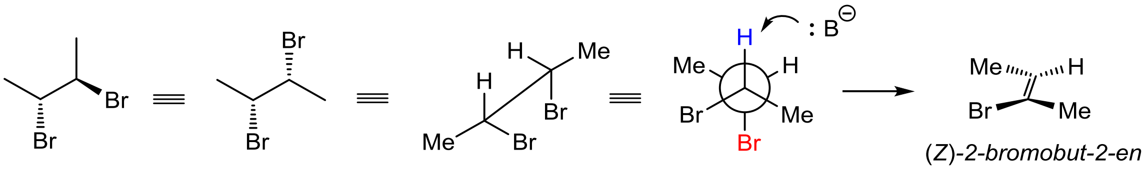
11.Vaje.5

a) 

b) Pri daljšem segrevanju bi nastal difeniletin.

11.Vaje.6

a) 



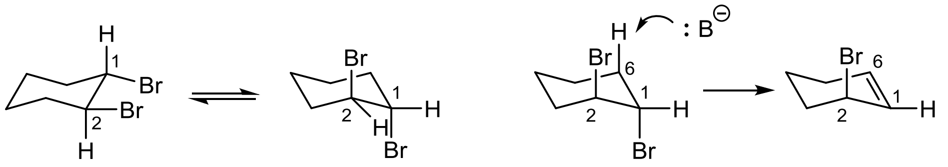
b) v obeh primerih nastane isti alken, (*Z*)-2-bromobut-2-en.

c) Potek z (*E*)-but-2-enom je popolnoma analogen, vendar imajo vse spojine obratno konfiguracijo. Produkt je (*E*)-2-bromobut-2-en.

11.Vaje.7 a) Heksaklorocikloheksan je v primerjavi s klorocikloheksanom manj reaktiven za S_N1 nukleofilno substitucijo in E1 eliminacijo. Reakciji potekata preko karbokationa, ki ga sosednje skupine CHCl, s svojim elektronprivlačnim efektom, destabilizirajo.

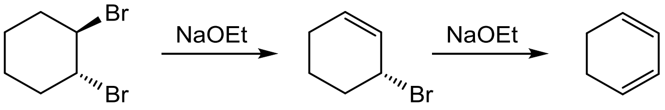
b) Nastali bi izomerni triklorobenzeni.

12. a) Pri trans-1,2-dibromocikloheksanu v nobenem od konformerov ne more poteči eliminacija med H1 in Br2 ali H2 in Br1, saj nista vodikov in bromov atom nikoli v *anti* legi.



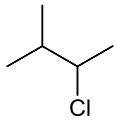
Eliminacija zato poteče z odtrganjem vodikovega atoma s sosednjih atomov C3 ali C6.

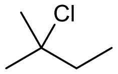
b) Produkta sta 3-bromocikloheksen in 1,3-cikloheksadien.

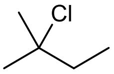


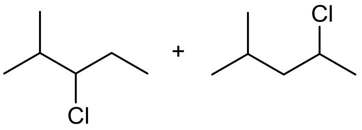
12. Alkeni in alkini. Elektrofilna adicija

12.2.1

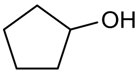
a) 

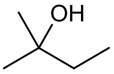
b) 

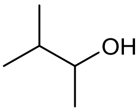
c) 

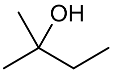
d) 

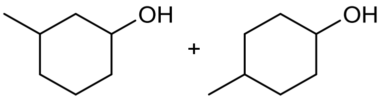
12.3.1

a) 

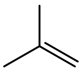
b) 

c) 

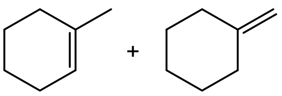
d) 

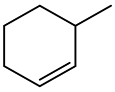
e) 

12.3.2

a) 

b) 

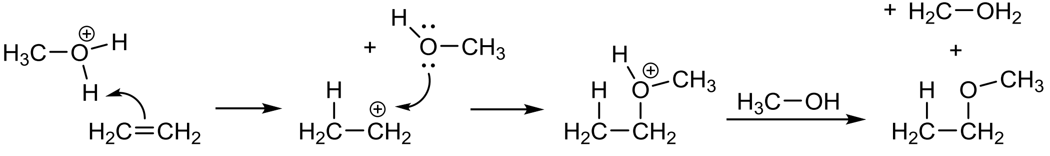
c) 

d) 

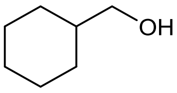
12.3.3 Če bi uporabili HCl bi se poleg vode na intermediarni karbokation adiral tudi kloridni ion, nastali bi β-kloroalkoholi. Hidrogensulfatni ion je slab nukleofil in se, razen v koncentrirani žveplovi kislini, ne adira.

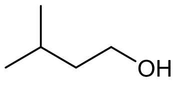
12.3.4 2-metil-2-metoksipropan (metil *t*-butil eter, MTBE).

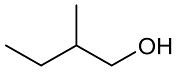
12.3.5



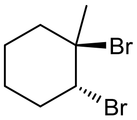
12.4.1

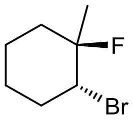
a) 

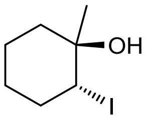
b) 

c 

12.5.1

a) 

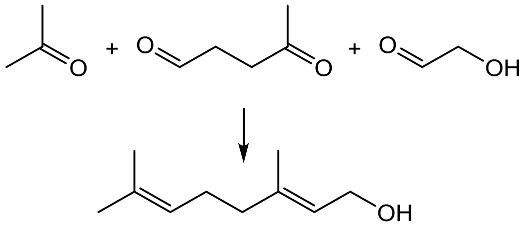
b) 

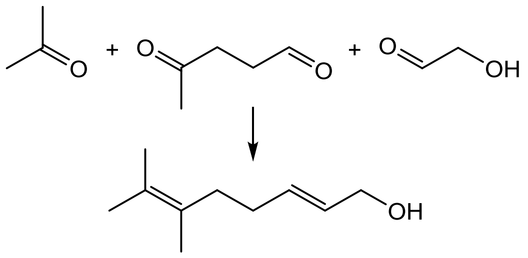
c) 

Prikazan je en enantiomer, nastane racemat.

12.6.1 *cis*-1,2-dimetilcikloheksan

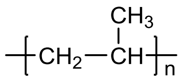
12.8 1 Nastanejo tri spojine, od katerih je ena dikarbonilna. Ta je nastala iz sredine verige in ima dve možni orientaciji. Iz teh podatkov je mogoče izpeljati dve strukturi. Geraniol predstavlja leva formula.



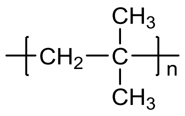


12.9.1

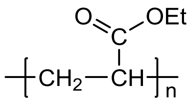
a) $\left[-CH_2-CH_2-\right]_n$

b) 

$\left[-CH_2-\overset{\overset{CH_3}{|}}{CH}-\right]_n$

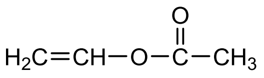
c) 

$\left[-CH_2-\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}-\right]_n$

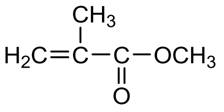
d) 

$\left[-CH_2-\overset{\overset{O=C-OEt}{|}}{CH}-\right]_n$

12.9.2

a) 

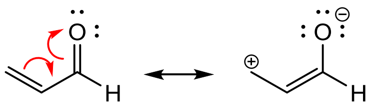
$H_2C=CH-O-\overset{\overset{O}{\|}}{C}-CH_3$

b) 

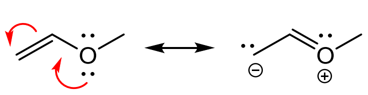
$H_2C=\overset{\overset{CH_3}{|}}{C}-\underset{\underset{O}{\|}}{C}-OCH_3$

c) $H_2C=CH-CN$

12.11.1

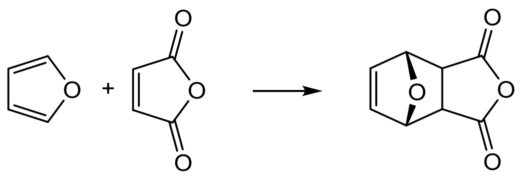


elektronsko reven



elektronsko bogat

12.11.2



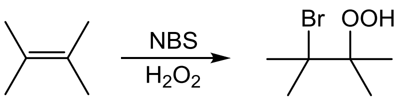
12.11.3 Cikloadicija a) poteka veliko lažje, saj je alken elektronsko reven. Nastali aldehid pa z lahkoto reduciramo v alkohol. Cikloadicija b) poteka težko, saj je alken elektronsko bogatejši. Primernejša pot je a).

12.Vaje.1 a) $\Delta H = -76$ kJ mol^{-1} b) $\Delta H = -179$ kJ mol^{-1}

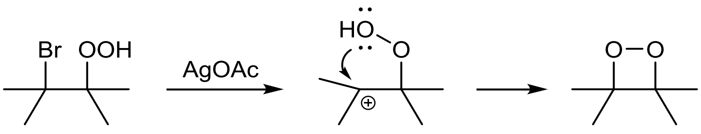
12.Vaje.2 Dietil eter. Poleg vode se na eten adira tudi produkt reakcije, tj. etanol.

12.Vaje.3

a)

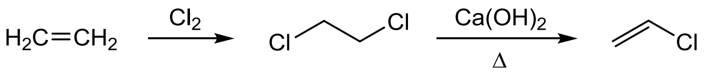


b)

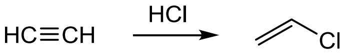


12.Vaje.4

a)



b)



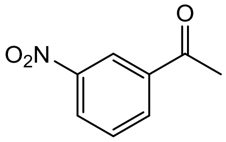
13. Aromatske spojine. Elektrofilna substitucija

13.2.1 a, d, e

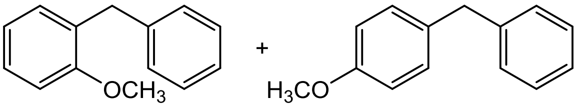
13.4.1 a) $PhSO_3H$ b) ne reagira c) PhCOPh d) dimetiletilbenzen (*t*-butilbenzen, poteče premestitev 1° karbokationa) e) vodikovi atomi se zamenjujejo z devterijem.

13.5.1

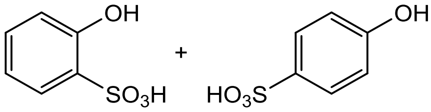
a)



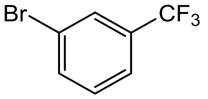
b)



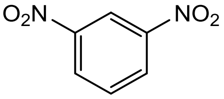
c)



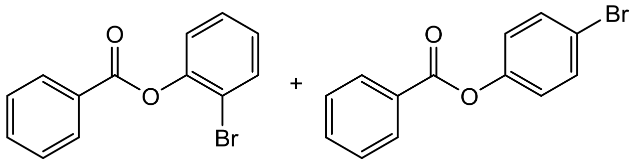
d)



e)

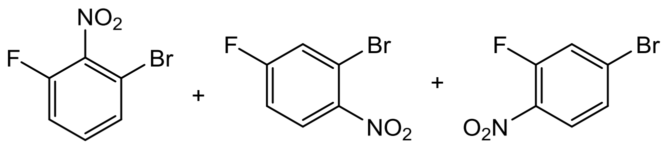


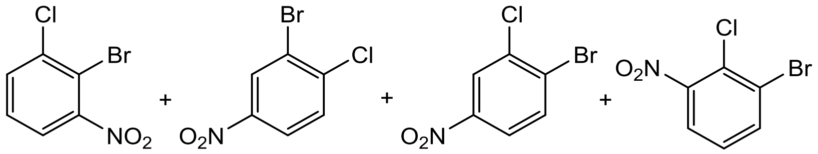
13.5.2

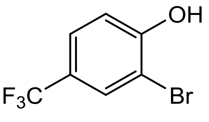


13.6.1

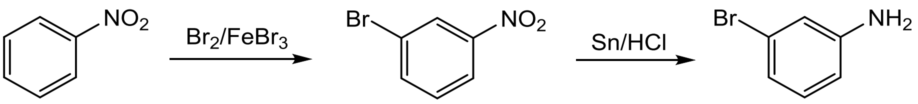
a)

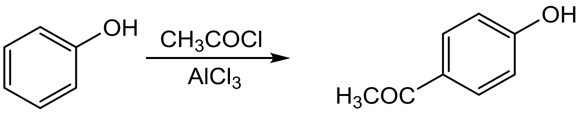


b) 

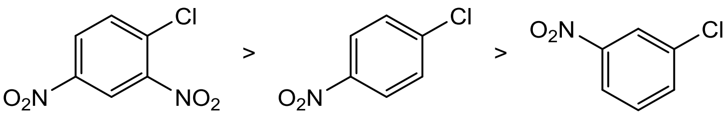
c) 

13.6.2

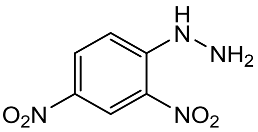
a) 

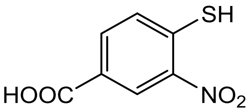
b) 

13.7.1

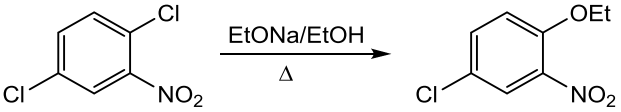


13.7.2

a) 

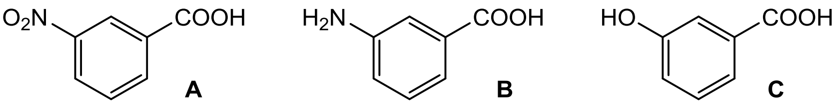
b) 

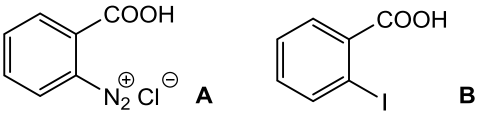
13.7.3



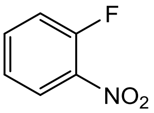
Substitucija poteče na mestu 1 zato, ker je to mesto aktivirano z *orto*-nitro skupino. Mesto 4 nima aktivirajoče skupine na *orto*- ali *para*-položaju.

13.7.4

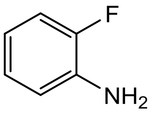
a) 

b) 

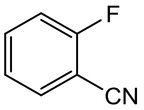
c)



A

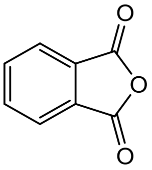


B



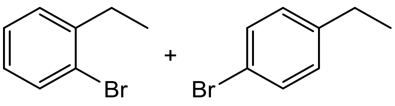
C

13.8.1



13.8.2

a)



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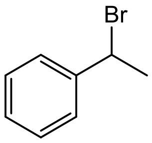
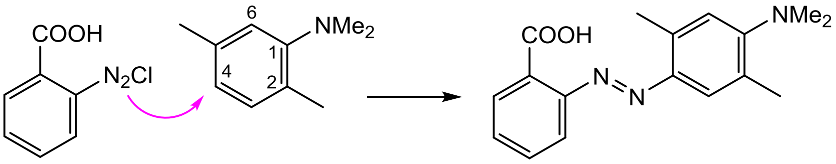
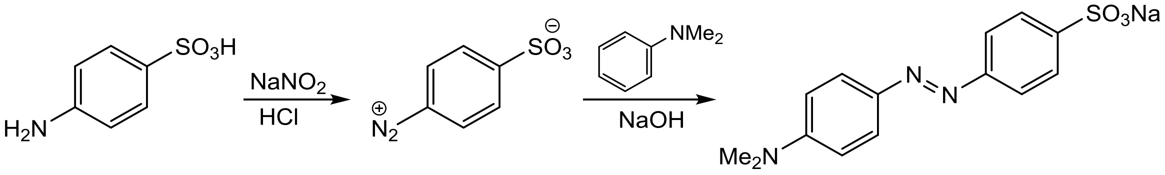


13.8.3



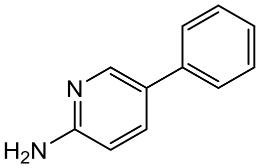
Elektrofil, diazonijev kation, lahko napade mesti 4 in 6. Verjetno bo produkta substitucije na mestu 6 več, zaradi boljše dostopnosti, oziroma manjše sterične oviranosti.

13.8.4



13.8.5

a)



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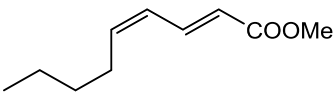
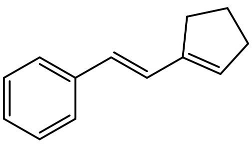
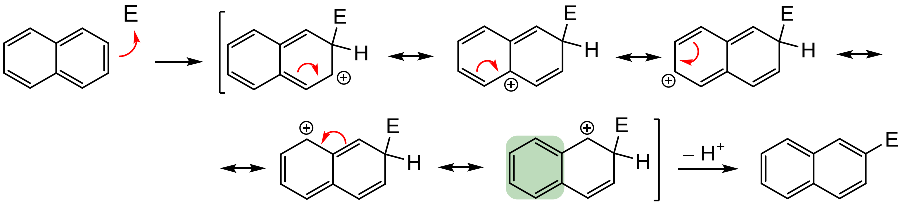


c)



13.9.1

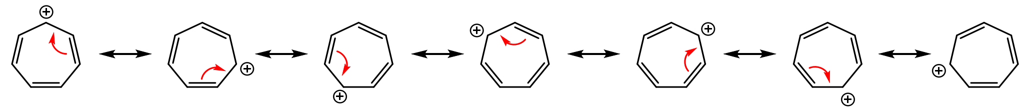


Intermediat pri substituciji na mestu 2 ima ravno tako, kot tisti na položaju 1, 5 resonančnih struktur. Vendar je v tem primeru le ena taka, z aromatskim obročem. Intermediat na mestu 1 je zato nekoliko stabilnejši, saj ima dve aromatski strukturi.

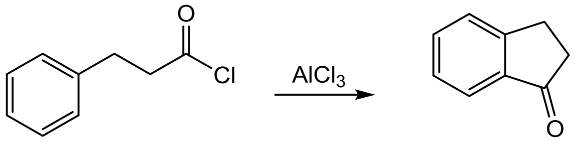
13.9.2 Pri substituciji na policikličnih aromatih je število resonančnih struktur pri intermediatih veliko. Zato so intermediati pri policikličnih aromatih bolj stabilizirani kot pri benzenu in posledično aktivacijske energije nižje.

13.10.1 Entalpija hidrogeniranja ciklooktatetraena je več kot štirikratnik entalpije hidrogeniranja ciklooktena. To pomeni, da pri ciklooktatetraenu ni nikakršne aromatske stabilizacije, celo obratno, spojina ima nekoliko bolj pozitivno tvorbeno entalpijo, kot bi jo imel nekonjugiran tetraen. Je antiaromatska.

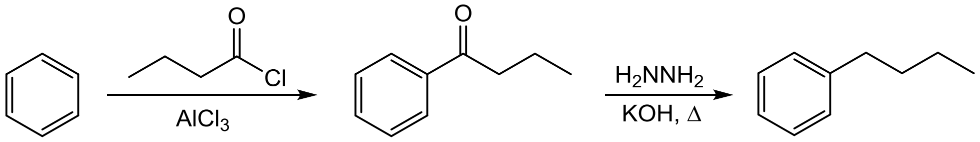
13.10.2



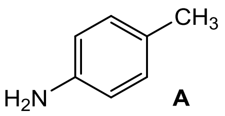
13.10.3

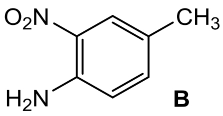


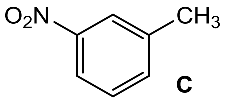
13.10.4



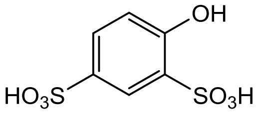
13.10.5

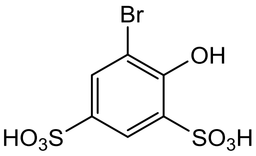

A

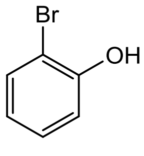

B


C

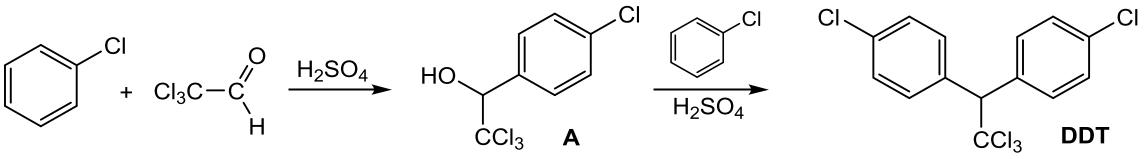
13.10.6


A


B

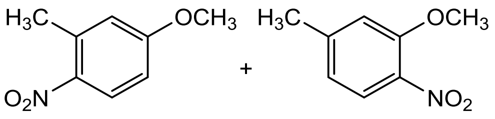

C

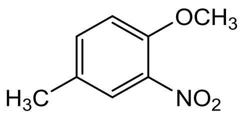
13.10.7

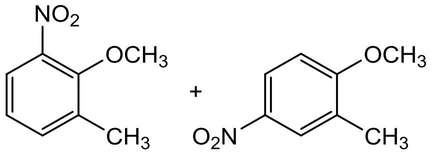


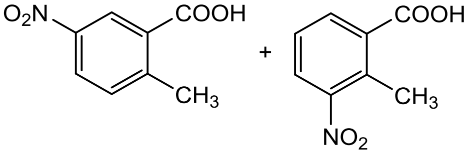
A: 1-(4-klorofenil)-2,2,2-trikloroetanol B: 1,1-bis-(4-klorofenil)-2,2,2-trikloroetan

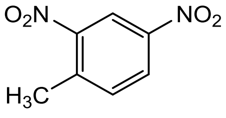
13.10.8

a) 

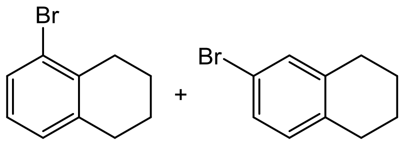
b) 

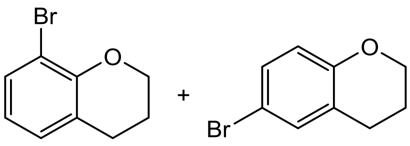
c) 

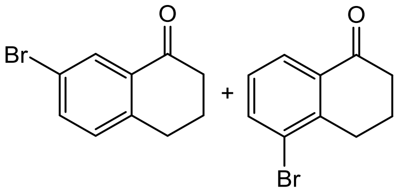
d) 

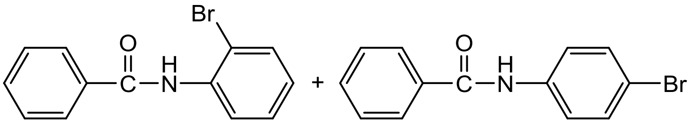
e) 

13.10.9

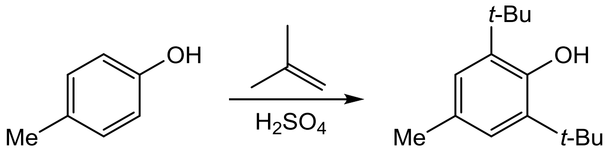
a) 

b) 

c) 

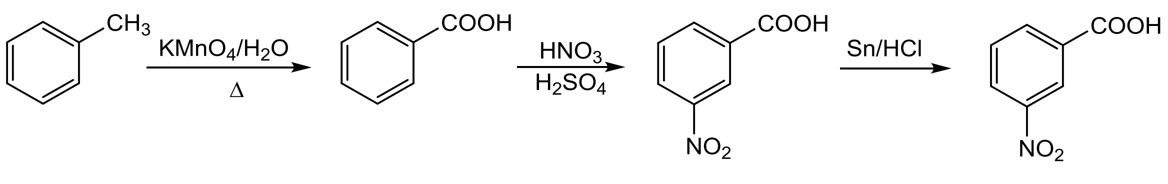
d) 

13.10.10

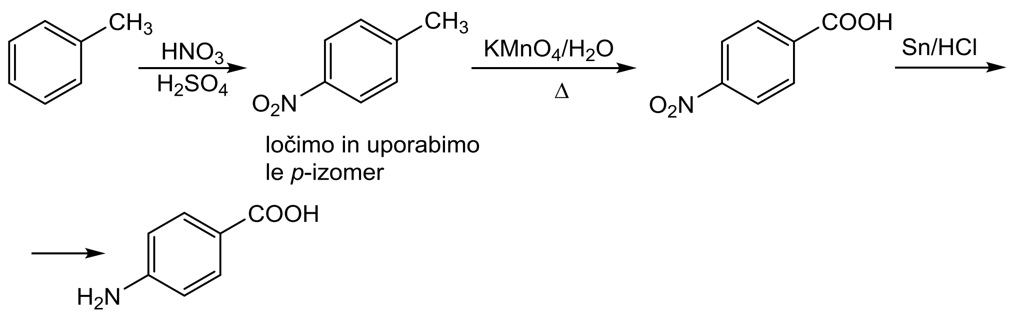


13.10.11 Pri nekaterih sintezah je več možnih sinteznih poti. Prikazana je ena od njih.

a)

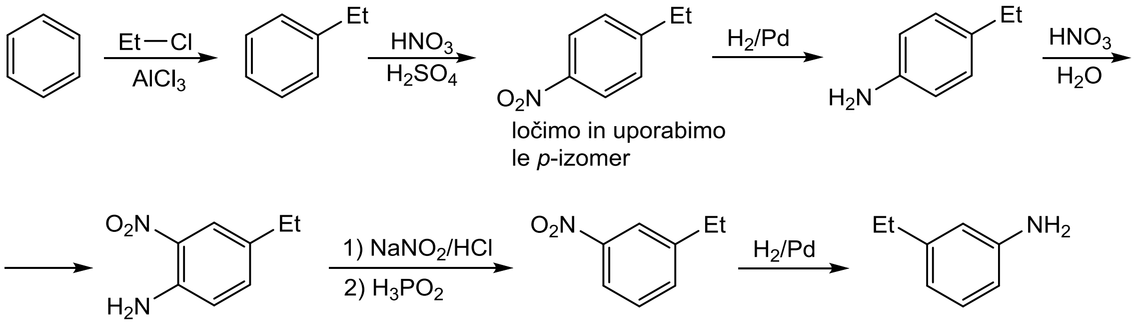


b)

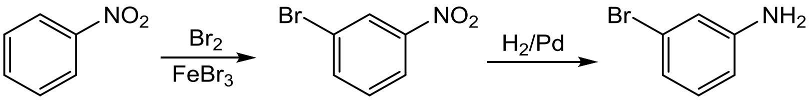


ločimo in uporabimo
le *p*-izomer

c)



d)



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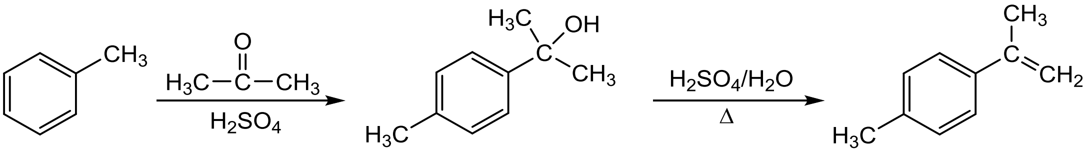
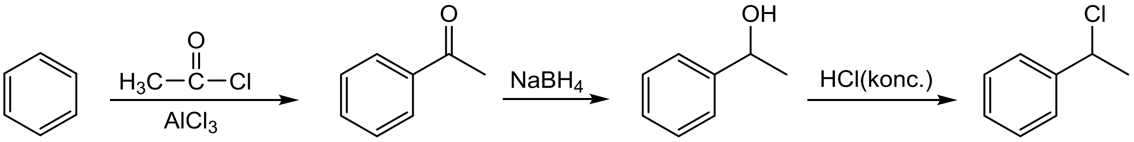
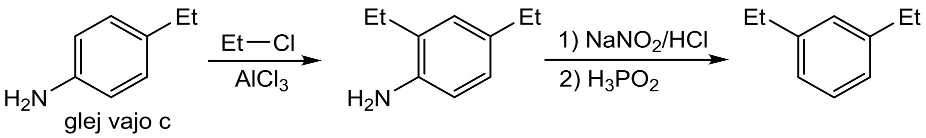


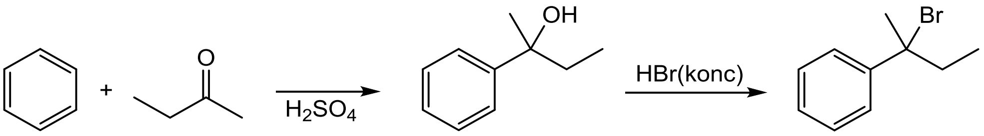
f)



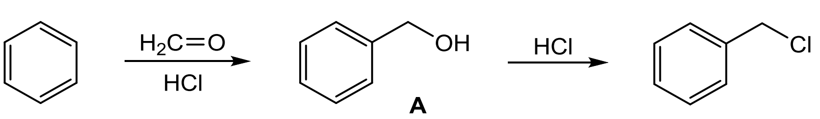
g)



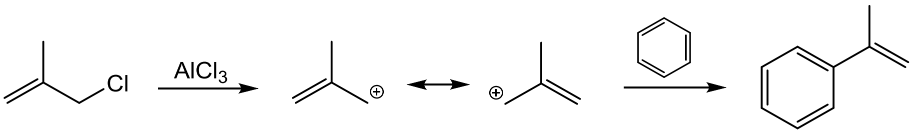
h)

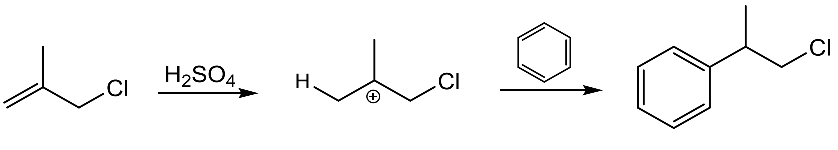


13.10.12



13.10.13





Razlika je v delovanju katalizatorja. $AlCl_3$ odtrga klorov atom, žveplova kislina pa protonira dvojno vez.

14. Alkoholi, fenoli in etri

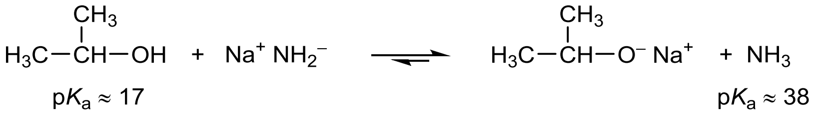
14.1.1 a) 2-metilpropan-1-ol (izobutil alkohol) b) butan-2-ol (*sek*-butil alkohol)
c) fenilmetanol (benzil alkohol) d) 2-metoksifenol e) 2-metiletoksipropan (diizopropil eter)
f) 2-metil-2-metoksipropan (*t*-butil metil eter) g) 2-metoksietanol h) 2-hidroksimetilfenol

14.1.2 Ksilitol: pentan-1,2,3,4,5-pentaol, sorbitol: heksan-1,2,3,4,5,6-heksaol.

14.1.3 Oksaciklopentan

14.1.4 Fenol je kisikov analog anilina, zato je tudi njegova bazičnost primerljivo nižja od bazičnosti alkoholov. Razlog za nižjo bazičnost je isti kot pri anilinu.

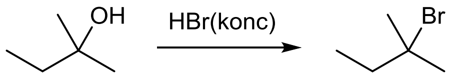
14.1.5 Natrijev amid (pK_a(NH_3) = ca. 38) je neprimerno bolj bazičen od propanola (pK_a(ROH) = ca 17), zato lahko z njim pripravimo propoksid iz propanola.



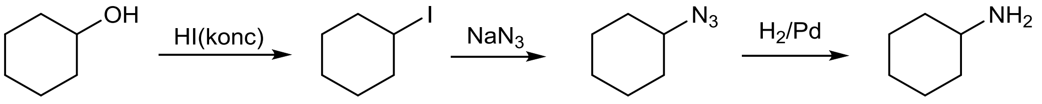
$$\underset{pK_a \approx 17}{H_3C-\overset{\displaystyle CH_3}{\overset{|}{C}H}-OH} + Na^+\,NH_2^- \rightleftharpoons H_3C-\overset{\displaystyle CH_3}{\overset{|}{C}H}-O^-\,Na^+ + \underset{pK_a \approx 38}{NH_3}$$

Reakcije ne smemo izvajati v vodi, ker bi v tem primeru nastal hidroksid in ne alkoksid.

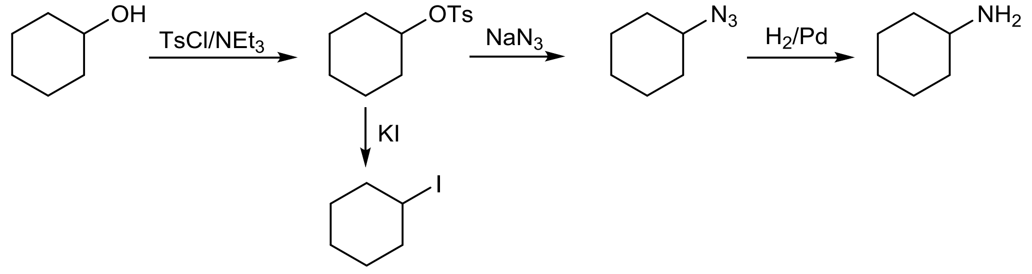
14.2.1



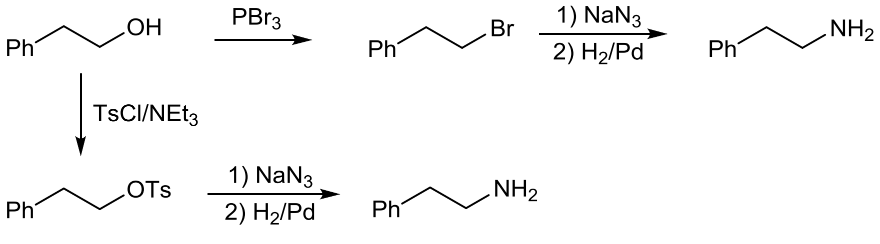
14.2.2



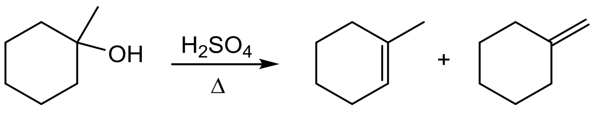
ali



14.2.3

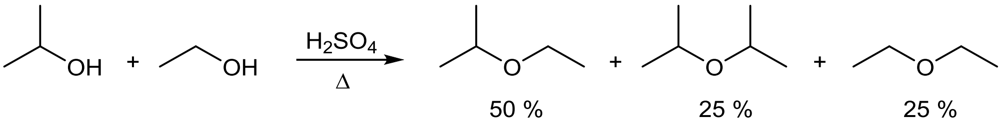


14.2.4



glavni produkt

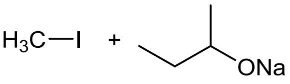
14.2.5

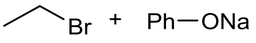


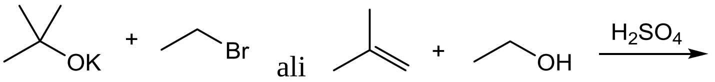
14.4.1

a) 

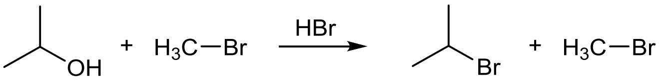
b) 

c) 

d) 

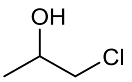
e) 

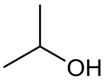
14.4.2 a) 

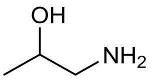
b) 

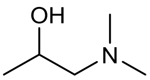
c) 

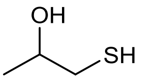
14.4.3

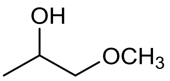
a) 

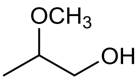
b) 

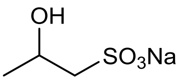
c) 

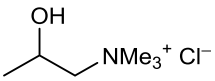
d) 

e) 

f) 

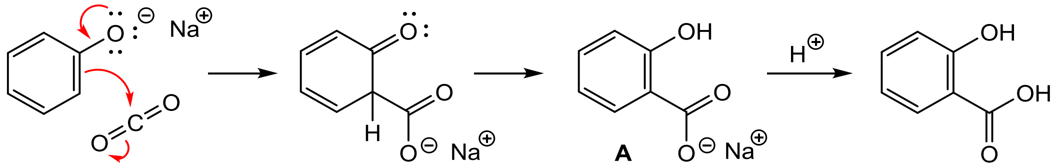
g) 

h) 

i) 

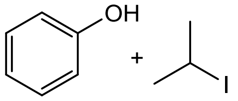
14.5.1 A: 10,3 B: 16 C: 4,7

14.5.2



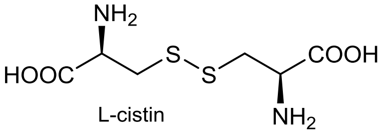
Stranski produkt je para izomer.

14.5.3



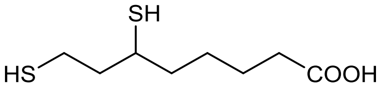
Ne, ker na aromatskem obroču ne pride do substitucije.

14.6.1



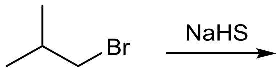
L-cistin

14.6.2

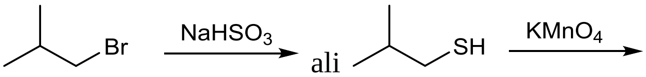


14.6.3

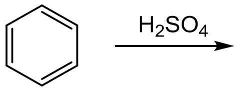
a)



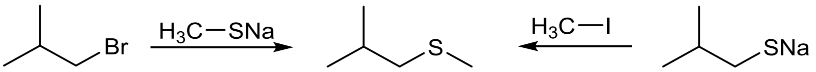
b)



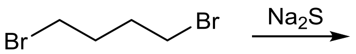
c)



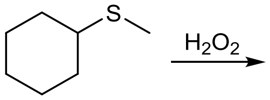
d)



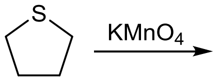
e)



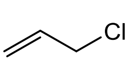
f)



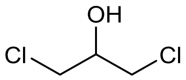
g)



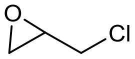
14.7.1



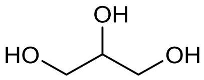
A



B

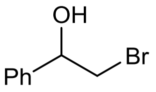


C

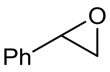


D

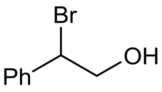
14.7.2



A



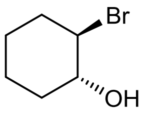
B



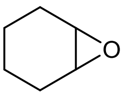
C

Spojini A in C sta regioizomera

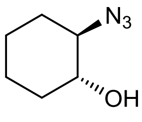
14.7.3



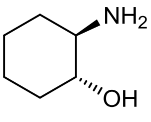
A



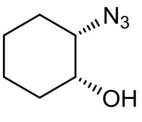
B



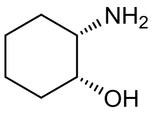
C



D



E



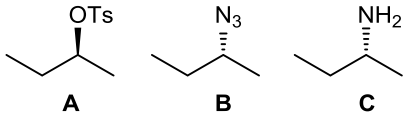
F

D in F sta geometrijska izomera

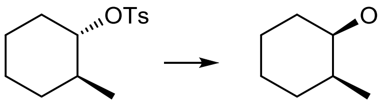
14.7.4 Alkoholi vrste A so terciarni, B sekundarni, A pa primarni.

14.7.5

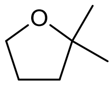
a)



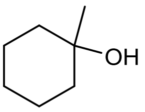
b)



14.7.6



14.7.7



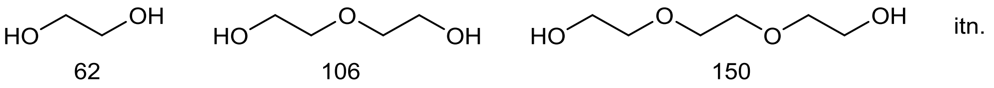
14.7.8

$$5\,\overset{-1}{\mathrm{RCH_2OH}} \quad + \quad 4\,\overset{+7}{\mathrm{MnO_4^-}} \quad + 12\,\mathrm{H^+} \longrightarrow 5\,\overset{+3}{\mathrm{RCOOH}} \quad + \quad 4\,\overset{+2}{\mathrm{Mn^{2+}}} \quad + \quad 11\,\mathrm{H_2O}$$

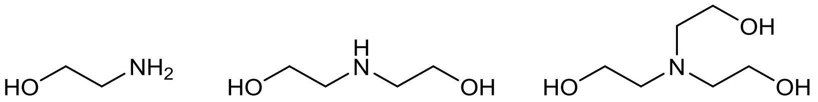
14.7.9

$$\overset{+3}{\mathrm{PhNO_2}} \quad + \quad 2\,\overset{0}{\mathrm{Fe}} \quad + \quad 4\,\mathrm{H_2O} \longrightarrow \overset{-3}{\mathrm{PhNH_2}} \quad + \quad 2\,\overset{+3}{\mathrm{Fe(OH)_3}}$$

14.7.10

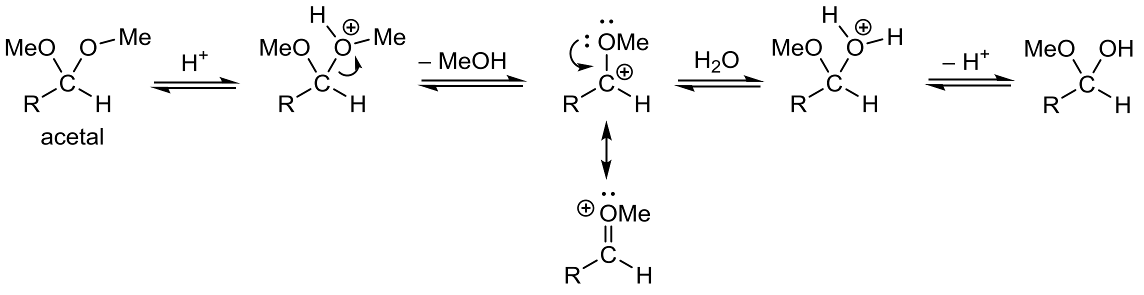


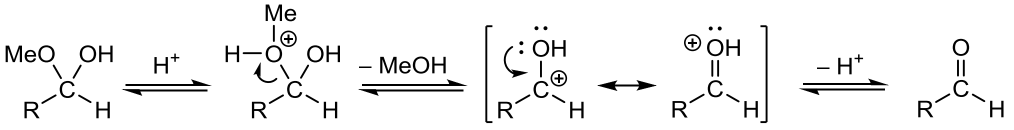
14.7.11



15. Karbonilne spojine – aldehidi in ketoni

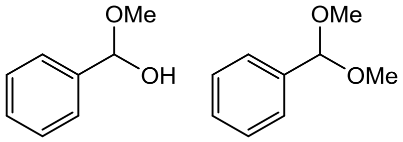
15. 2.1

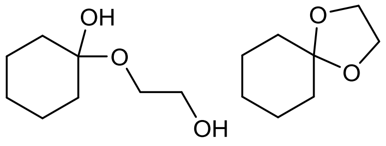


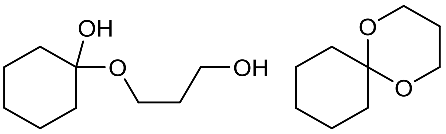


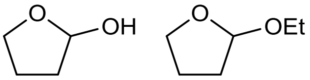
15.2.2 V bazičnem mediju bi reakcija morala potekati po mehanizmu S_N2, kar pa ne gre, saj so izstopajoče skupine OR ali OH zelo slabe.

15.2.3

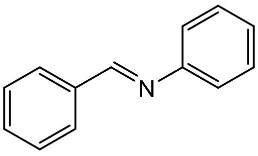
a) 

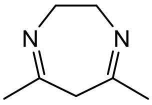
b) 

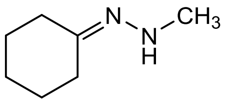
c) 

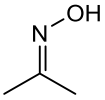
d) 

15.3.1

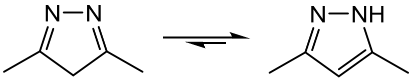
a) 

b) 

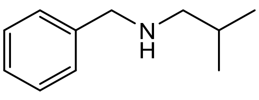
c) 

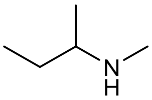
d) 

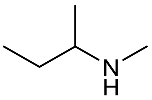
15.3.2



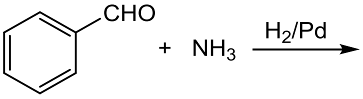
15.4.1

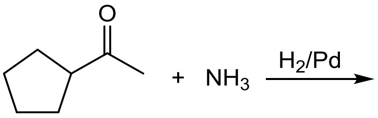
a) 

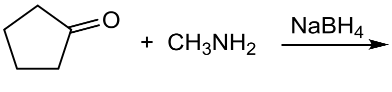
b) 

c) 

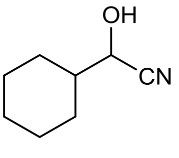
15.4.2

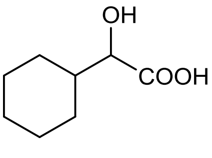
a) 

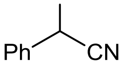
b) 

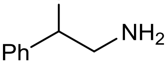
c) 

15.5.1

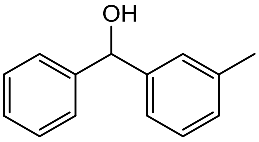
a) **A**: 

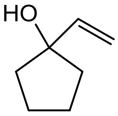
B: 

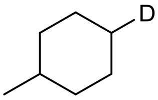
b) **A**: 

B: 

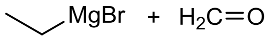
15.6.1

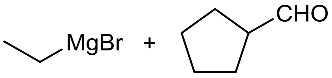
a) 

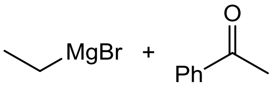
b) 

c) 

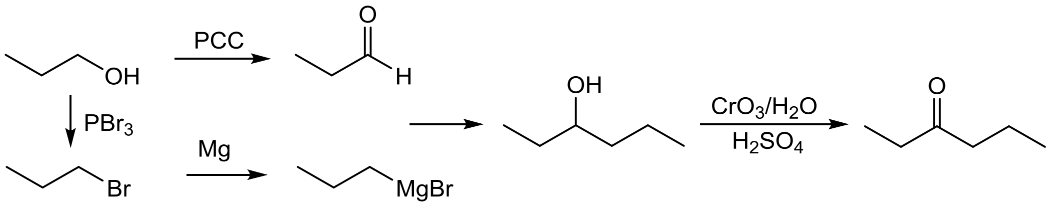
15.6.2

a) 

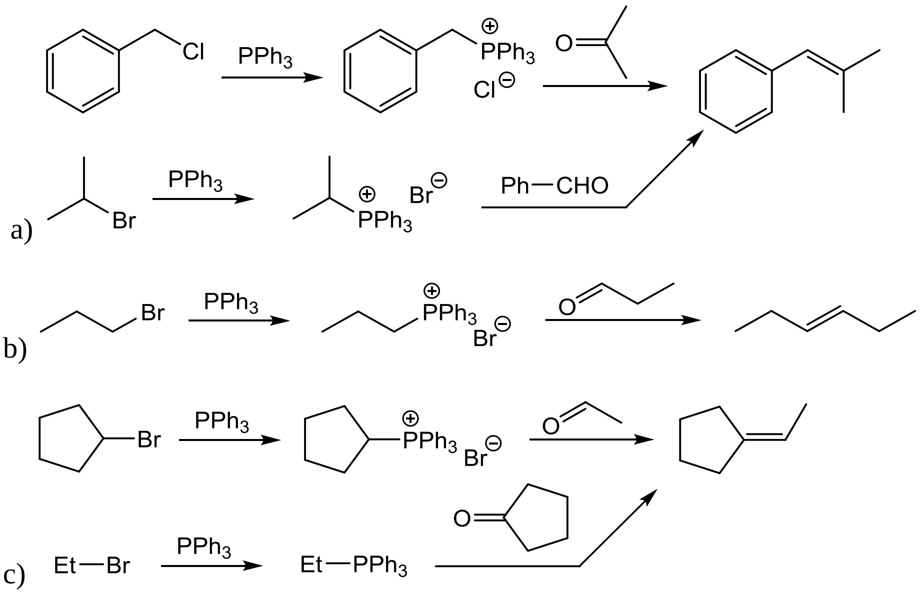
b) 

c) 

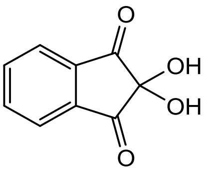
15.6.3



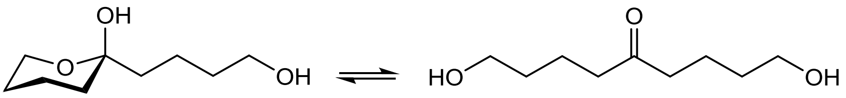
15.7.1



15.9.1

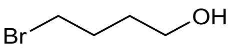


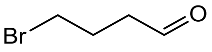
15.9.2

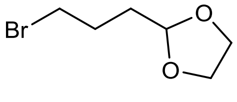


15.9.3 Skupina CN je elektronprivlačna in zmanjša elektronsko gostoto na atomu bora in sosednjih vodikovih atomih. Zato je ta spojina manj nukleofilna in slabše bazična.

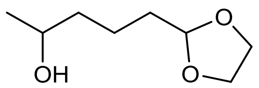
15.9.4

A: 

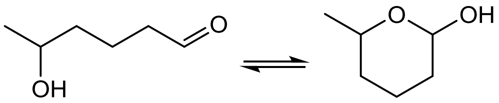
B: 

C: 

D:

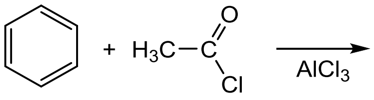


E, **F**:

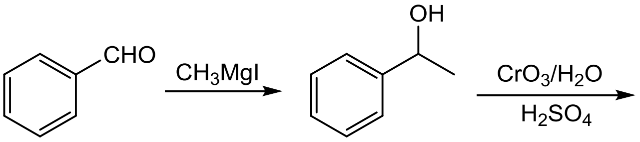


15.9.5

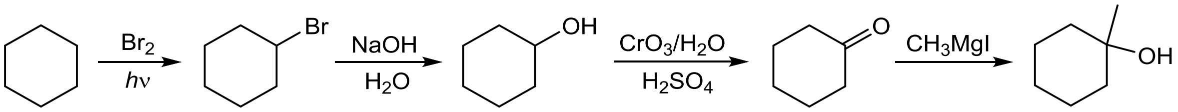
npr. a)



b)

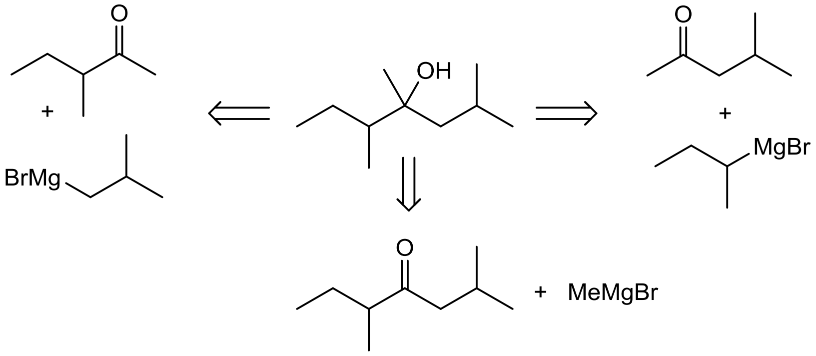


15.9.6

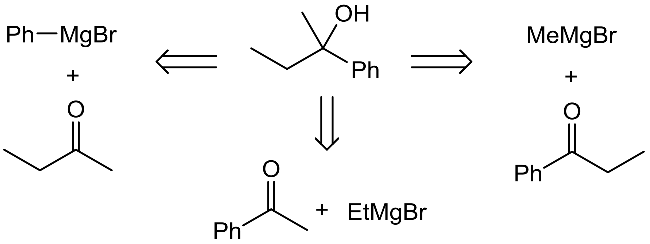


15.9.7

a)

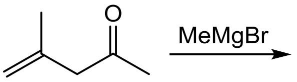


b)

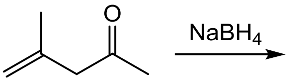


15.9.8

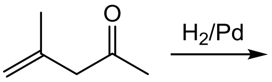
a)



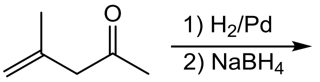
b)



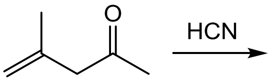
c)



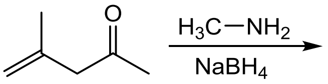
d)



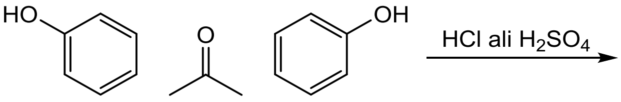
e)



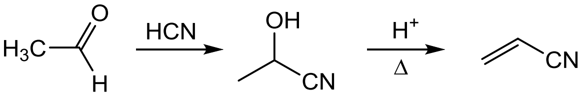
f)



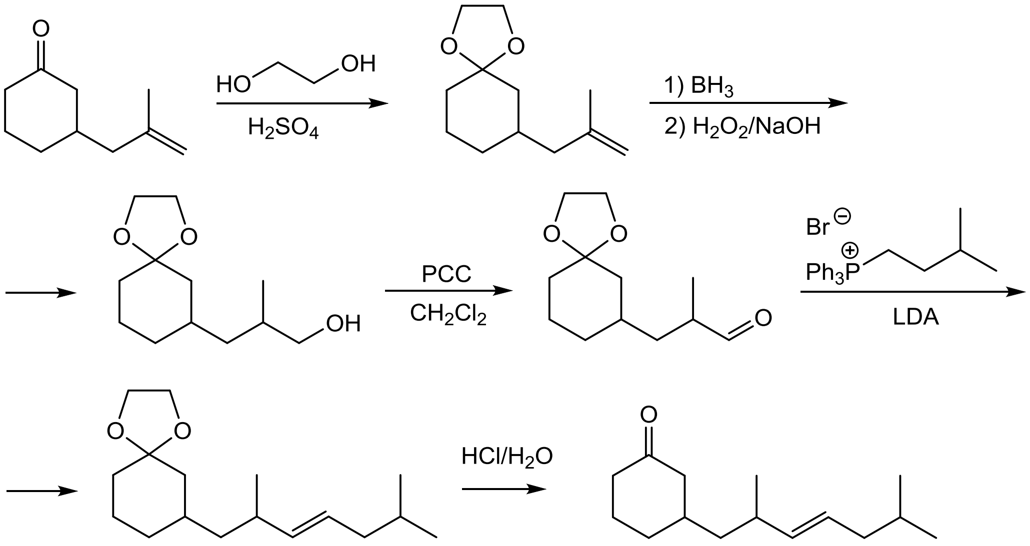
15.9.9



15.9.10



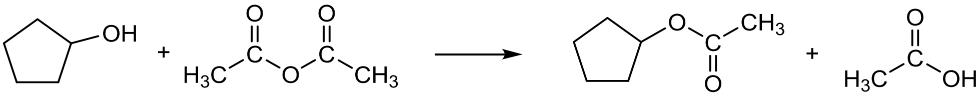
15.9.11



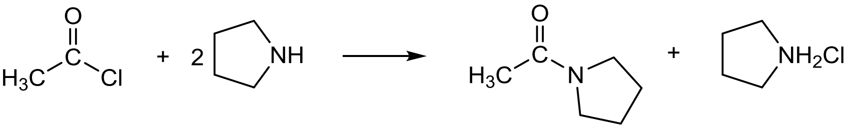
16. Karboksilne kisline in derivati

16.3.1

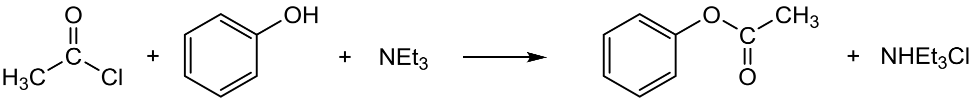
a)



b)

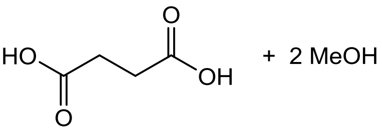


c)

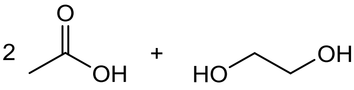


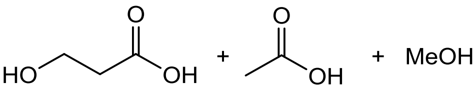
16.3.2

a)

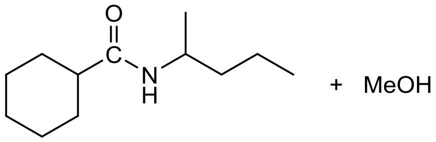


b)

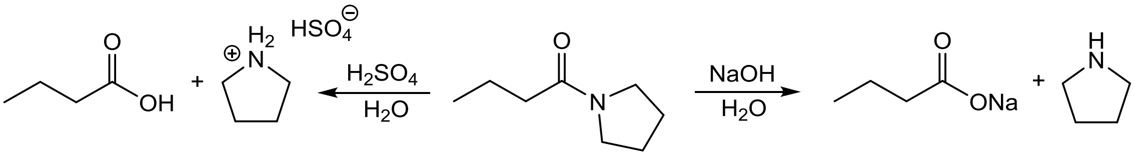


c) 

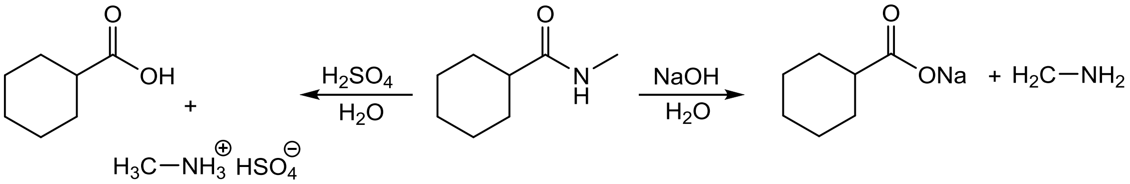
16.3.3



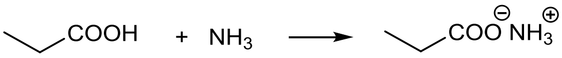
16.3.4 a)



16.3.4 b)

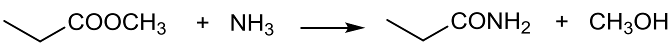


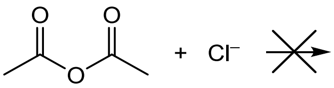
16.3.5

a) 

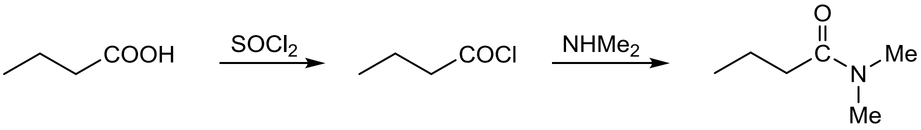
b) 

c) 

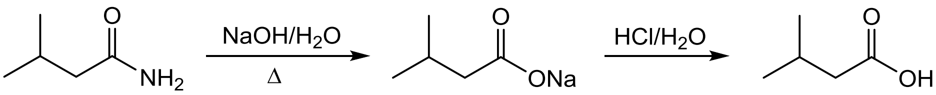
d) 

e) 

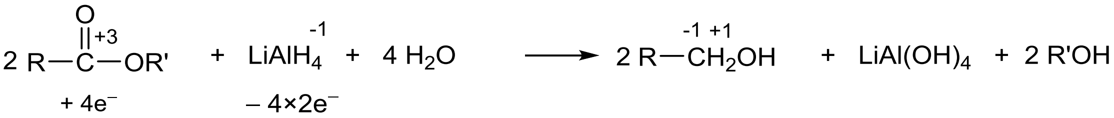
f) 



a)

b) 

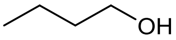
16.4.1



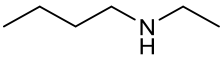
$$2\ R{-}\overset{\overset{O}{\|}\ +3}{C}{-}OR' + \overset{-1}{LiAlH_4} + 4\ H_2O \longrightarrow 2\ R{-}\overset{-1\ +1}{CH_2OH} + LiAl(OH)_4 + 2\ R'OH$$

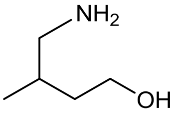
$$+4e^- \qquad -4{\times}2e^-$$

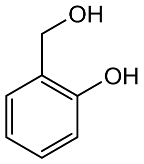
16.4.2

a) 

+ CH_3OH

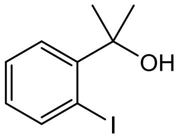
b) 

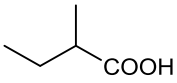
c) 

d) 

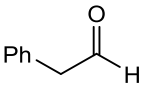
+ EtOH

16.4.3

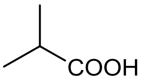
a) 

b) 

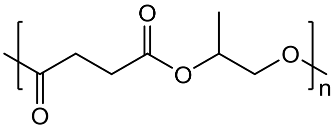
+ EtH

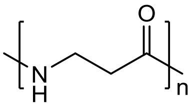
c) 

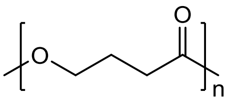
+ $NHMe_2$

d) 

16.5.1

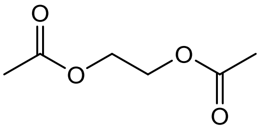
a) 

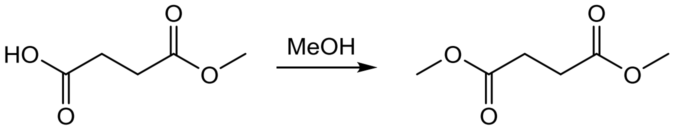
b) 

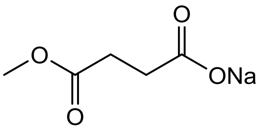
c) 

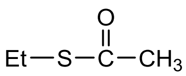
16.5.2 Bazo, npr. NaOH.

16.6.1

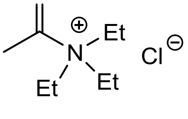
a) 

b) 

c) 

d) 

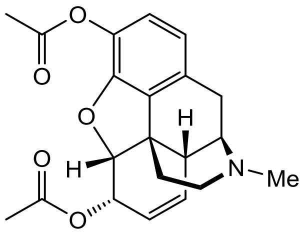
$Et{-}S{-}\overset{\overset{O}{\|}}{C}{-}CH_3$

16.6.2 a) 

b) Zato, ker je skupina -NEt_3^+ zrlo dobra izstopajoča skupina in spojina reagira z različnimi nukleofili.

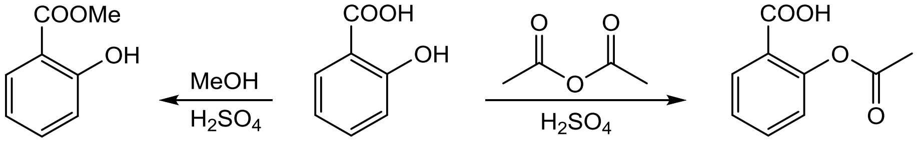
c) Metil acetat in trietilamonijev klorid.

16.6.3 a)

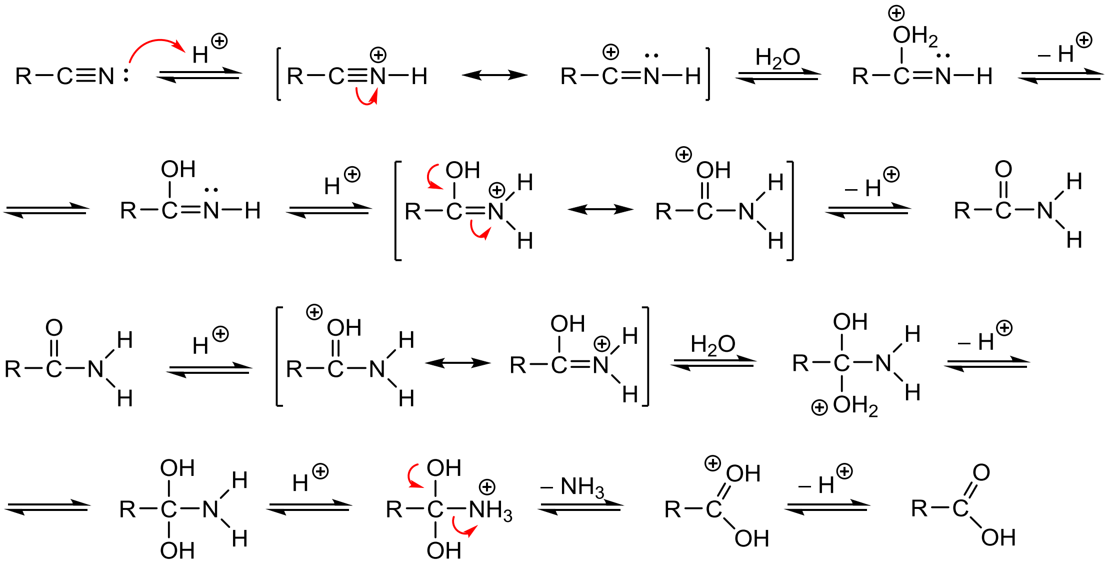


b) Dodatek katalizatorja ni potreben, saj je morfin terciarni amin in sam deluje kot katalizator.

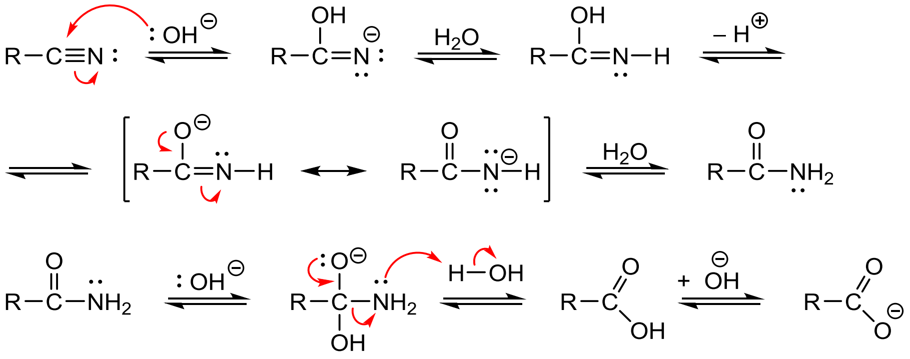
16.6.4



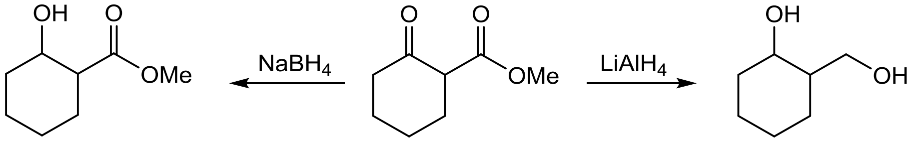
16.6.5 a) kisla hidroliza



b) bazična hidroliza

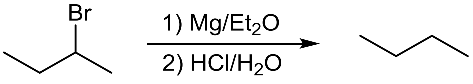


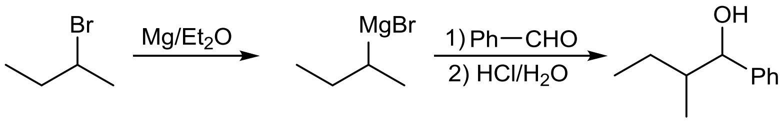
16.6.6



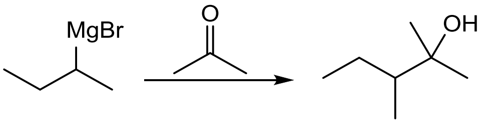
16.6.7

a)

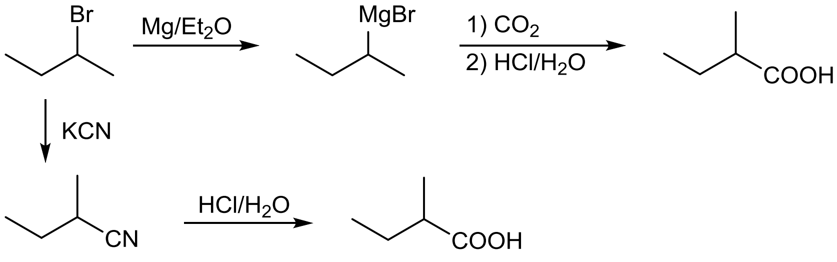




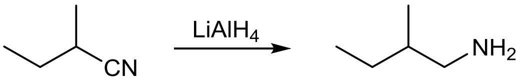
b)



c)



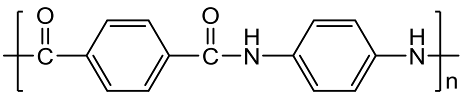
d)



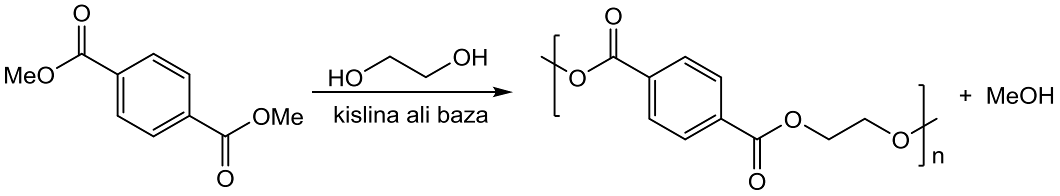
e)

16.6.8 Polieten ali polipropen, ker sta alkana, odporna na baze. PET je poliester in v bazičnem mediju hidrolizira.

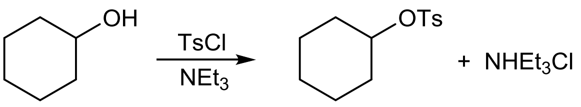
16.6.9



16.6.10

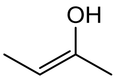


16.6.11

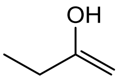


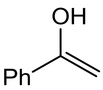
17. Enoli in enoni

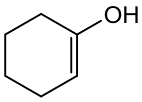
17.1 1

. a) 

in

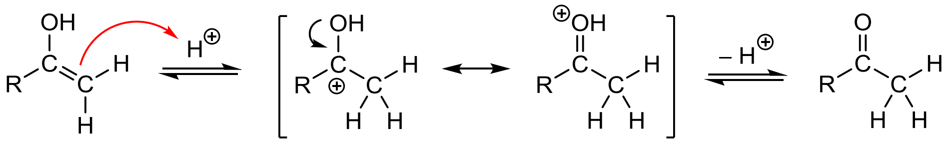


b) 

c) 

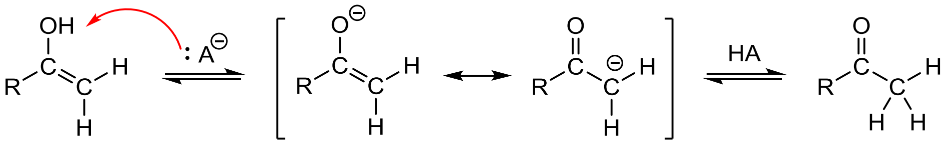
17.1 2

. a)

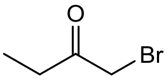


17.1 2

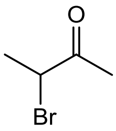
b)



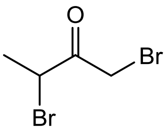
17.2 1

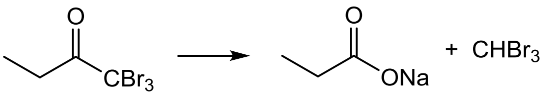
a) 

in

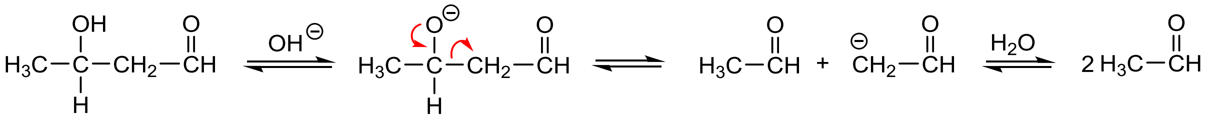


b) isto kot pri a)

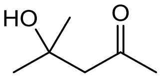
c) 

d) 

17.3.1

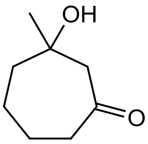


17.3.2

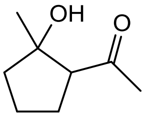


4-hidroksi-4-metilpentan-2-on

17.3.3



a

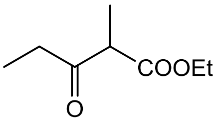


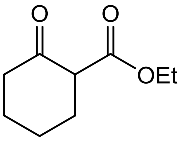
b

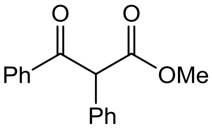
Prevladuje **b**

17.3.4 b in c

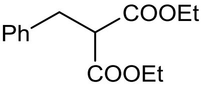
17.3.5

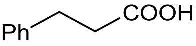
a) 

b) 

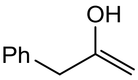
c) 

17.3.6

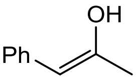
A 

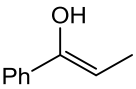
B 

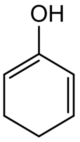
17.5.1

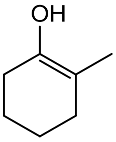
a) 

in

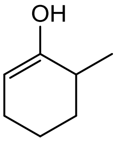


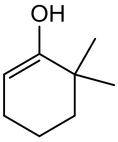
b) 

c) 

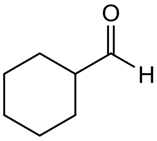
d) 

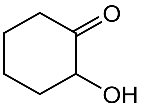
in

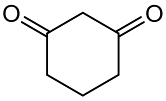


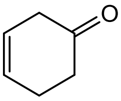
e) 

17.5.2

a) 

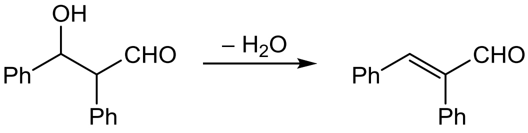
b) 

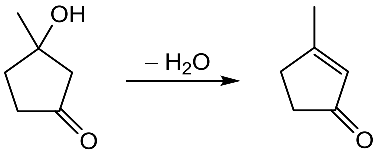
c) 

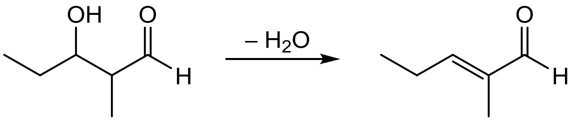
d) 

17.5.3 A in D

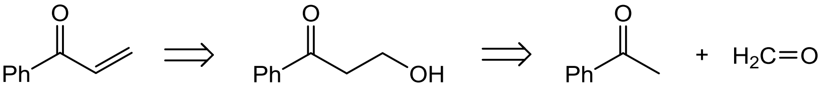
17.5.4

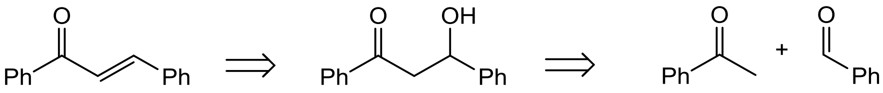
a) 

b) 

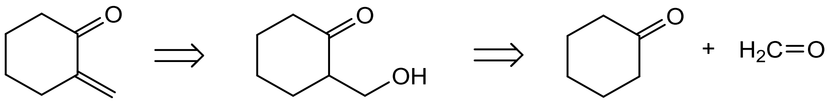
c) 

17.5.5

a) 

b) 

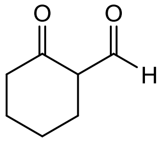
c)



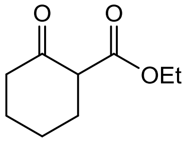
17.5.6 Pri tem pride do enolizacije in izmenjave vodikovih atomov na metilnih skupinah. Če je D_2O v velikem prebitku, se postopno izmenjajo (skoraj) vsi atomi ^1H z atomi ^2H = D. Nastane heksadevterioaceton CD_3COCD_3.

17.5.7

a)

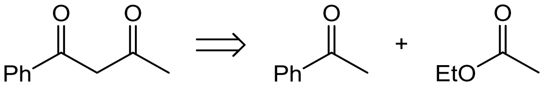


b)

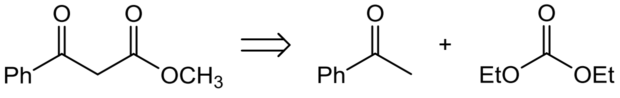


17.5.8

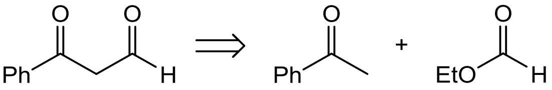
a)



b)

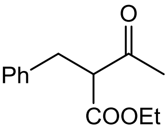


c)

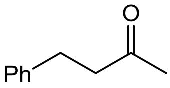


17.5.9

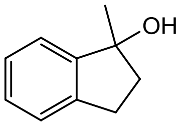
A



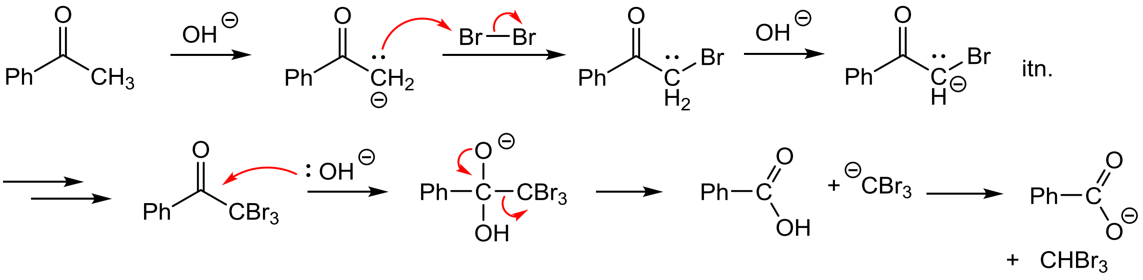
B



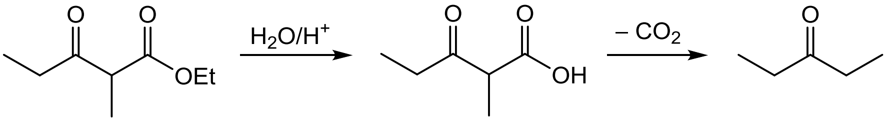
C



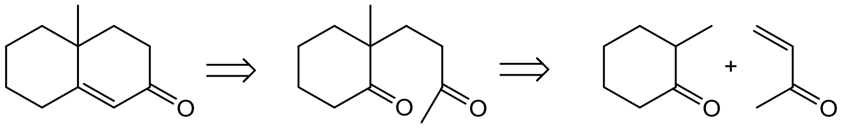
17.5.10



17.5.11

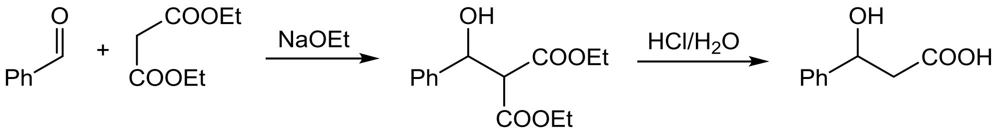


17.5.12

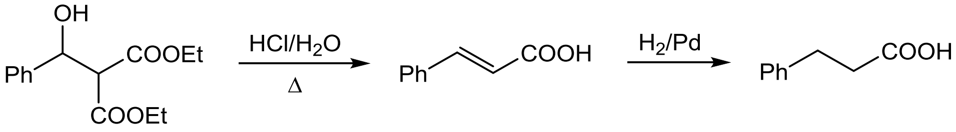


17.5.13

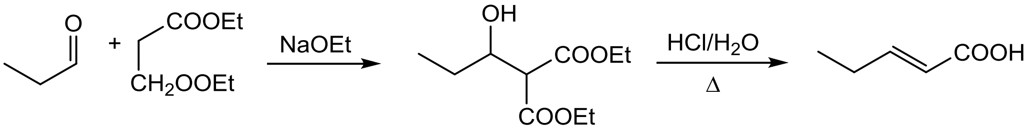
a)



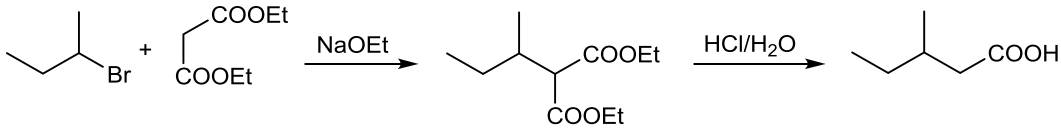
b)



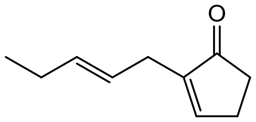
c)



d)



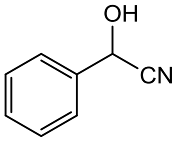
17.5.14



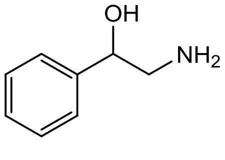
18. Organske dušikove spojine

18.2.1

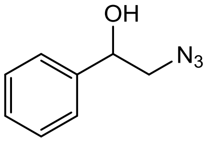
a) **A**



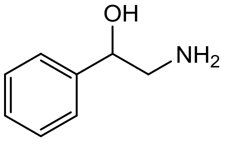
B



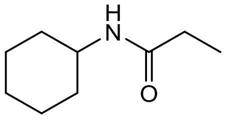
b) **A**



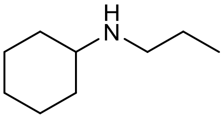
B



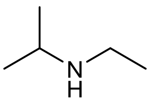
c) **A**



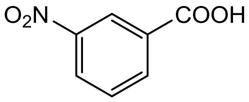
B



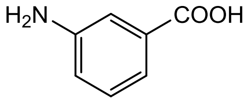
d)



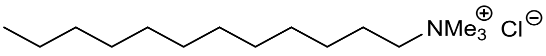
e) **A**



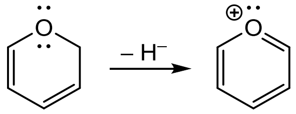
B



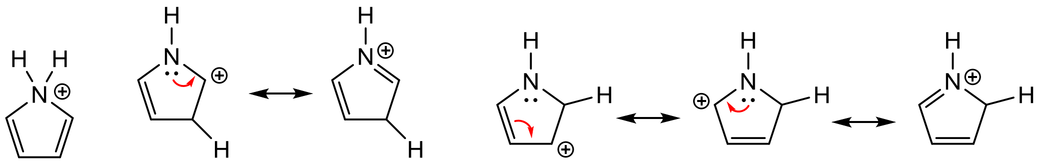
f)



18.5.1

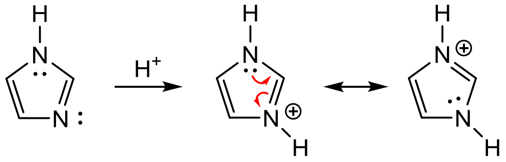


18.5.2



Pirol se protonira na položaju 2. Nastali kation je najbolj delokaliziran.

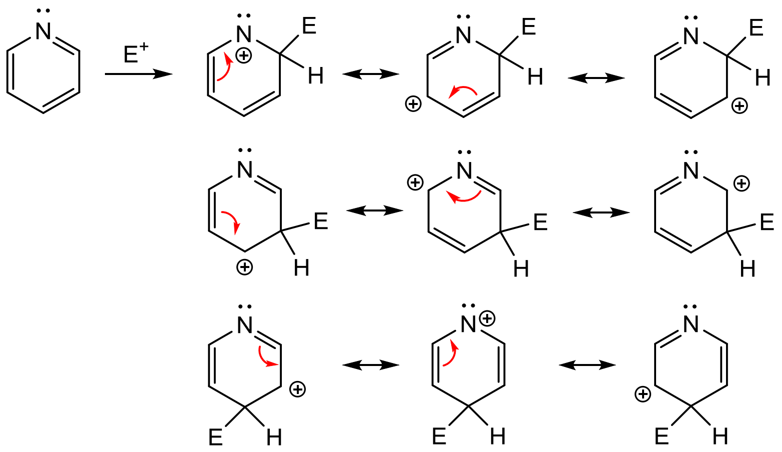
18.5.3



Aromatski sistem imidazola se s protoniranjem ne spremeni, saj se proton veže na tisti nevezni elektronski par dušikovega atoma, ki ni angažiran v aromatskem oblaku. V imidazolijevem kationu sta oba dušikova atoma enakovredna.

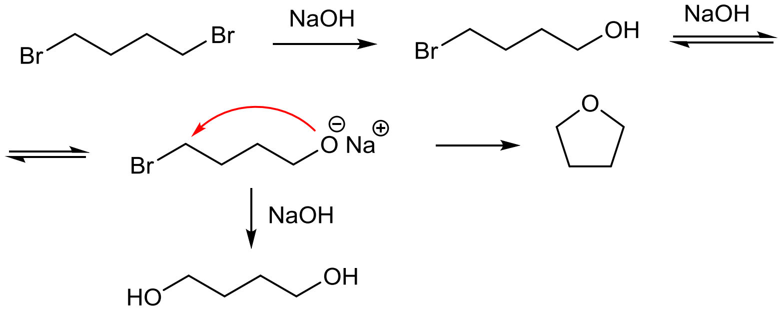
18.6.1 a) bolj b) manj c) bolj d) manj

18.6.2 Pri substituciji na položajih 2 in 4 se kation pojavi na dušikovem atomu, kar je izrazito neugodno. Zato ima intermediat pri substituciji na mestu 3 najnižjo energijo.

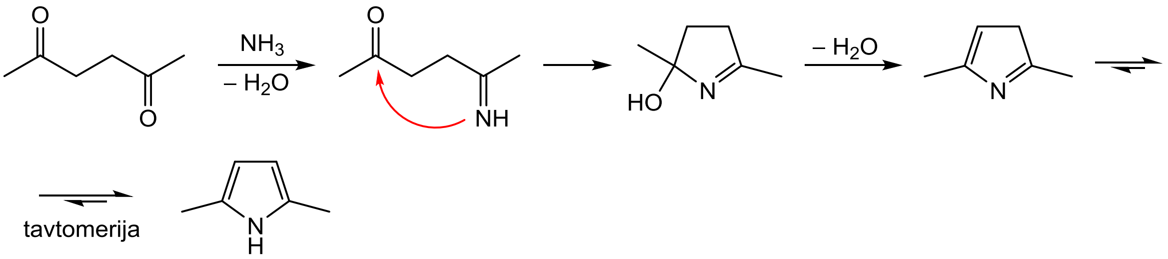


18.6.3 a) na benzenovem obroču b) na heterocikličnem obroču

18.7.1 Stranski produkt je butan-1,4-diol. Glavni produkt je tetrahidrofuran, ker je intramolekularna reakcija bistveno hitrejša od intermolekularne.



18.7.2



18.9.1

a) etanamin, etilamin

b) *N*-etiletanamin, dietilamin

c) *N*-metiletanamin, etilmetilamin

d) 2-metilbenzenamin, 2-metilfenilamin, 2-metilanilin, *o*-toluidin

e) *N*-metilbenzenamin, fenilmetilamin, *N*-metilanilin

f) *N*,*N*-dimetilmetanamin, trimetilamin

18.9.2

a) 1-aminopropan-2-ol,

b) 2,6-diaminoheksanojska kislina

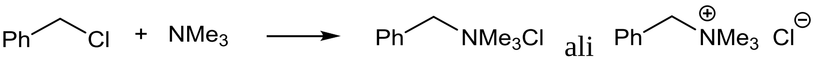
c) *N*,*N*-dietil-(3-metilbenzen)karboksamid (*N*,*N*-dietil-*m*-toluamid)

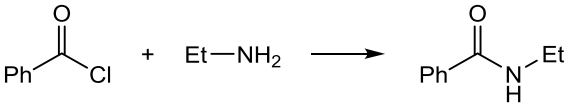
d) (*R*)-2-metilamino-2-(3,4-dihidroksifenil)etanol

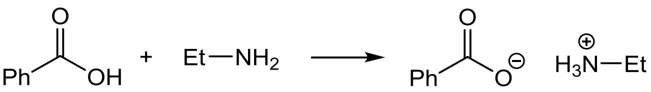
e) 3-hidroksi-6-hidroksimetil-2-metilpiridin-4-karbaldehid

f) (*S*)-2-propilpiperidin

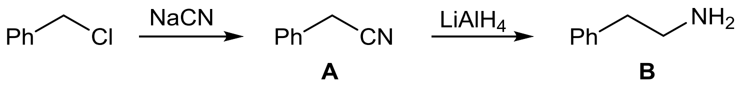
18.9.3

a) 

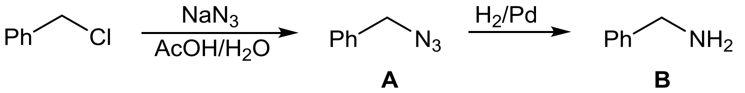
b) 

c) 

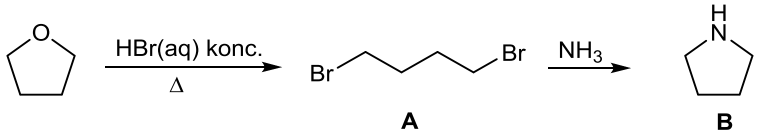
d)



e)

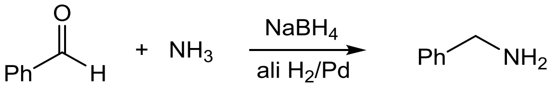


f)

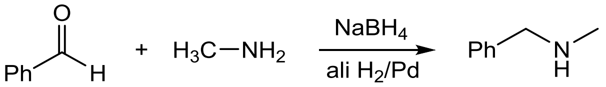


18.9.4

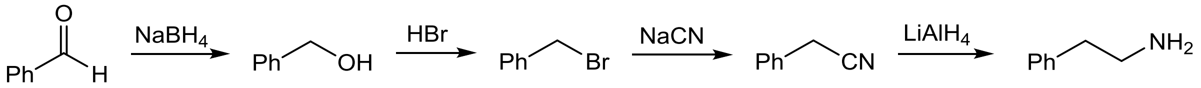
a)



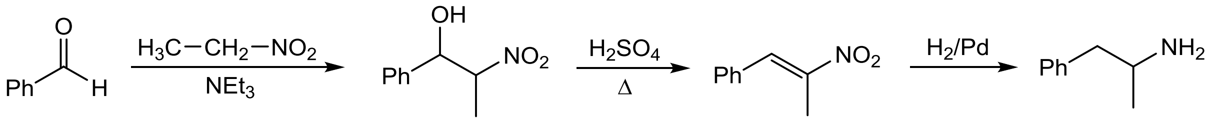
b)



c)



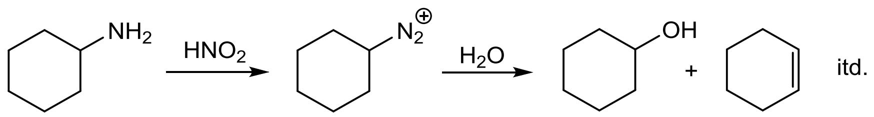
d)



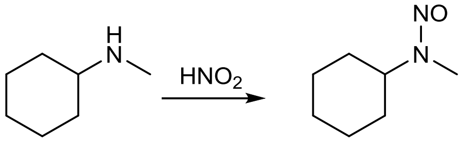
18.9.5 Pot B. Po poti A nastaja poleg primarnega amina tudi sekundarni in naprej terciarni ...

18.9.6

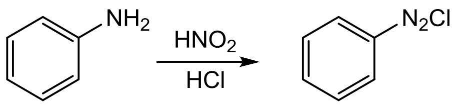
a)



b)

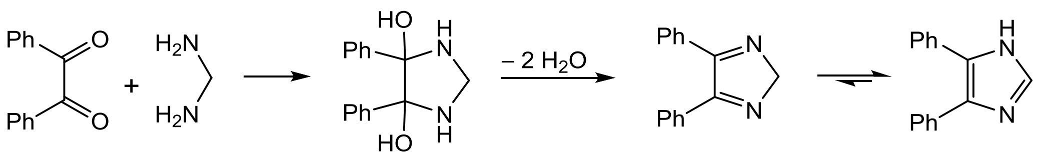


c)

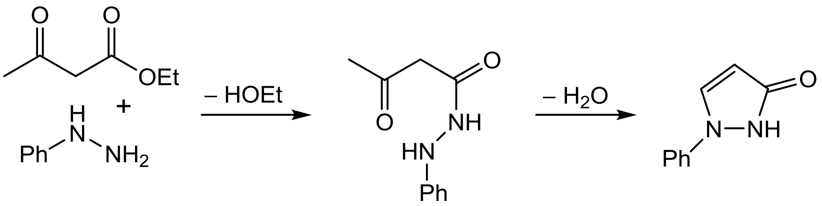


18.9.7

a)

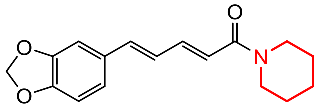


b)



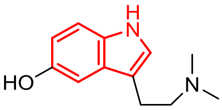
18.9.8

a)



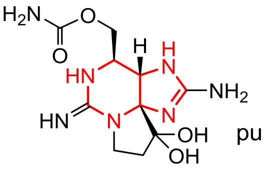
piperidin

b)



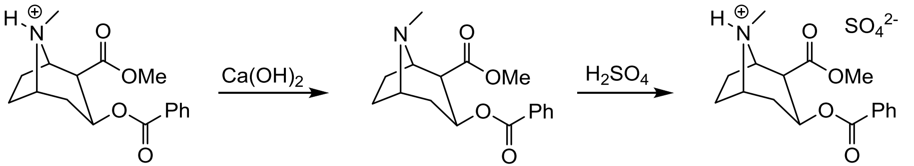
indol

c)



purin

18.9.9

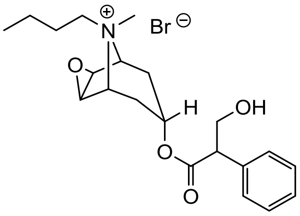


kation (sol)
topen v vodi

prosti amin
topen v bencinu

sulfat (sol)
preide nazaj v vodo

18.9.10



N-butilskopolaminijev bromid

19. Lipidi

19.1.1. a) P = palmitinska, O = oleinska kislina. Trigliceridi: PPP, PPO, POP, POO, OPO, OOO.

b) Stereogeni center se pojavi na C2 glicerola, kadar sta acilni skupini na C1 in C3 različni. Kiralna sta: PPO in POO.

19.2.1 Olje hidrogeniramo, da pretvorimo nenasičene maščobne kisline v stearinsko. Nato produkt preestrimo z 2 ekvivalentoma glicerola. Mogoča bi bila tudi delna hidroliza triglicerida, vendar bi v tem primeru dobili zmes monoglicerida in mila, ki bi jo zelo težko ločili.

19.6.1 S stearinska, O = oleinska, L linolna kislina.

Trigliceridi: SSS, SSO, SOS, SSL, SLS, OOO, OOS, OSO, OOL, OLO, LLL, LLS, LSL, LLO; LOL, SOL, SLO, OSL (18 različnih trigliceridov). Optična izomerija je mogoča, kiralni so trigliceridi, ki imajo na mestih 1 in 3 različne acilne skupine.

19.6.2 a) M(TG) = 884 g mol^{-1}, M(NaOH) = 40 g mol^{-1}. n(TG) = 100 g/ 884 g mol^{-1} = 0,113 mol.

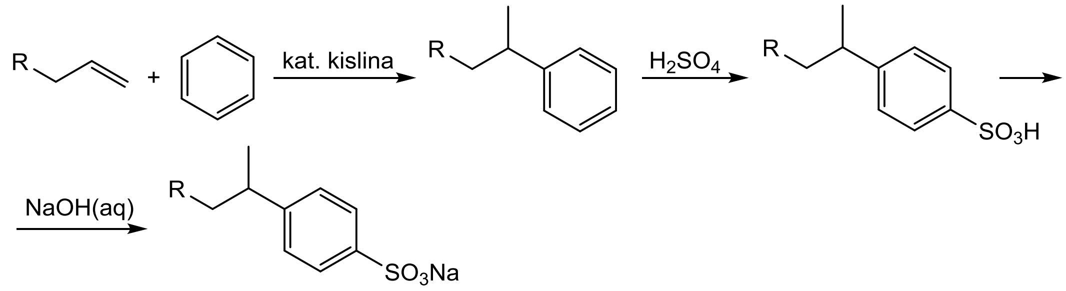
n(NaOH) = 3 n(TG) = 0,339 mol, m(NaOH) = 13,6 g.

b) Bolje je vzeti nekaj manj hidroksida, saj bo v tem primeru v produktu ostalo nekaj monogliceridov, ki so tudi sami emulgatorji. Če vzamemo prebitek hidroksida, bo v produktu odvečen hidroksid, ki je močna baza in škodljiv za kožo.

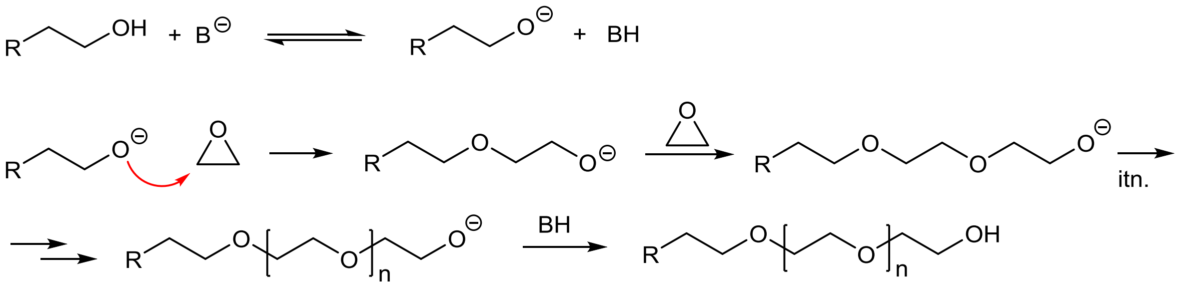
19.6.3 Maščoba hidrolizira, produkti so maščobne kisline in glicerol.

19.6.4 Sestavine biodizla so metil ali etil estri maščobnih kislin. V vodo se izpere katalizator in glicerol.

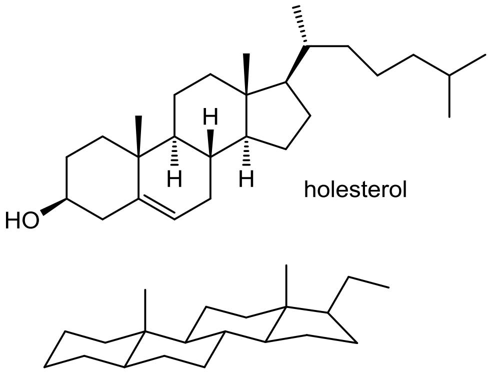
19.6.5

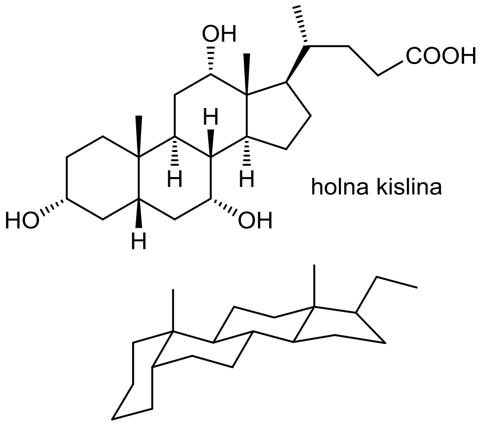


19.6.6

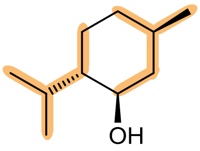


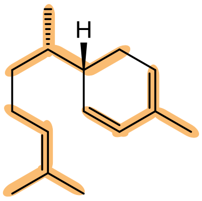
19.6.7 Holesterol ima povezavo obročev A in B *trans*-diekvatorialno, (kakor je tudi pri povezavah B-C in C-D), pri holni kislini pa sta obroča A in B povezana *cis*-ekvatorialno-aksialno. To spremeni obliko molekule kot je prikazano spodaj. Skelet molekule holesterola je približno planaren, holne kisline pa ne.





19.6.8

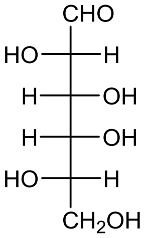




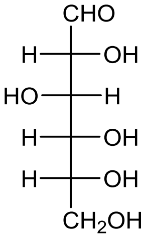
19.6.9 Karvon destilira skupaj z vodo (destilacija z vodno paro) in ga najdemo v destilatu. Ker se z vodo ne meša, ga lahko ločimo z lijem ločnikom. Vendar, ker ga je v destilatu malo, ga navadno ekstrahiramo iz zmesi z vodo z dietil etrom, eter pa nato uparimo.

20. Ogljikovi hidrati

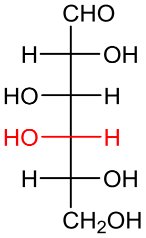
20.2.1



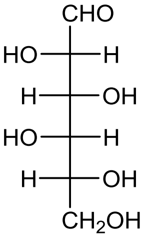
20.2.2



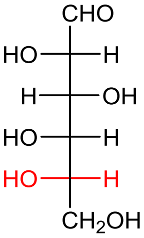
a) D-glukoza



D-galaktoza



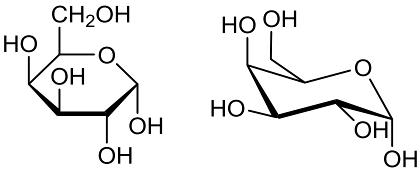
b) D-idoza



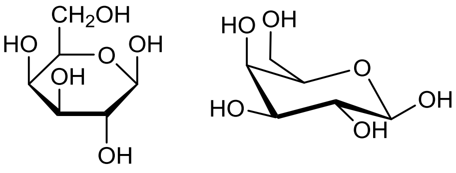
L-glukoza

20.2.3 2

20.3.1

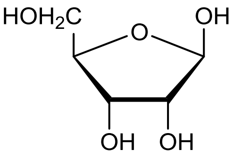


α-D-galaktopiranoza

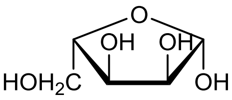


β-D-galaktopiranoza

20.3.2

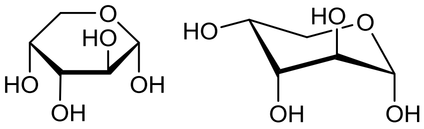


β-D-ribofuranoza

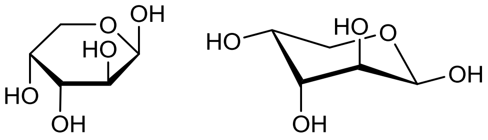


β-L-ribofuranoza

20.3.3

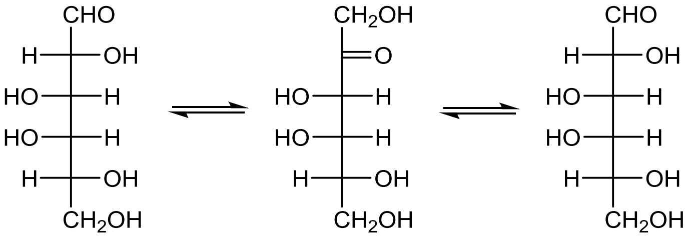


α-D-arabinopiranoza



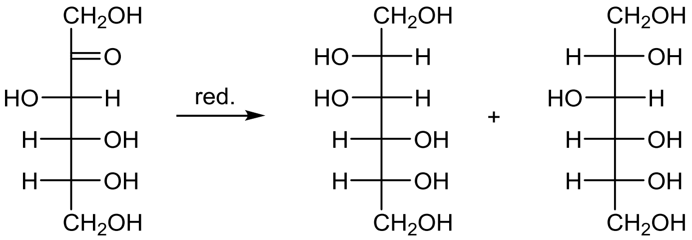
β-D-arabinopiranoza

20.4.1



D-galaktoza D-tagatoza D-taloza

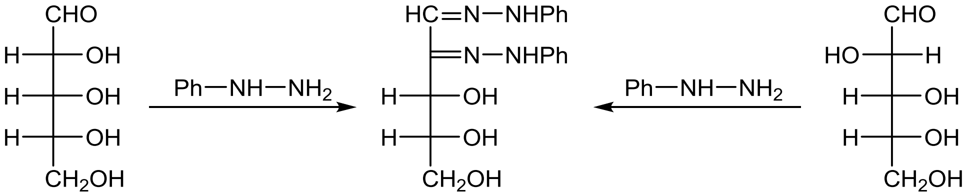
20.4.2



D-fruktoza D-manitol D-sorbitol

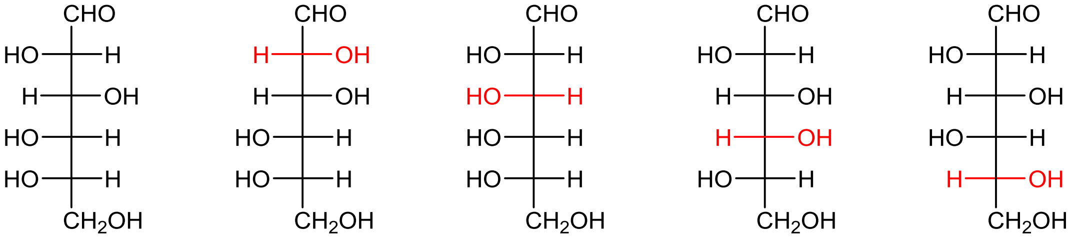
Alkohola ne nastaneta v enakih množinah, ker je izhodna spojina, fruktoza, kiralna, in napad reagenta ne poteka z obeh strani karbonilne skupine v enaki meri.

20.4.3



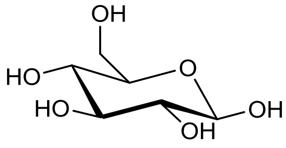
D-riboza D-arabinoza

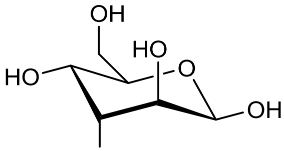
20.10.1

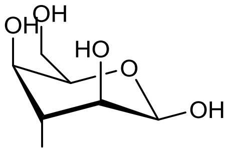


L-glukoza L-manoza L-aloza L-galaktoza D-idoza

20.10.2


D-glukoza


D-altroza


D-idoza

Najstabilnejša v tej konformaciji je glukoza, saj ima vse skupine OH in CH_2OH v ekvatorialni legi. Ostala dva monosaharida imata več skupin v aksialni legi in sta v tej konformaciji manj stabilni. Obroči se lahko tudi preklopijo in tako dosežejo stabilnejše konformacije.

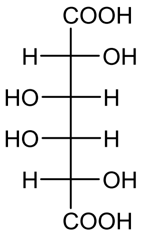
20.10.3 α(Z) = spec. sučnost zmesi α(A) = spec. sučnost α-glukoze α(B) = spec. sučnost β-glukoze x(A) ali x(B) je množinski delež α in β-glukoze.

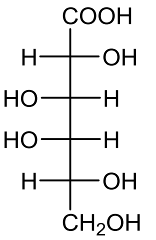
α(Z) = α(A) × x(A) + α(B) × x(B) iz tega sledi

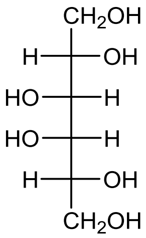
x(A) = [α(Z) – α(B)] / [α(A) – α(B)] = [52,7 – 18,7] / [112,7 – 18,7] = 0,36

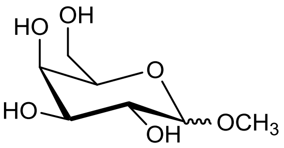
Delež α-glukoze je 36 %, β-glukoze pa 64 %.

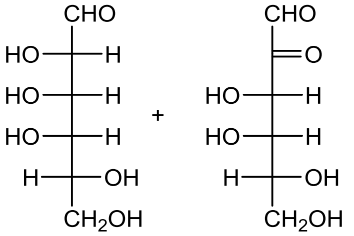
20.10.4


a) D-galaktarska kislina

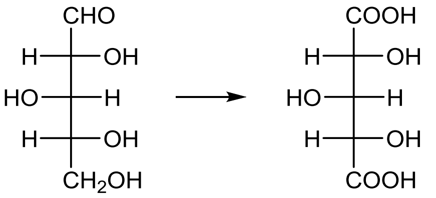

b in c) D-galaktonska kislina


d) D-galaktitol

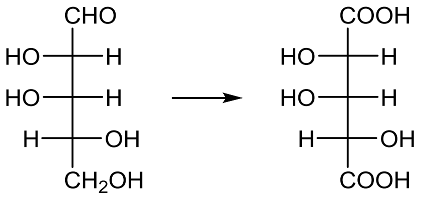

e) metil α-D-galaktopiranozid + β-D-galaktopiranozid


f) D-taloza D-tagatoza

20.10.5

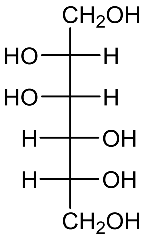

D-ksiloza

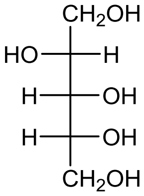
optično neaktivna *mezo*-kislina

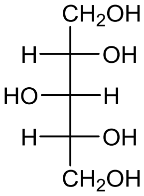

D-liksoza

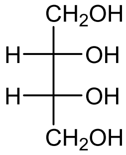
optično aktivna kislina

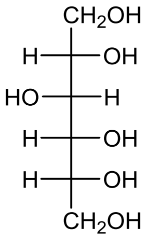
20.10.6


a) D-manitol
opt. aktiven

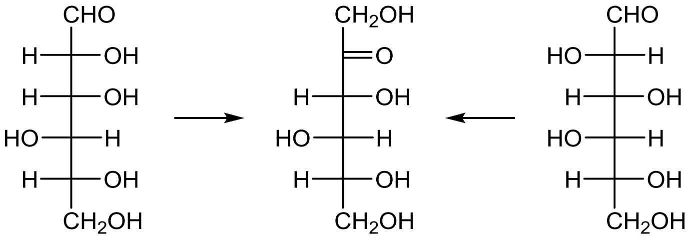

b) D-arabitol
opt. aktiven


c) ksilitol
opt. neaktiven


d) eritritol
opt. neaktiven


e) D-sorbitol
opt. aktiven

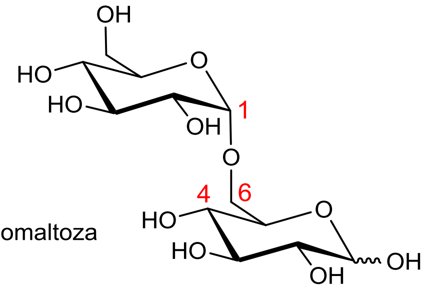
20.10.7


D-guloza D-sorboza D-idoza

20.10.8 a) Vsi, razen trehaloze. b) Isto

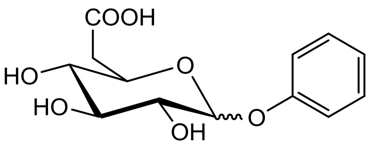
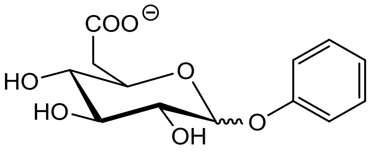
20.10.9 Saharoza ni reduktiven sladkor. Vzorec obdelamo s kislino (segrevamo z razredčeno HCl) pri čemer saharoza hidrolizira na monosaharida, ki sta reduktivna.

20.10.10 V amilopektinu so glukozne enote povezane tudi z 1→6 glikozidnimi vezmi. Izomaltoza je α-glukopiranozil-(1→6)-glukopiranoza

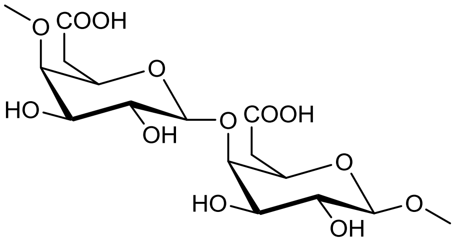


izomaltoza

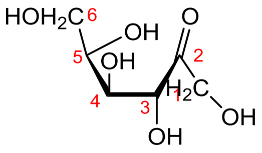
20.10.11

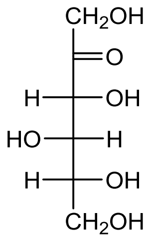

, oziroma pri fiziološkem pH


20.10.12



20.10.13

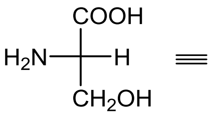




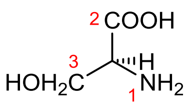
D-fruktoza

21. Proteini in nukleinske kisline

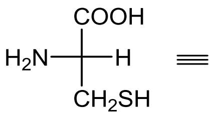
21.1.1



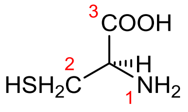
L-serin



(*S*)-serin



L-cistein

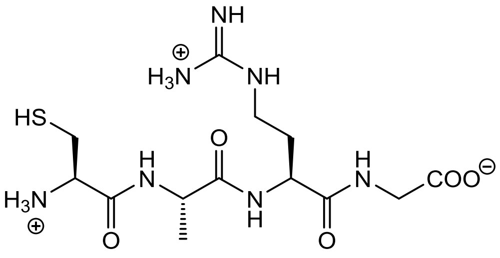


(*R*)-cistein

21.1.2 Imidazol je bazičen, obroč z vezavo protona ostane aromatski. Indol ima heterociklični obroč pirolskega tipa, ki ni bazičen. Nevezni elektronski par je angažiran v aromatskem π-oblaku.

21.1.2 a) 0 b) 0 c) 0 d) + e) –

21.2.1



Naboj pri pH = 6 je +1

21.2.2 *N*-konec Arg-Pro-Pro-Gly-Phe-Ser-Pro-Phe-Arg C-konec