Решења 7. Српске хемијске олимпијаде

Задатак 1: „Титровала, нитровала...”

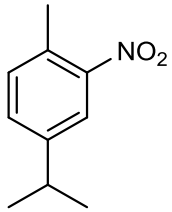
1. pH = 1,81

2. $[HPO_4^{2-}] = \frac{K_{a1}K_{a2}[H^+]c}{[H^+]^3 + K_{a1}[H^+]^2 + K_{a1}K_{a2}[H^+] + K_{a1}K_{a2}K_{a3}}$

3. а) 2,15 б) 7,20 в) 9,68; г) 12,15; д) 12,41

4. –4,6%

5.



6. $[H^+]$ = 1,43 M; $[OH^-] = 6{,}99 \cdot 10^{-15}$ M; $[HSO_4^-]$ = 0,993 M;

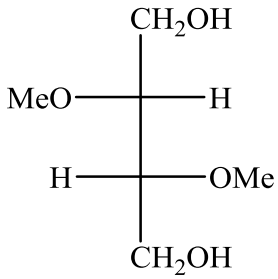
$[SO_4^{2-}] = 7{,}08 \cdot 10^{-3}$ M; $[NO_3^-]$ = 0,423 M

7. 1,63

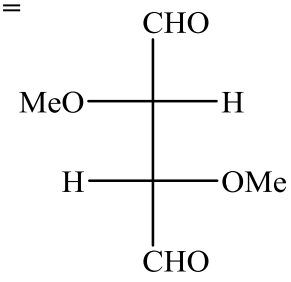
Задатак 2: Сладић

1.

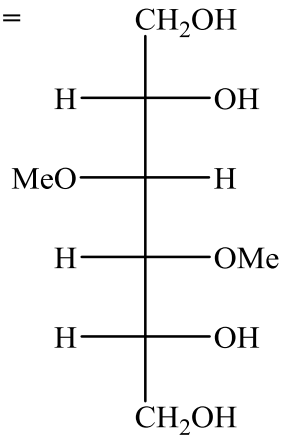
З =



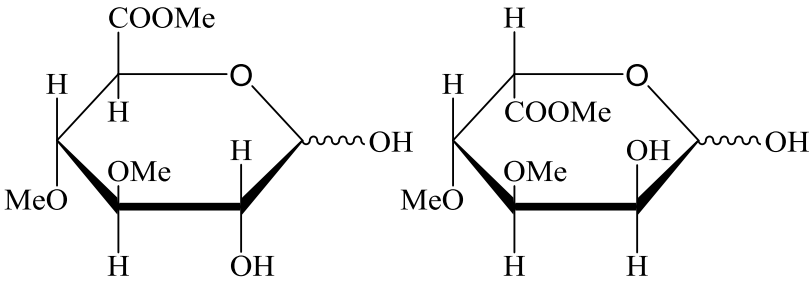
Ж =



Е =

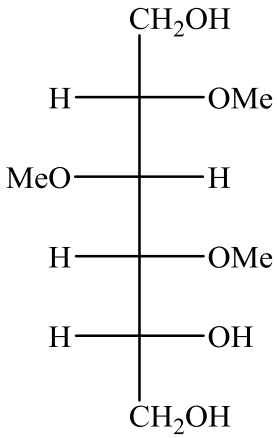


2.



3.

К =



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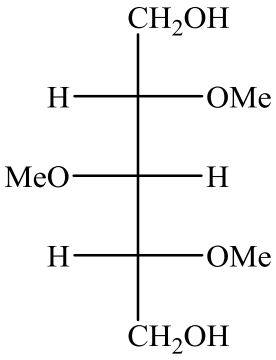

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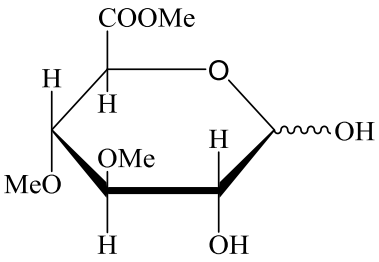
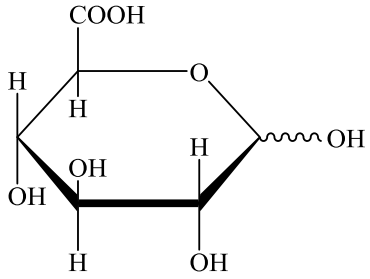
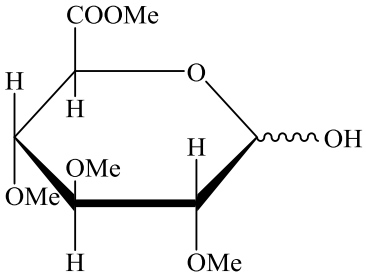


5.

Б =



Г =



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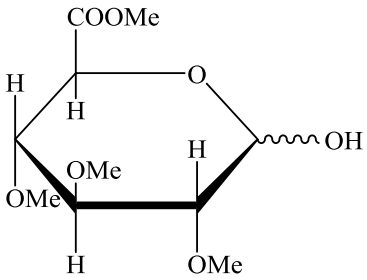

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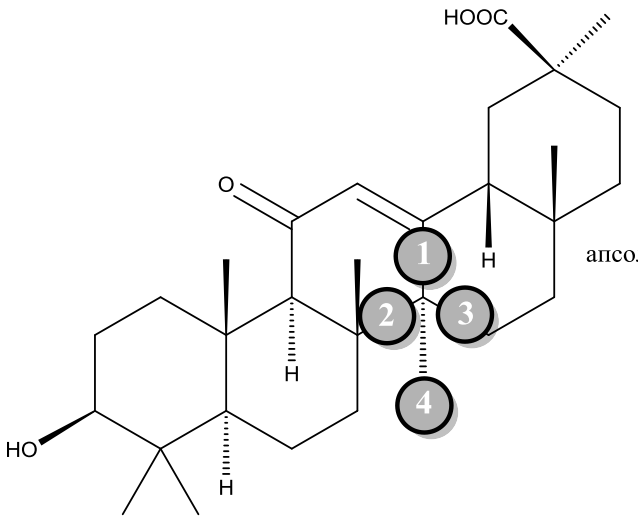
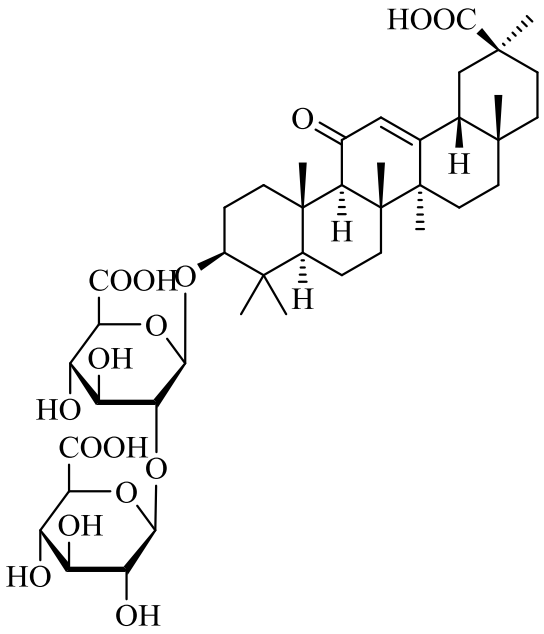


апсолутна конфигурација:

S

7.



Задатак 3: Етанол

1. V_1 = 796 cm^3, V_2 = 233 cm^3

2. V_1 = 1091 cm^3, V_2 = 1051 cm^3

3.1. ΔH = –1350 kJ/mol

3.2. ΔH = –886 kJ/mol

3.3. б

4.1. катода: $3\ O_2 + 12\ H^+ + 12\ e^- \rightarrow 6\ H_2O$

анода: $C_2H_5OH + 3\ H_2O \rightarrow 2\ CO_2 + 12\ H^+ + 12\ e^-$

4.2. E = +0,21 V

4.3. $1{,}78 \cdot 10^5$ h

5.1. $2\ K_2Cr_2O_7 + 3\ C_2H_5OH + 8\ H_2SO_4 \rightarrow$

$2\ Cr_2(SO_4)_3 + 3\ CH_3COOH + 2\ K_2SO_4 + 11\ H_2O$

$K_2Cr_2O_7 + 6\ KI + 7\ H_2SO_4 \rightarrow Cr_2(SO_4)_3 + 3\ I_2 + 4\ K_2SO_4 + 7\ H_2O$

$I_2 + 2\ Na_2S_2O_3 \rightarrow 2\ NaI + Na_2S_4O_6$

5.2. 10,1%

6.1. $CH_3CH_2OH_2^+\ HSO_4^-$

6.2. $CH_3CH_2OSO_3H$

6.3. $CH_3CH_2OSO_2OCH_2CH_3$

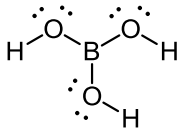
6.4. $CH_3CH_2OCH_2CH_3$

6.5. $CH_2{=}CH_2$

7. 162 cm^3

Задатак 4: Twenty-mule team

1. а)



б)

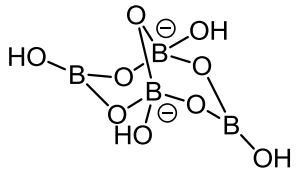
$Na_2B_4O_7 + H_2SO_4 + 5\ H_2O \rightarrow 4\ H_3BO_3 + Na_2SO_4$

$Na_2B_4O_7 + 2\ HCl + 5\ H_2O \rightarrow 4\ H_3BO_3 + 2\ NaCl$

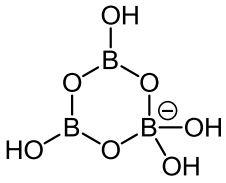
в) $H_3BO_3 + H_2O \rightarrow H^+ + [B(OH)_4]^-$

2.

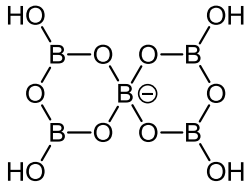
$[B_4O_5(OH)_4]^{2-}$



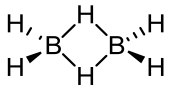
$[B_3O_3(OH)_4]^-$



$[B_5O_6(OH)_4]^-$

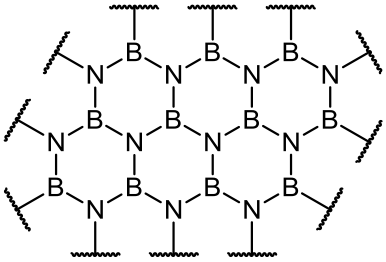


3.



д)

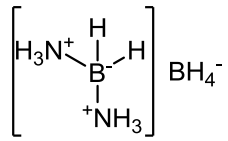
4.



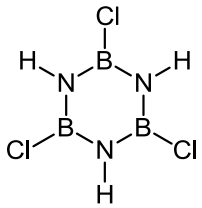
б, в, г, д

5.

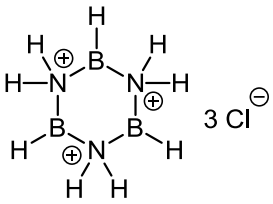
А



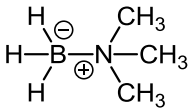
Б



В



Г



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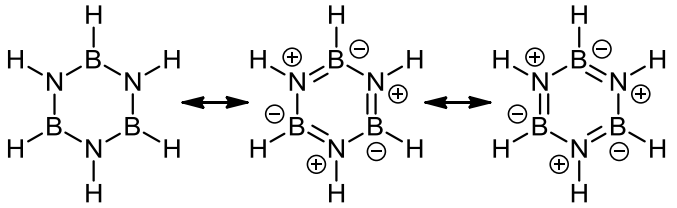


1: $B_2H_6 + 2\ NH_3 \rightarrow [B(NH_3)_2H_2]^+[BH_4]^-$

2: $3\ [B(NH_3)_2H_2]^+[BH_4]^- \rightarrow 2\ H_6B_3N_3$

3: $3\ NH_4Cl + BCl_3 \rightarrow H_3B_3N_3Cl_3 + 9\ HCl$

4: $2\ H_3B_3N_3Cl_3 + 6\ NaBH_4 \rightarrow 2\ H_6B_3N_3 + 6\ NaCl + 3\ B_2H_6$

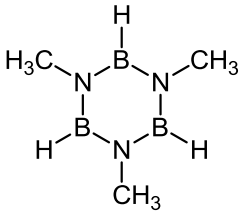
5: $H_6B_3N_3 + 3\ HCl \rightarrow [H_9B_3N_3]Cl_3$

6: $B_2H_6 + 2\ N(CH_3)_3 \rightarrow 2\ H_3B\text{-}N(CH_3)_3$

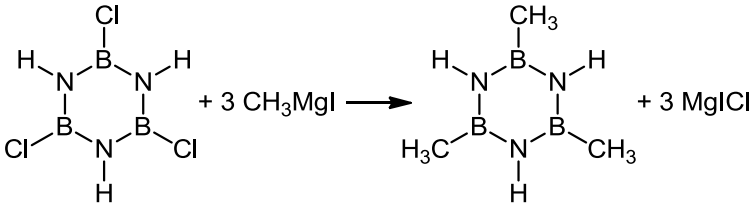
синтеза **Д**:

$CH_3NH_2 + BH_3THF \rightarrow H_3B\text{-}N(CH_3)H_2 + THF$

$H_3B\text{-}N(CH_3)H_2$ →

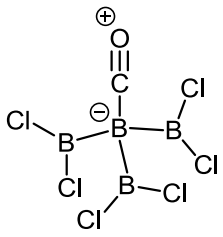


или



6. pH = 12,66

7. B_4Cl_6CO



Задатак 5: (Затворене) границе фаза

1. T = 272,4 K

2. T = 266,8 K, p = 86 Mpa

3. а, г, ђ

4. а, в, г, д

5. p^* = 30,5 kPa

6. 51,1 K

7. а) p = p_B^* + (p_A^* – p_B^*)·x_A, б) $p = \frac{p_A^* p_B^*}{p_A^* + (p_B^* - p_A^*) y_A}$

8. ω_l(бензен) = 0,285; x_{vap} = 0,272

9. а) p = 581 mmHg, б) Заостаје 2,1 mol воде.

Задатак 6: Target

1. E_1^o = +1,798 V; E_2^o = +1,444 V; E_3^o = +0,607 V; E_4^o = +0,327 V; E_5^o = +0,062 V; E_6^o = +0,620 V; E_7^o = +1,191 V; б)

2. E_1 = +1,444 V; E_2 = +1,326 V; E_3 = +0,253 V; E_4 = –0,027 V; E_5 = +0,417 V; E_6 = –0,444 V; г)

3. pH_{min} = 3,50

4. б)

5. ^{238}U: број α-распада: 8, број β-распада: 6.

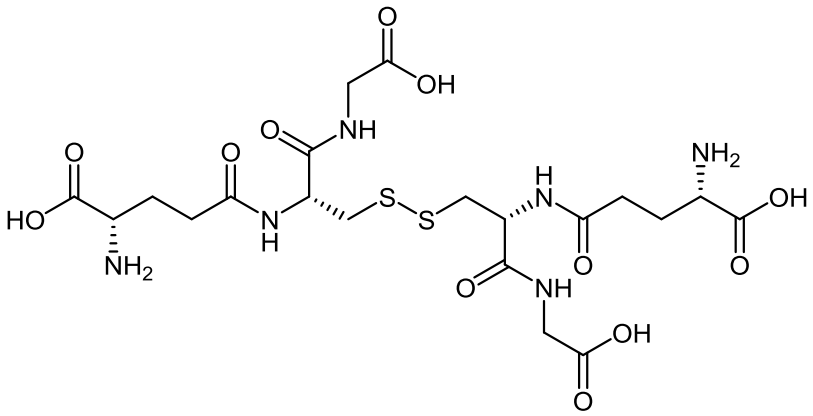
^{235}U: број α-распада: 7, број β-распада: 4.

6. $6{,}0 \cdot 10^9$ година

Задатак 7: Кошење траве, напад патогена и мирис јасмина

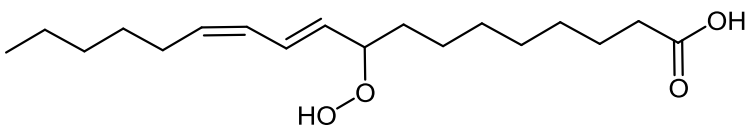
1. RCHO

2.

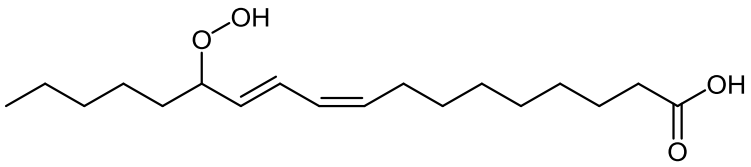


3. 1), реактивацијом ензима повећава се оксидационо стање из +2 у +3.

4.



9-хидропероксн-10,12-октадекадиенска киселина



13-хидропероксн-9,11-октадекадиенска киселина

Оба хидрогенпероксида садрже две двогубе везе и један хирални центар, па је могуће 2^3, тј. 8 стереоизомера.

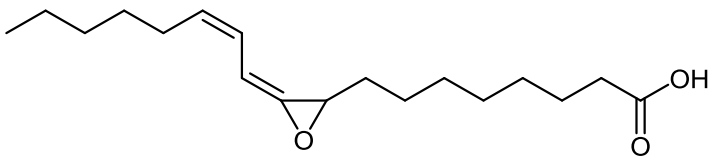
5. 9-хидропероксн-10,12-октадекадиенска киселина је настала глава оријентацијом (тј. глава улази у шупљину прва)

13-хидропероксн-9,11-октадекадиенска киселина је настала реп оријентацијом.

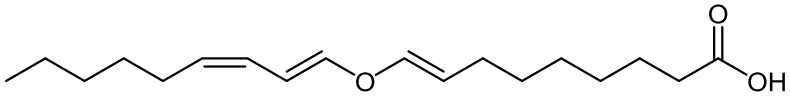
6. +4

7. остатак фенилаланина стабилизује катјонски интермедијер (донира електроне преко π-облака)

8.

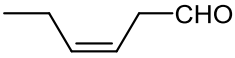


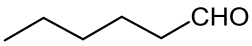
9.

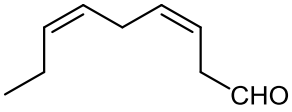


10. 3) изомеризацију хидропероксида

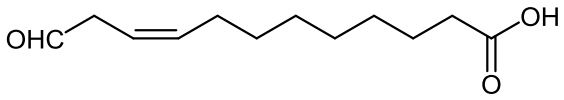
11.

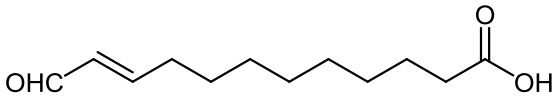
$C_6H_{10}O$  α-линоленска киселина

$C_6H_{12}O$  линолна киселина

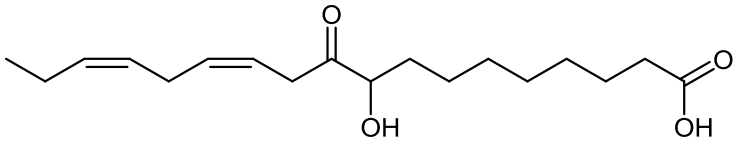
$C_9H_{14}O$  α-линоленска киселина

12.

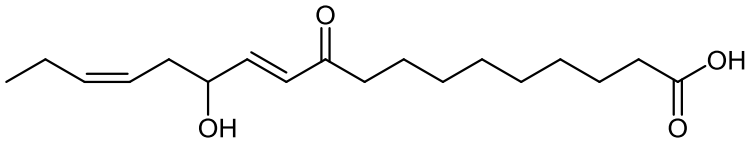


или  (трауматин)

13. из 9-хидроперкоски деривата α-линоленске киселине

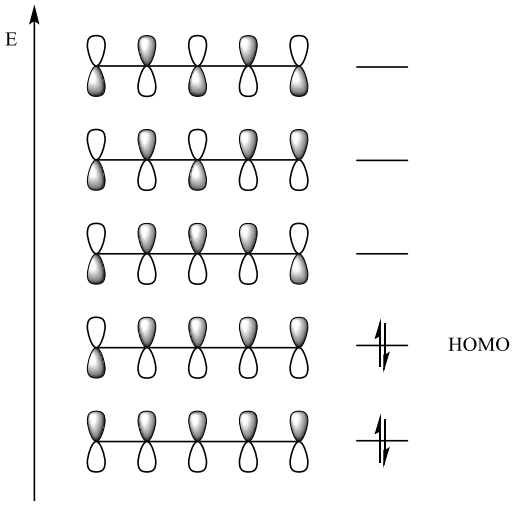


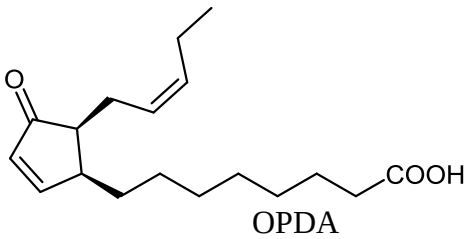
α-кетол



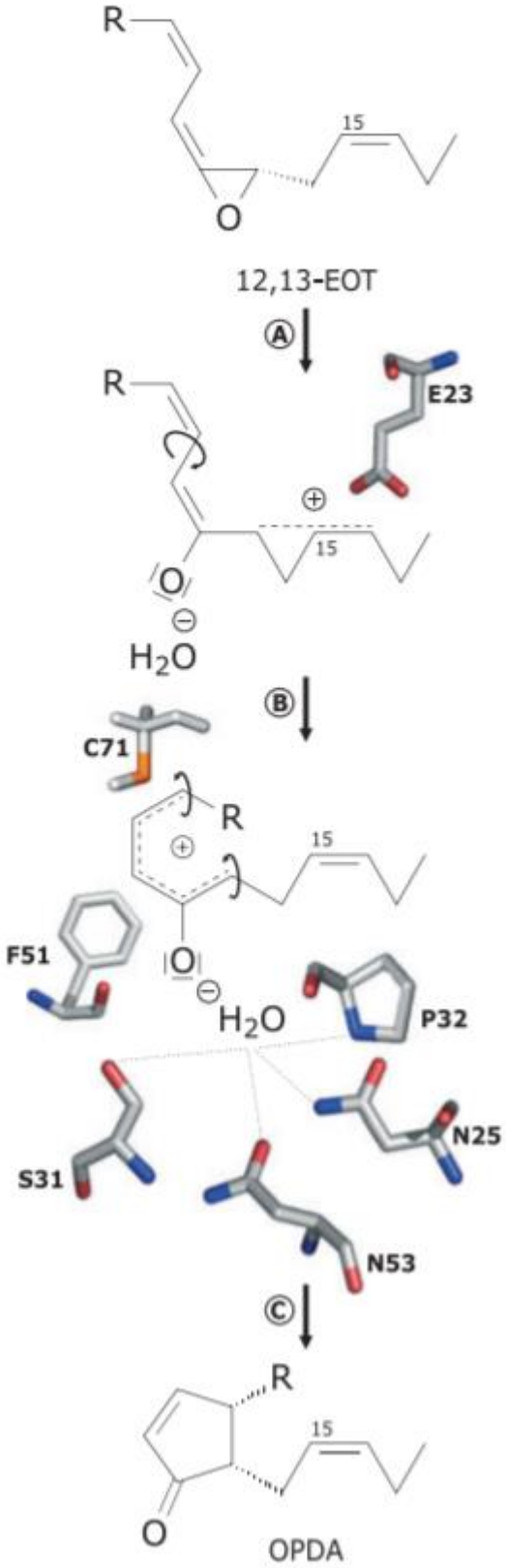
γ-кетол

14.

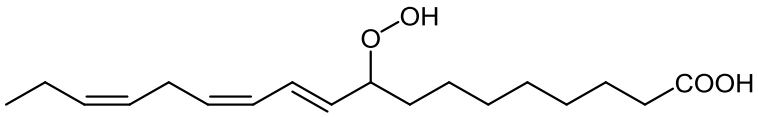

E
HOMO


O
COOH
OPDA

15.


R
15
O
12,13-EOT
A
E23
H2O
B
C71
F51
P32
N25
S31
N53
C
OPDA

16.



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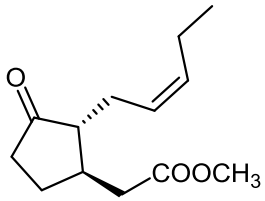
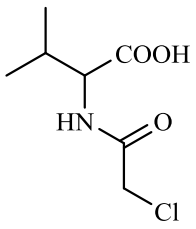
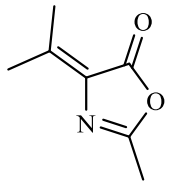
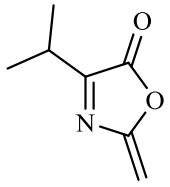


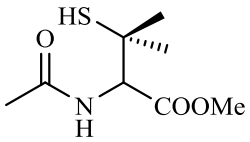
Задатак 8: Пеницилин V

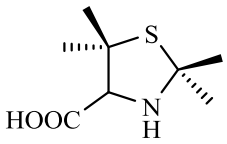
1.

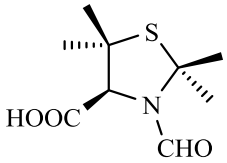
A = 

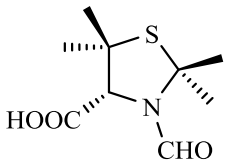
B = 

B' = 

C = 

D = 

E = 

E' = 

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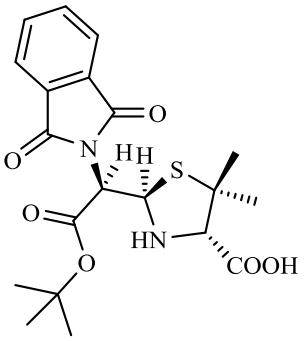
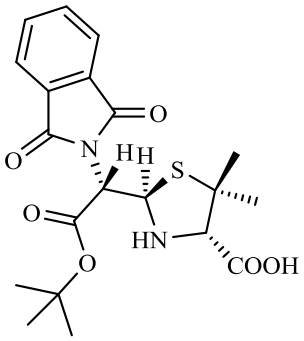
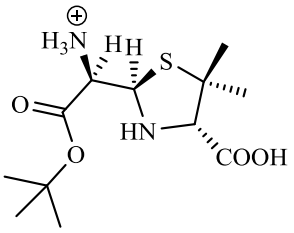
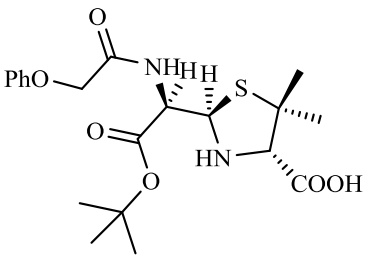
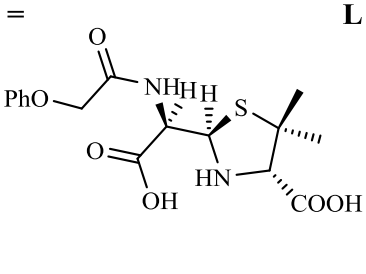
H = 

H' = 

I = 

J = 

K = 

L =