ACS Review Enols and Enolates

1. Which of the following have an enol form?

   I. benzaldehyde, C_6H_5CHO
   II. 2,2-dimethylpropanal, $(CH_3)_3CCHO$
   III. 2-chloropropanal, $CH_3CHClCHO$

   A. only I
   B. only II
   C. only III
   D. all of them have an enol form

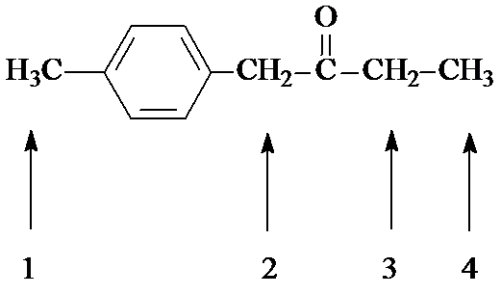
2. Which one of the following has two different enol forms?

   A. cyclohexanone
   B. 2,2-dimethylcyclohexanone
   C. 3,3-dimethylcyclohexanone
   D. 4,4-dimethylcyclohexanone

3. How many alpha hydrogens are there on 2,4-dimethyl-3-pentanone?

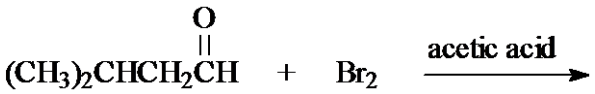
   A. two
   B. three
   C. four
   D. six

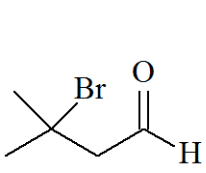
4. Identify the most acid hydrogen for the following compound.



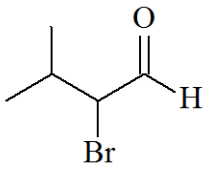
   A. 1
   B. 2
   C. 3
   D. 4

5. What is the product of the reaction below?

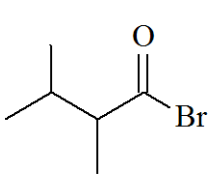




A)



B)



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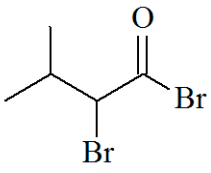
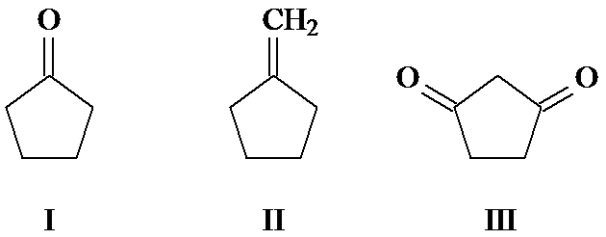


D)

   A. A

B. B
C. C
D. D

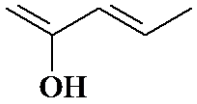
6. Arrange the following compounds in order of decreasing acidity.



I II III

A. I > II > III
B. II > III > I
C. III > II > I
D. III > I > II

7. Identify the keto form of the following enol.



A. 1-penten-3-one
B. (*E*)-3-penten-2-one
C. 2-pentanone
D. (*E*)-3-pentenal

8. What is the relationship between keto and enol tautomers?

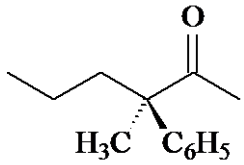
A. resonance forms
B. stereoisomers
C. constitutional isomers
D. different conformations of the same compound

9. Which of the following has the highest percentage of enol in a keto-enol equilibrium?

A. hexanal
B. 2-hexanone
C. 2,4-hexanedione
D. 2,5-hexanedione

10. Which one of the following optically active compounds racemizes in dilute KOH/CH_3OH solution?

A)



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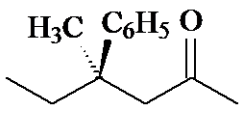
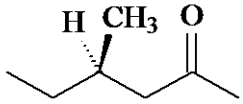
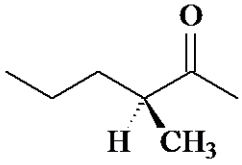
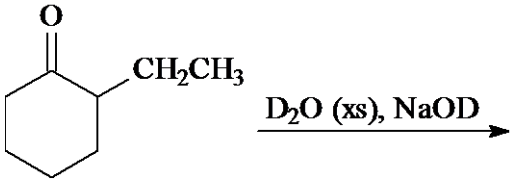


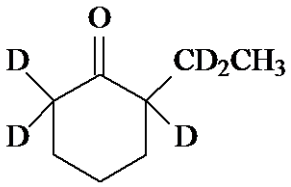
C) 

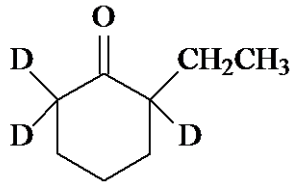
D) 

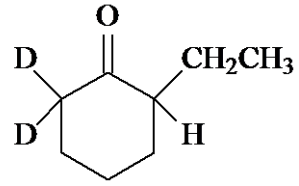
A. A
B. B
C. C
D. D

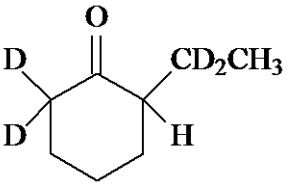
11. Identify the deuterated compound resulting from the following reaction.



A) 

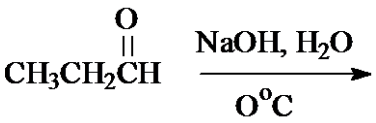
B) 

C) 

D) 

A. A
B. B
C. C
D. D

12. What is the aldol addition product of propanal?

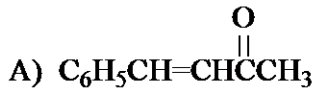


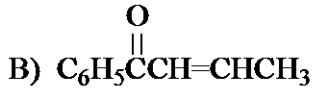
A. 2-hydroxy-2-methylpentanal
B. 3-hydroxy-2-methylpentanal
C. 3-hydroxyhexanal
D. 4-hydroxyhexanal

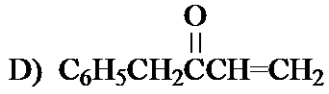
13. How many different aldol addition products can be formed in the reaction of equal amounts of propanal and butanal with aqueous sodium hydroxide at O°C? (Consider only constitutional isomer - not stereoisomers.)

A. only one
B. two
C. three
D. four

14. Benzalacetone is the crossed aldol condensation product formed between benzaldehyde and acetone. Which of the following is the structure of benzalacetone?

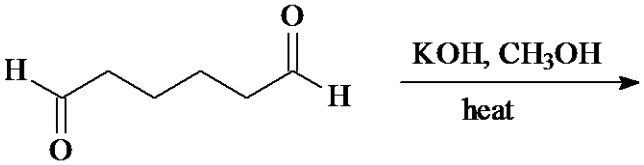


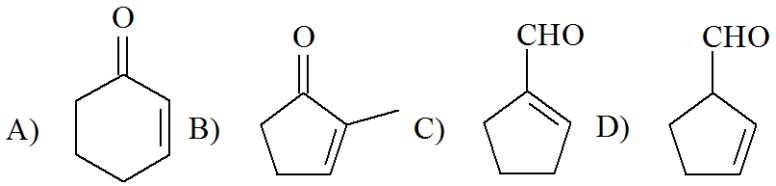




A. A
B. B
C. C
D. D

15. What is the product of the following intramolecular aldol condensation reaction?

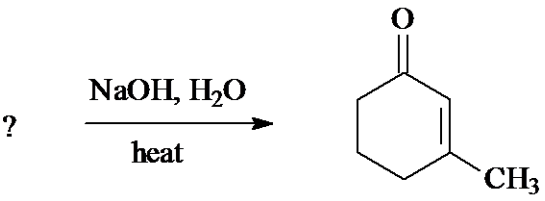


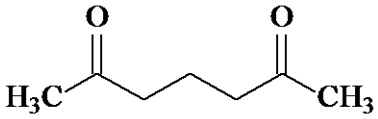


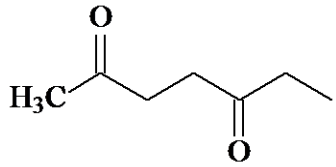
A. A

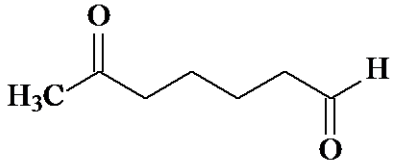
B. B
C. C
D. D

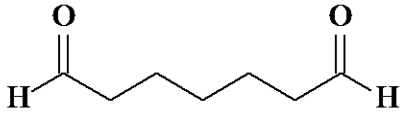
16. Identify the starting reagent needed to make the following cyclic ketone by an intramolecular aldol condensation reaction.



A) 

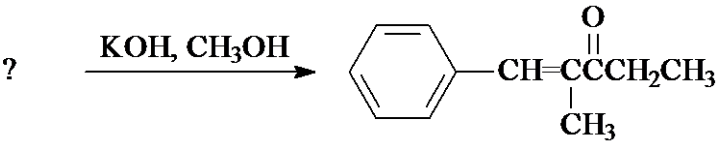
B) 

C) 

D) 

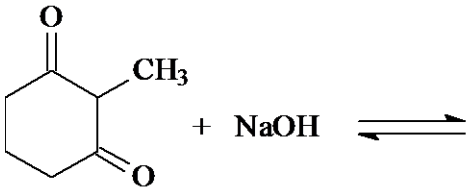
A. A
B. B
C. C
D. D

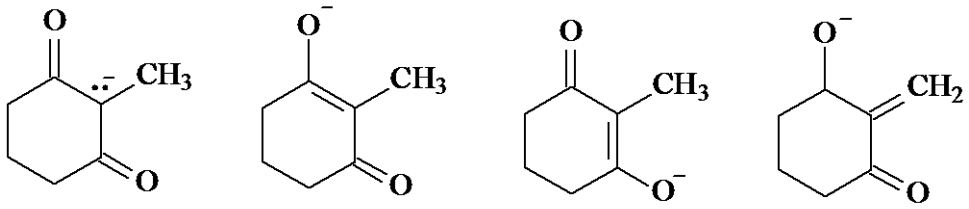
17. Identify the starting reagents needed to make the following compound by a mixed aldol condensation.



A. benzaldehyde ($C_6H_5CH=O$) and 3-pentanone
B. benzaldehyde ($C_6H_5CH=O$) and 2-pentanone
C. acetophenone (methyl phenyl ketone) and 2-butanone
D. acetophenone (methyl phenyl ketone) and butanal

18. Which of the following is not a resonance form of the enolate ion formed in the following acid-base equilibrium?

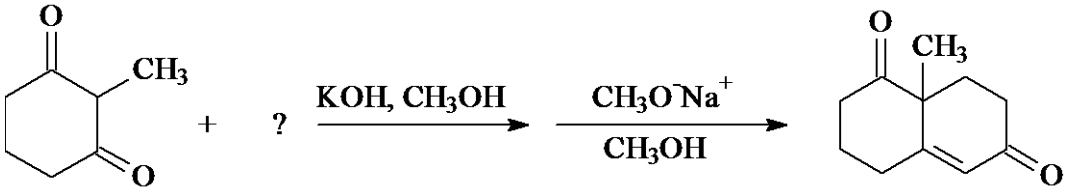




I II III IV

A. I
B. II
C. III
D. IV

19. The Robinson annulation reaction is shown below. Identify the missing reagent in the first step.



A) $CH_3CH{=}CHC(=O)H$

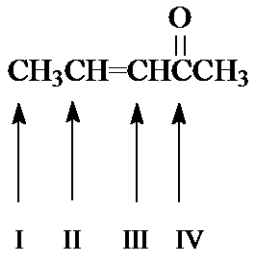
B) $H_2C{=}CHC(=O)CH_3$

C) $H_2C{=}CHCH_2C(=O)H$

D) $CH_3C(=O)CH_2CH_3$

A. A
B. B
C. C
D. D

20. Which carbon atoms are most susceptible to nucleophilic attack?

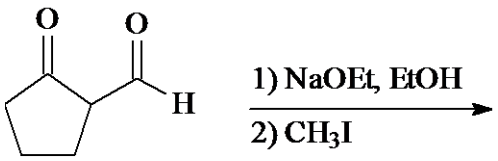


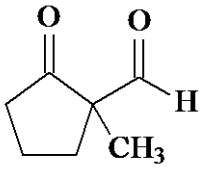
A. I and II
B. II and III
C. II and IV
D. I and IV

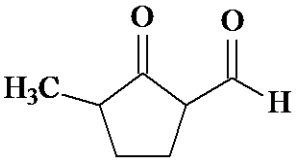
21. Which one of the following reagents adds a methyl group by conjugate (1,4-addition) addition to an α,β-unsaturated ketone or aldehyde?

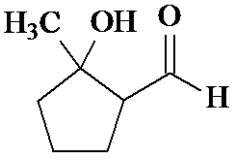
A. $LiCu(CH_3)_2$
B. CH_3MgBr
C. $Hg(O_2CCH_3)_2$
D. CH_3Li

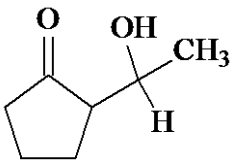
22. What is the product of the following reaction?



A)


B)


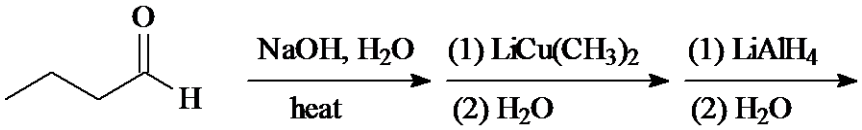
C)


D)


A. A
B. B
C. C

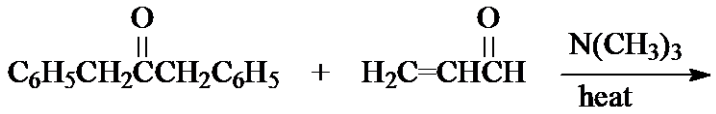
D. D

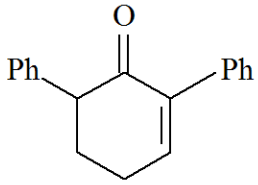
23. What is the product of the following reaction sequence?



A. 2,3-dimethyl-1-pentanol
B. 3,3-dimethyl-1-pentanol
C. 3-ethyl-2-methyl-1-hexanol
D. 2-ethyl-3-methyl-1-hexanol

24. Heating a mixture of 1,3-diphenylacetone and acrolein in trimethylamine gives a product, $C_{18}H_{16}O$, in 53% yield. The mechanism for product formation is a Michael addition followed by an intramolecular aldol condensation. Which of the following is the product of this reaction?



A)


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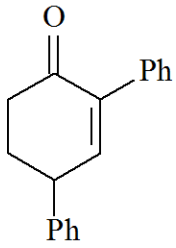

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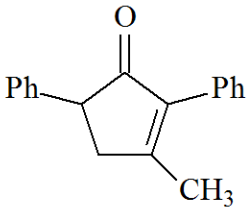
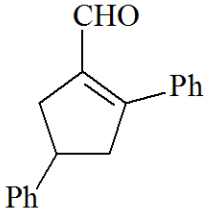
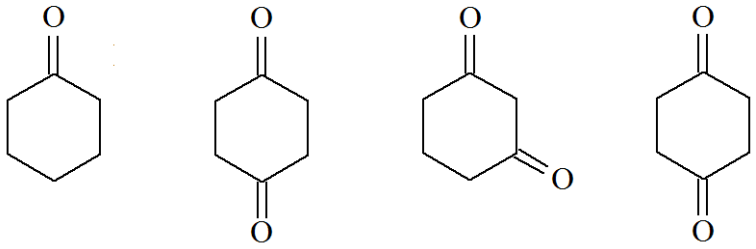


D)


A. A
B. B
C. C
D. D

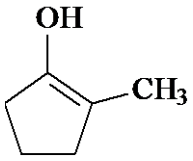
25. Which of the following has the largest acid dissociation constant, K_a?



A) B) C) D)

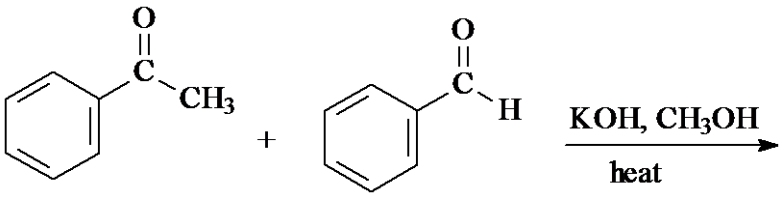
A. A
B. B
C. C
D. D

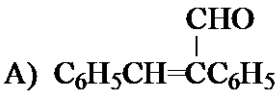
26. Identify the keto form of the following enol structure.

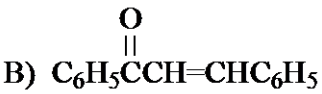


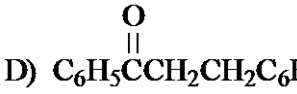
A. 2-methylcyclopentanone
B. 3-methylcyclopentanone
C. 1-methylcyclopentanol
D. 2-methylcyclopentanol

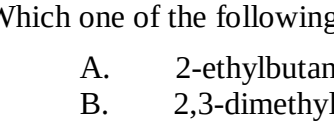
27. Which of the following is the mixed aldol condensation product of the reaction shown below?









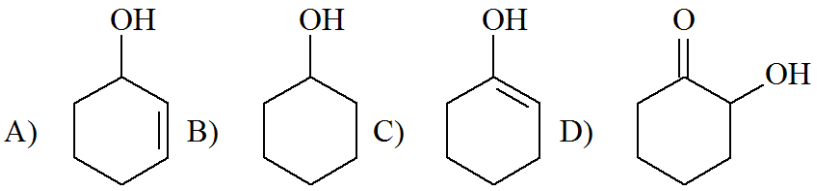


A. A
B. B
C. C
D. D

28. Which one of the following cannot form an enolate anion?

A. 2-ethylbutanal
B. 2,3-dimethylbutanal
C. 3,3-dimethylbutanal
D. 2,2-dimethylbutanal

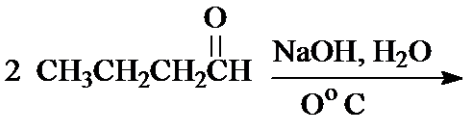
29. Which of the following is the enol of cyclohexanone?



A. A

B. B
C. C
D. D

30. Which of the following is the aldol addition product of butanal?



A. 2-ethyl-3-hydroxyhexanal
B. 2-methyl-2-hydroxyheptanal
C. 3-ethyl-2-hydroxyhexanal
D. 2-ethyl-2-hydroxyhexanal

ACS Review Enols and Enolates KEY

1. C
2. C
3. A
4. B
5. B
6. D
7. B
8. C
9. C
10. D
11. B
12. B
13. D
14. A
15. C
16. A
17. A
18. D
19. B
20. C
21. A
22. A
23. D
24. A
25. C
26. A
27. B
28. D
29. C
30. A