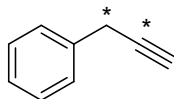




Organic Chemistry, Full-Year Practice Items

Study Question – Chapter 1 (Structure: Shape and Stability)

- 1A. What hybrid orbitals are used to form the sigma bond between the indicated carbon atoms (indicated with stars)?

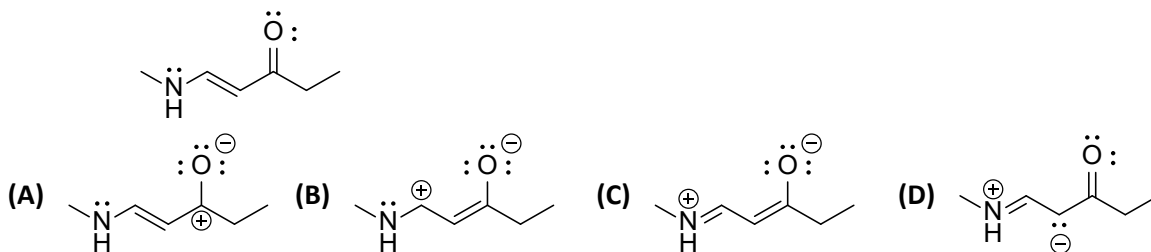


- (A) sp and sp (B) sp^3 and sp (C) sp^2 and sp (D) sp^2 and sp^3

Work:

Practice Question – Chapter 1 (Structure: Shape and Stability)

- 1B. Which of the following structures contributes more to the hybrid structure for this molecule?



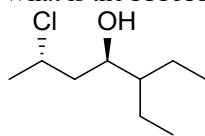
Work:

References below are to the ACS Exams Organic Chemistry Study Guide

For more practice, please see: Study Questions: SQ 6 and 10 (p. 20 - 23)
Practice Questions: PQ 11-16, 25-26 (p. 25-29)

Study Question – Chapter 3 (Structure: Isomers)

2A. What is the IUPAC name of this molecule?



(A) (2*S*, 4*S*) 2-chloro-5-ethylheptan-4-ol

(B) (2*S*, 4*R*) 2-chloro-5-ethylheptan-4-ol

(C) (2*R*, 4*S*) 2-chloro-5-ethylheptan-4-ol

(D) (2*R*, 4*R*) 2-chloro-5-ethylheptan-4-ol

Work:

Practice Question – Chapter 3 (Structure: Isomers)

2B. Which best describes the most stable conformation of *cis*-1-chloro-4-isopropylcyclohexane?

(A) The isopropyl group is equatorial, and the chloro group is axial.

(B) The isopropyl group is axial, and the chloro group is equatorial.

(C) Both the chloro and isopropyl group are equatorial.

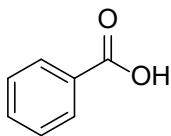
(D) Both the chloro and isopropyl group are axial.

Work:

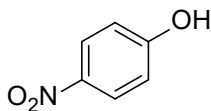
For more practice, please see: Study Questions: SQ1, 4 (p. 41-45)
Practice Questions: PQ1-5, 11-14 (p. 48-50)

Study Question – Chapter 4 (Acids and Bases)

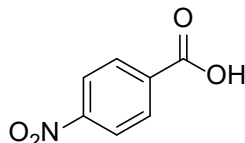
3A. Rank the following compounds in order of increasing acidity.



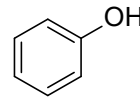
I



II



III



IV

(A) II < IV < I < III

(B) II < IV < III < I

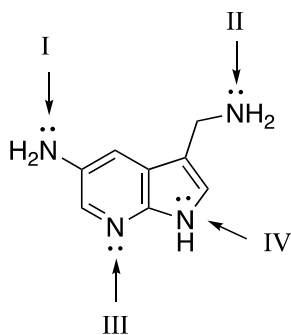
(C) IV < III < II < I

(D) IV < II < I < III

Work:

Practice Question – Chapter 4 (Acids and Bases)

3B. What is the most basic nitrogen lone pair in the molecule below?



(A) I

(B) II

(C) III

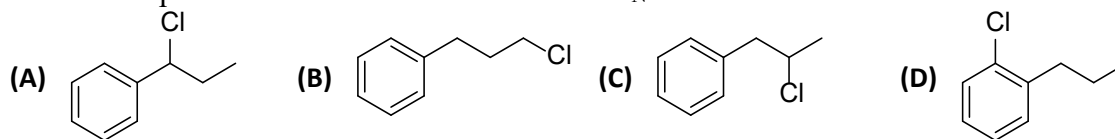
(D) IV

Work:

For more practice, please see: Study Questions: SQ 7-8 (p.59-60)
Practice Questions: PQ 22-27 (p.63-64)

Study Question – Chapter 5 (Nucleophilic Substitution Reactions)

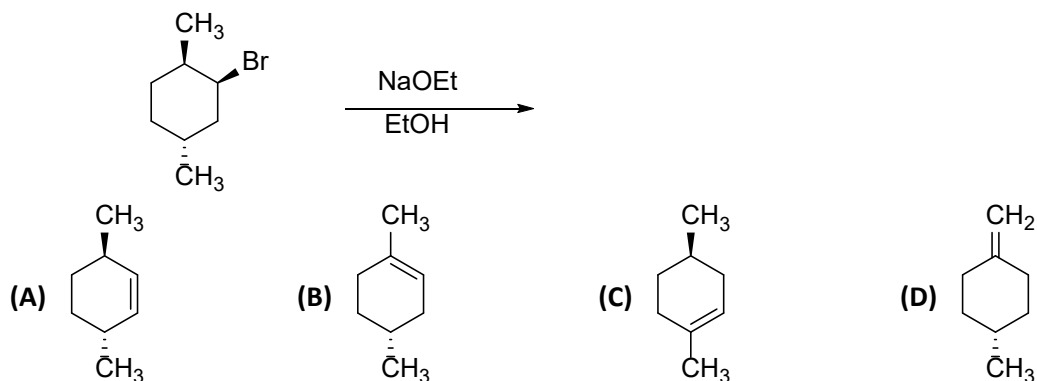
4A. Which compound would react the fastest in an S_N1 reaction?



Work:

Practice Question – Chapter 6 (Elimination Reactions)

4B. What is the major product of the following reaction?

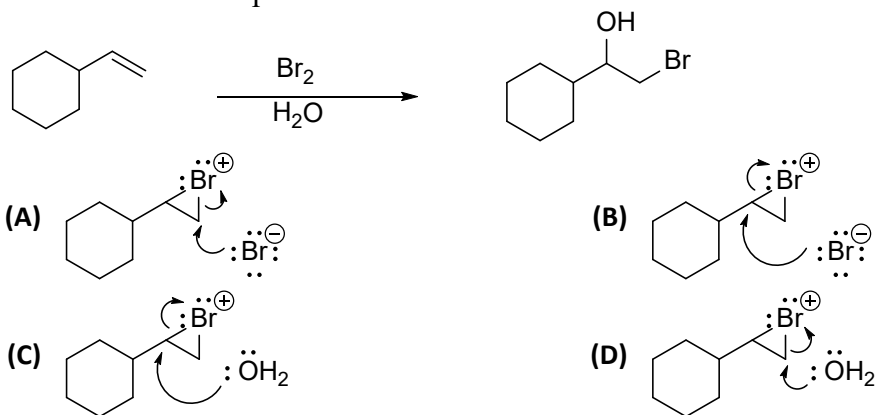


Work:

For more practice, please see: Study Questions: Ch 5 SQ-5, Ch 6 SQ- 3(p.70, 80-81)
Practice Questions: Ch 5 PQ 13-18, Ch 6 PQ 3-8 (p.75-76, 86-87)

Study Question – Chapter 7 (Addition Reactions: Alkenes and Alkynes)

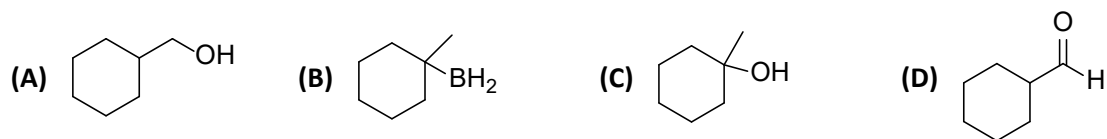
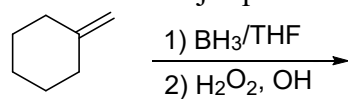
5A. Which reaction step occurs in this reaction mechanism?



Work:

Practice Question – Chapter 7 (Addition Reactions: Alkenes and Alkynes)

5B. What is the major product of the following reaction?

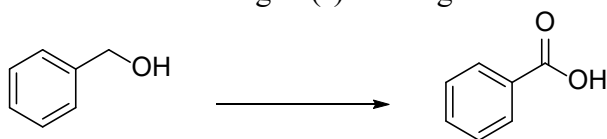


Work:

For more practice, please see: Study Questions: SQ 4, 7 (p.96-98)
Practice Questions: PQ 12-14, 18-19 (p.103-105)

Study Question – Chapter 8 (Addition Reactions: Alcohols and Ethers)

6A. What is the best reagent(s) to bring about the following transformation?

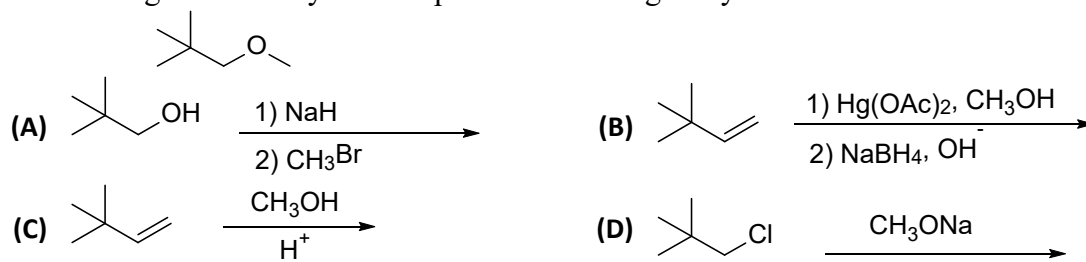


- (A) PCC, CH_2Cl_2 (B) LiAlH_4 , H_3O^+ (C) $\text{K}_2\text{Cr}_2\text{O}_7$, NaOH (D) *m*CPBA

Work:

Practice Question – Chapter 8 (Addition Reactions: Alcohols and Ethers)

6B. Which reagents would yield this product in the highest yield?

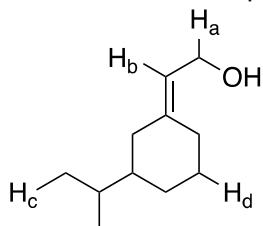


Work:

For more practice, please see: Study Questions: SQ 3, 7 (p.111-113)
Practice Questions: PQ 5-9, 18-20 (p.115-120)

Study Question – Chapter 9 (Spectroscopy)

7A. Which of the following hydrogen(s) would best account for a doublet in the ^1H NMR spectra at a chemical shift of 0.8 ppm?



(A) H_a

(B) H_b

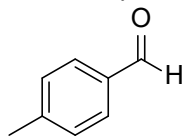
(C) H_c

(D) H_d

Work:

Practice Question – Chapter 9 (Spectroscopy)

7B. How many chemically distinct carbon signals are present in an NMR of 4-methylbenzaldehyde?



(A) 5

(B) 6

(C) 7

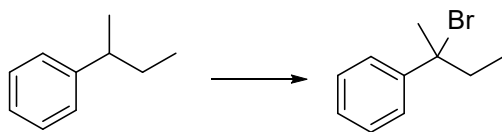
(D) 8

Work:

For more practice, please see: Study Questions: SQ 3,6 (p.126-129)
Practice Questions: PQ 4-6, 13-16 (p.133-136)

Study Question – Chapter 10 (Radical Reactions)

8A. What set of reagents will complete the following transformation?



- (A) HBr and peroxides (B) Br₂ and FeBr₃ (C) HBr and CCl₄ (D) Br₂ and light

Work:

Practice Question – Chapter 10 (Radical Reactions)

8B. Which of these is a termination step in a radical chlorination reaction?

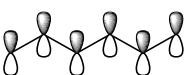
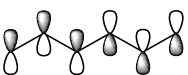
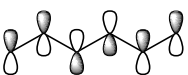
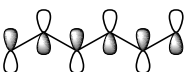
- (A)
- (B)
- (C)
- (D)

Work:

For more practice, please see: Study Questions: SQ 1, 2 (p.143-144)
Practice Questions: PQ 1-10 (p.145-146)

Study Question – Chapter 11 (Conjugated Systems & Aromaticity)

9A. What is the HOMO for 1,3,5-hexatriene?

- (A) 
- (B) 
- (C) 
- (D) 

Work:

Practice Question – Chapter 11 (Conjugated Systems & Aromaticity)

9B. A reaction under kinetic (or rate) control will yield predominantly:

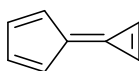
- (A) the most stable product.
- (B) the product that can be formed in the fewest steps.
- (C) the product with the least potential energy.
- (D) the product whose formation requires the smallest free energy of activation.

Work:

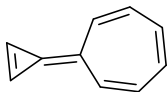
For more practice, please see: Study Questions: SQ 3, 9 (p.153, 157)
Practice Questions: PQ 9-11, 28-30 (p.158, 161)

Study Question – Chapter 11 (Conjugated Systems & Aromaticity)

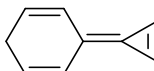
10A. In which of the following molecules would both rings be aromatic?



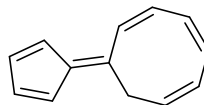
I



II



III



IV

(A) I

(B) II

(C) III

(D) IV

Work:

Practice Question – Chapter 11 (Conjugated Systems & Aromaticity)

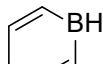
10B. Which of the following molecules would be the strongest Lewis acid?



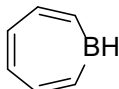
I



II



III



IV

(A) I

(B) II

(C) III

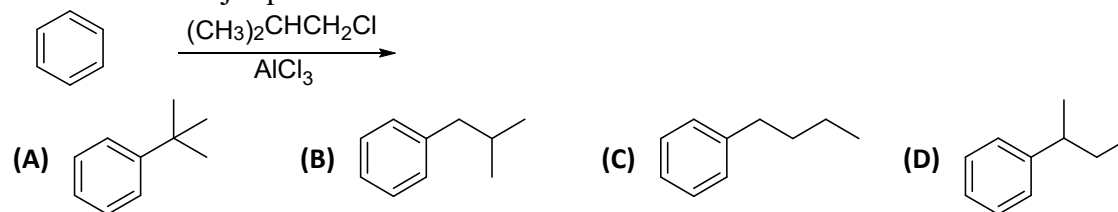
(D) IV

Work:

For more practice, please see: Study Questions: SQ 2,5 (p.152-153, 155)
Practice Questions: PQ 5-8, 14-15 (p.158-159)

Study Question – Chapter 12 (Aromatic Reactions)

11A. What is the major product of this reaction?



Work:

Practice Question – Chapter 12 (Aromatic Reactions)

11B. Which substituent would be classified as an activating, *ortho*, *para*- director in an electrophilic aromatic substitution reaction?

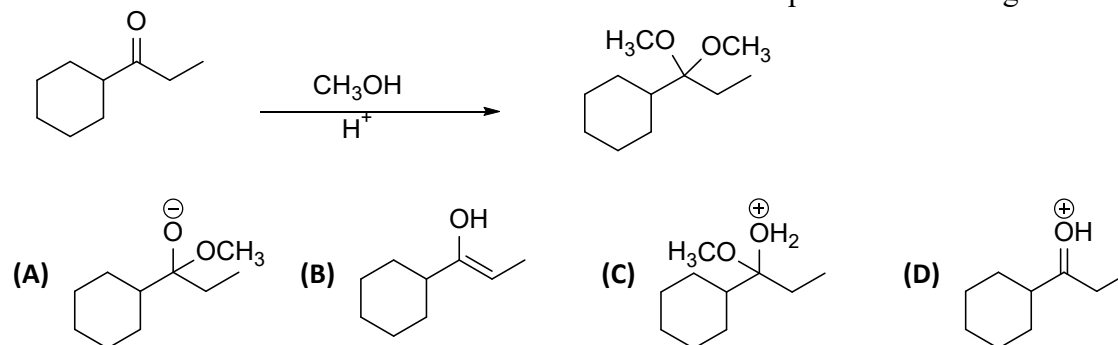
- (A)** $-\text{COOCH}_3$ **(B)** $-\text{Br}$ **(C)** $-\text{OCONH}_2$ **(D)** $-\text{SO}_3\text{H}$

Work:

For more practice, please see: Study Questions: SQ 1, 3 (p.163-165)
Practice Questions: PQ 1-7, 11-17 (p.170-171)

Study Question – Chapter 13 (Carbonyl chemistry)

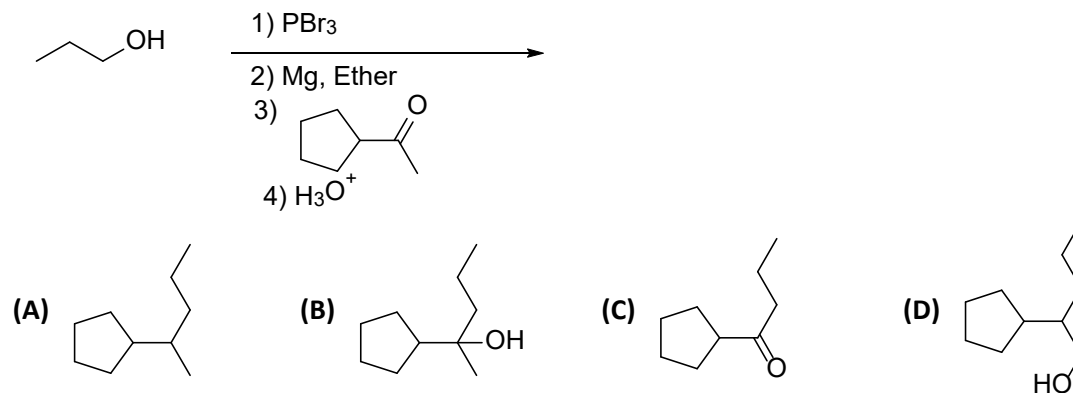
12A. What is the intermediate formed in the first mechanistic step of the following reaction?



Work:

Practice Question – Chapter 13 (Carbonyl chemistry)

12B. What is the major product of this reaction?

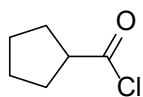


Work:

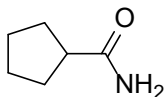
For more practice, please see: Study Questions: SQ 2, 5 (p.178-181)
Practice Questions: PQ 4-7, 15-18 (p.184 - 187)

Study Question – Chapter 13 (Carbonyl chemistry)

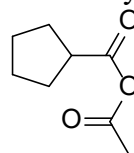
13A. Rank the molecules from least reactive to most reactive in a hydrolysis reaction.



I



II



III

(A) **I < II < III**

(B) **III < I < II**

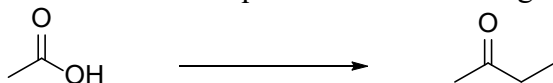
(C) **II < III < I**

(D) **III < II < I**

Work:

Practice Question – Chapter 13 (Carbonyl chemistry)

13B. Which reaction sequence is best for bringing about this conversion?



(A) $\xrightarrow[2) \text{H}_3\text{O}^+]{1) \text{CH}_3\text{Li}}$

(B) $\xrightarrow[2) (\text{CH}_3\text{CH}_2)_2\text{CuLi}]{1) \text{SOCl}_2}$

(C) $\xrightarrow[3) \text{H}_3\text{O}^+]{2) \text{CH}_3\text{CH}_2\text{MgBr}, 1) \text{SOCl}_2}$

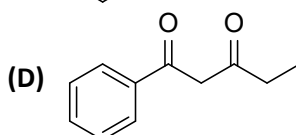
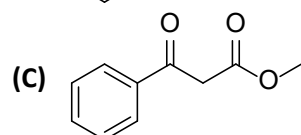
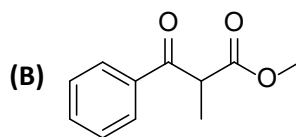
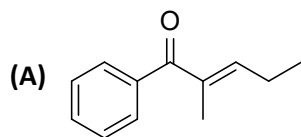
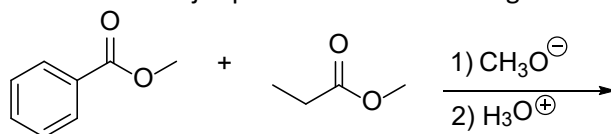
(D) $\xrightarrow[3) \text{H}_3\text{O}^+]{2) \text{CH}_3\text{CH}_2\text{Li}, 1) \text{CH}_3\text{OH}, \text{H}^+}$

Work:

For more practice, please see: Study Questions: SQ 7, 9 (p.181-183)
Practice Questions: PQ 20-21, 28-29 (p.187-189)

Study Question – Chapter 14 (Enols and Enolates)

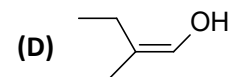
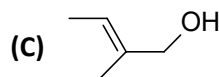
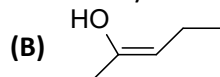
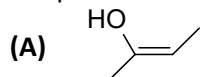
14A. What is the major product of the following reaction?



Work:

Practice Question – Chapter 14 (Enols and Enolates)

14B. Select the correct structure of the intermediate enol in the racemization of (R)-2-methylbutanal in presence of catalytic sodium hydroxide.



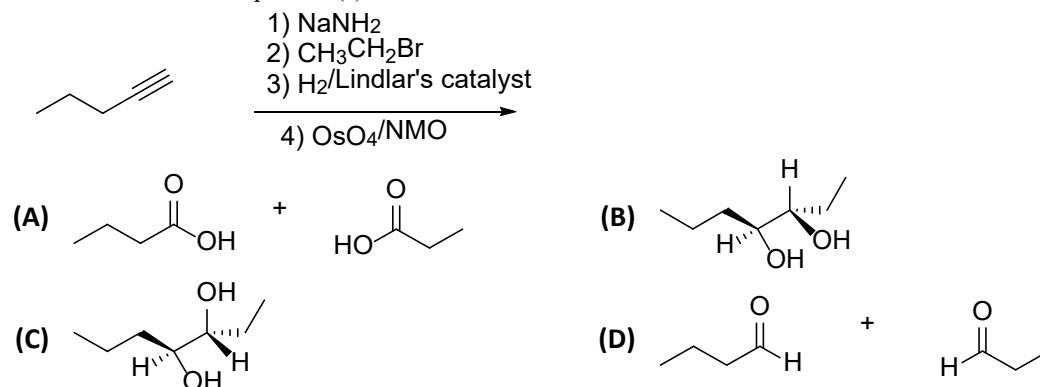
Work:

For more practice, please see: Study Questions: SQ 1, 6 (p.191-196)

Practice Questions: PQ 1-3, 19 - 23 (p.198, 201-202)

Study Question – Chapter 15(Multistep Synthesis)

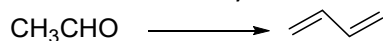
15A. What is/are the final product(s) of this reaction?



Work:

Practice Question – Chapter 15(Multistep Synthesis)

15B. Select the correct synthetic route for the following transformation.



- | | |
|---|---|
| <p>(A)</p> <ol style="list-style-type: none"> 1) a) NaH, b) CH_3I 2) $\text{H}_2\text{C}=\text{PPh}_3$ 3) NBS, CCl_4 4) $\text{NaOCH}_2\text{CH}_3$ | <p>(B)</p> <ol style="list-style-type: none"> 1) a) NaH, b) CH_3I 2) $\text{H}_2\text{C}=\text{PPh}_3$ 3) HBr 4) Potassium tert-butoxide |
| <p>(C)</p> <ol style="list-style-type: none"> 1) $\text{H}_2\text{C}=\text{PPh}_3$ 2) a) NaH, b) CH_3I 3) NBS, CCl_4 4) NaOH | <p>(D)</p> <ol style="list-style-type: none"> 1) $\text{CH}_3\text{CO}_2\text{H}$ 2) a) NaH, b) CH_3I 3) NBS, CCl_4 4) $(\text{CH}_3)_2\text{CuLi}$ |

Work:

For more practice, please see: Study Questions: SQ 1 and 3 (p.206-209)
Practice Questions: PQ 1-7, 9-15 (p.209-213)