

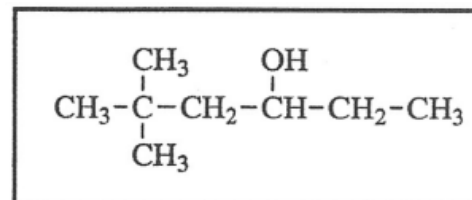
ACS Examination guide (Selected Questions)

Organic Chemistry

Nomenclature

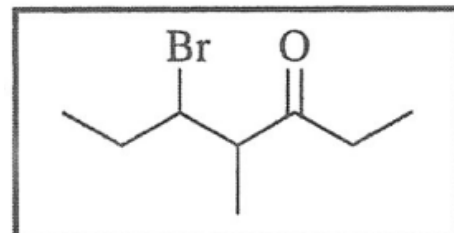
1. What is the IUPAC names for this compound?

- a) 1-tert-butyl-2-butanol
- b) 5,5-dimethyl-3-hexanol
- c) 2,2-dimethyl-4-hexanol
- d) 1,1,1-trimethy-3-pentanol



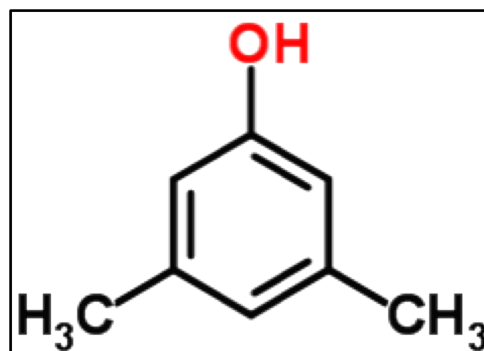
4. What is the IUPAC name for this structure?

- a) 3-bromo-4-methylheptanone
- b) 5-bromo-4-methylheptanone
- c) 5-bromo-4-methyl-3-heptanone
- d) 3-bromo-4-methyl-5-heptanone



9. What is the IUPAC name of this compound?

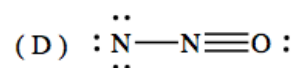
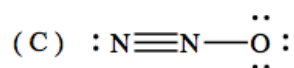
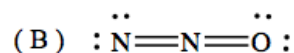
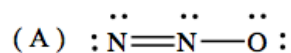
- a) m-hydroxy-m-xylene
- b) 3,5-dimethylphenol
- c) 2,4-dimethyl-6-hydroxybenzene
- d) 3-hydroxy-5-methyltoluene



Answer: 1, b; 4, c; 9, b.

Structure, Hybridization, Resonance, Aromaticity Chapter Book p 17,18,19

1) identify the lowest-energy Lewis structure for nitrogen oxide. (Formal charges not shown.)

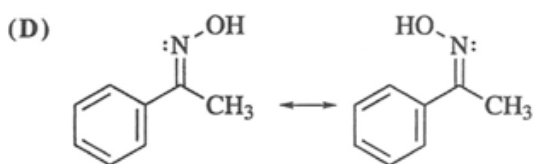
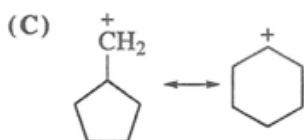
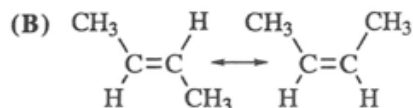
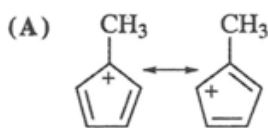


8) The heat of combustion (per CH₂) of several cycloalkanes is listed below. Based on the data given, which of these cycloalkanes would be considered most stable.

Heat of combustion (kJ/CH ₂)	Cycloalkane
-686.5	cyclobutane
-664.0	cyclopentane
-663.6	cyclooctane
-659.0	cyclopentadecane

a) cyclobutane b) cyclopentane c) cyclooctane d) cyclopentadecane

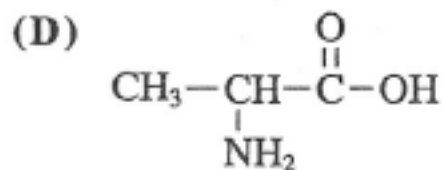
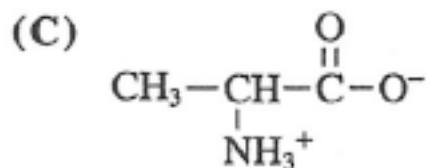
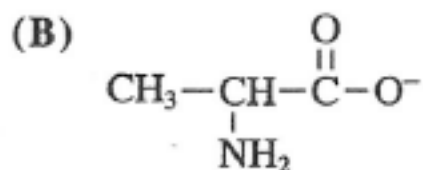
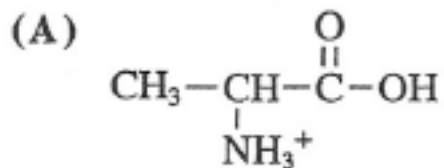
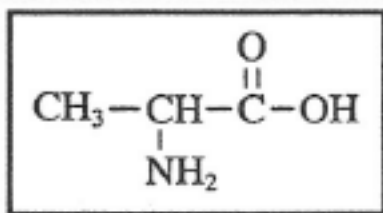
11) Which pair consists of the resonance structure?



Answer: 1, c; 8, d; 11, a

Acid and Bases Book P 30, 31

1. Which structure corresponds to the predominant form of this molecule near pH 7?



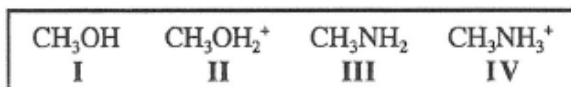
4. Which is the order from the strongest acid to the weakest acid for these species?

A) II > IV > I > III

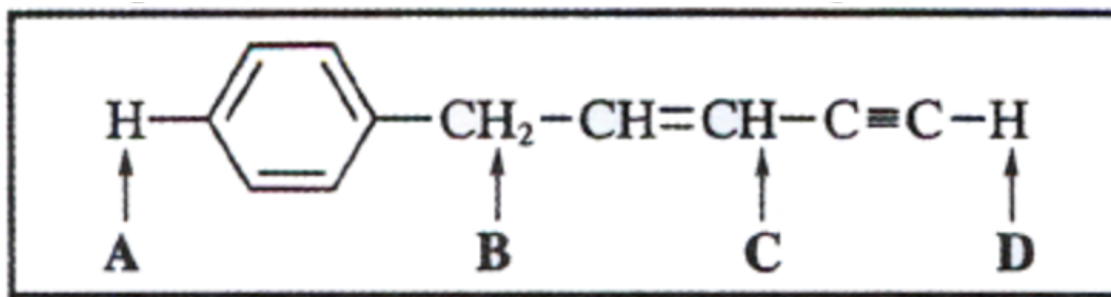
B) III > I > IV > II

C) III > IV > I > II

D) II > I > IV > III



8) Which of the indicated protons in this compound would have the smallest pKa values?

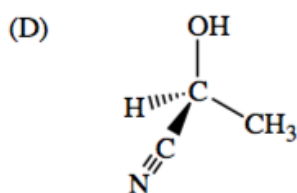
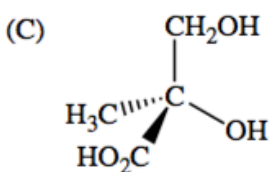
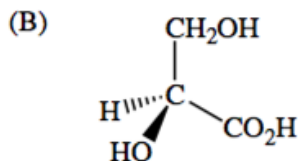
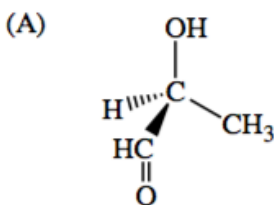


(A) A (B) B (C) C (D) D

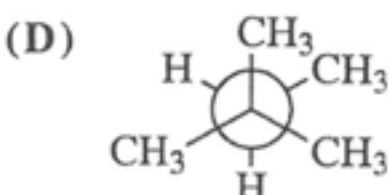
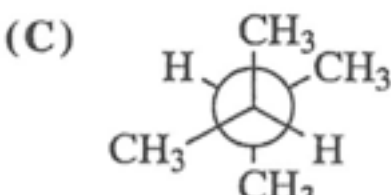
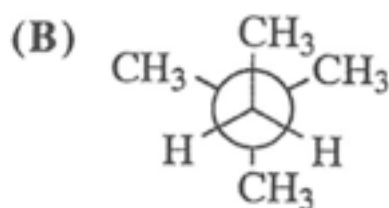
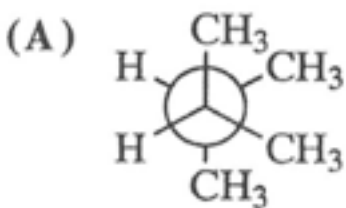
Answer: 1, c; 4, a; 8, d.

Stereoisomerism Book P38, 39,

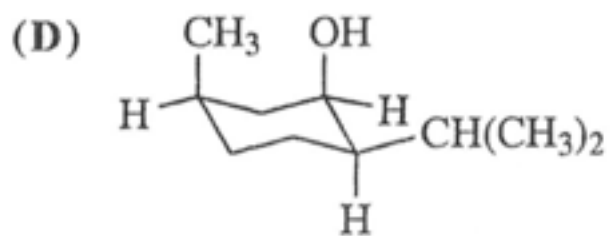
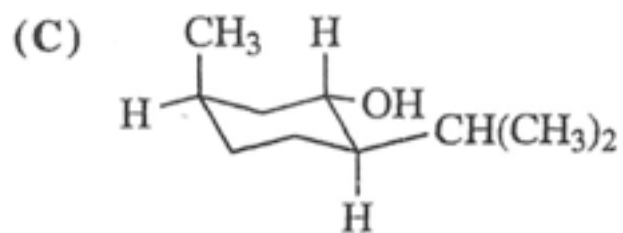
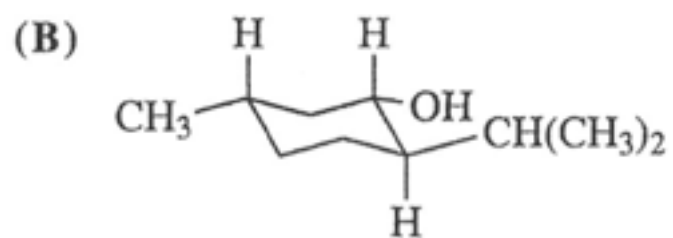
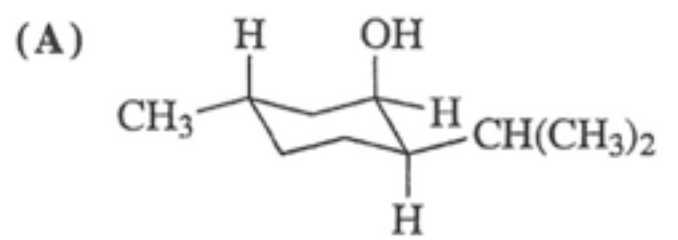
1) Which molecule has the R configuration?



6) Which Newman projection represents the most stable configuration of $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$



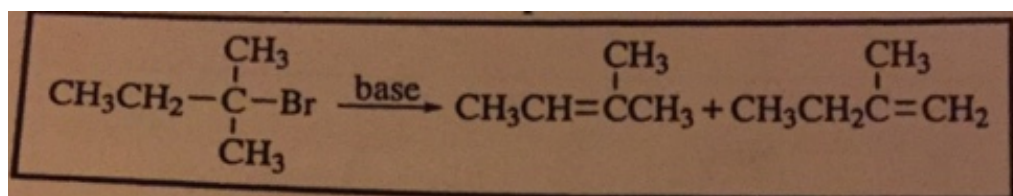
10) Which diastereoisomer is most stable?



Answer: 1, c; 6, c, 10, b.

Nucleophilic Substitution and Elimination

2) When 2-bromo-2-methylbutane is treated with a base, a mixture of 2-methyl-2-butene and 2-methyl-1-butene is produced



When potassium hydroxide is the base, 2-methyl-1-butene accounts for 45% of the mixture, but when potassium tert-butoxide is the base, 2-methyl-1-butene accounts for 70% of the mixture. What would you predict for the percent of 2-methyl-1-butene in the mixture if the potassium prop-oxide were the base?

- (a) Less than 45%
- (b) 45%
- (c) between 45% and 70%
- (d) more than 70%

11) Why would the concentrated hydrobromic acid be an inappropriate catalyst for the dehydration of alcohols?

- a) HBr is too weakly acidic to protonate the alcohol.
- b) The conjugate base, Br⁻, is a good nucleophile and it would attack the carbocation to form an alkyl bromide.
- c) HBr is strongly acidic, so the water molecule would not be a good leaving group after protonation of the alcohol.
- d) HBr would be more likely to promote rearrangement of the carbocation intermediate.

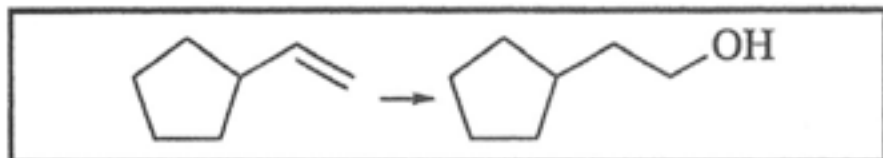
17) What would be the first step in the dehydration of cyclohexanol in sulfuric acid?

- a) loss of OH⁻
- b) loss of H⁺ by the alcohol
- c) formation of a sulfite ester
- d) protonation of the alcohol

Answer: 2, c, 11, b, 17, d.

Electrophilic Additions

7) which set of the reagents will carry out the conversion shown?

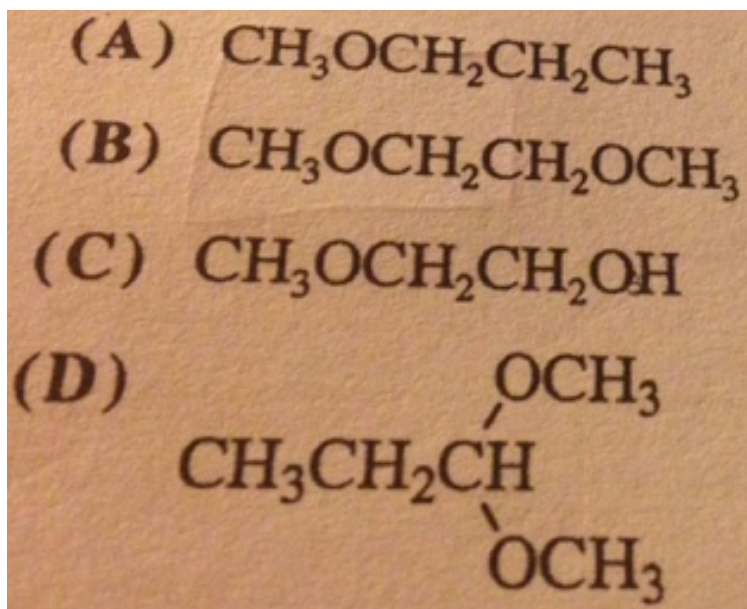


- (A) H_2O , peroxides
- (B) H_2O , H^+
- (C) B_2H_6 followed by H_2O_2 , NaOH
- (D) $\text{Hg}(\text{OAc})_2$, H_2O followed by NaBH_4

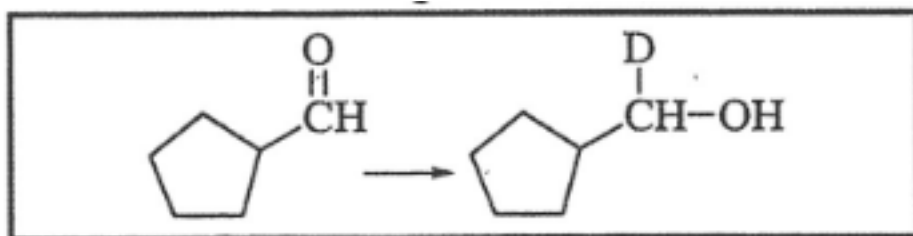
Answer: 7, c

Nucleophilic Addition at Carbonyl Groups

8) which compound would be most rapidly hydrolyzed by aqueous HC to give methanol as one of the products?

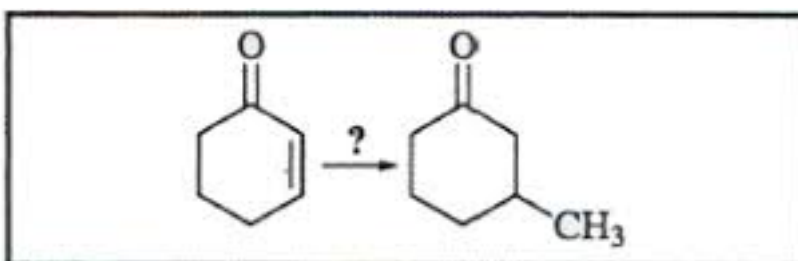


12) which is the best reagent for this conversion?



- (A) D_2O , containing catalytic amounts of HCl
- (B) NaBD_4 in $\text{CH}_3\text{CH}_2\text{OH}$ (and an aqueous workup)
- (C) NaOD in $\text{CH}_3\text{CH}_2\text{OD}$ (and an aqueous workup)
- (D) D_2O_2 in $\text{CH}_3\text{CO}_2\text{H}$

17) which reagent will accomplish the conversion shown?

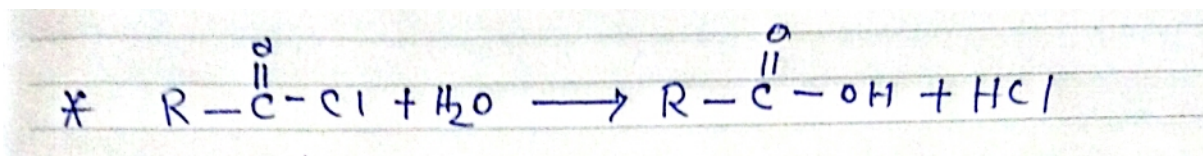


- (A) CH_3I
- (B) CH_3MgBr
- (C) CH_3Li
- (D) $(\text{CH}_3)_2\text{CuLi}$

Answer: 8, d, 12, b, 17, d.

Nucleophilic Substitution at Carbonyl Groups

1) This reaction that is typical of carboxylic acids, ester, acid halides, anhydrides, and amides is called.

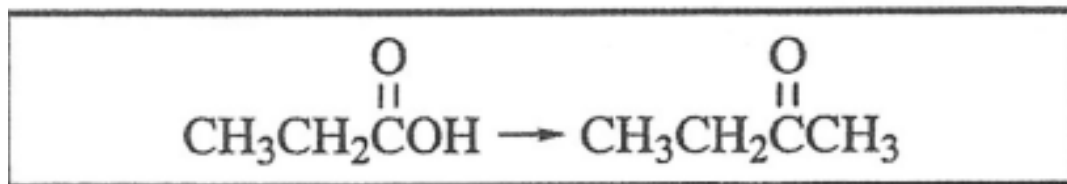


- (a) nucleophilic non-acyl substitution
- (b) nucleophilic addition
- (c) nucleophilic acyl substitution
- (d) electrophilic substitution

3) Which would be hydrolyzed most slowly with aqueous NaOH?

- (A) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{NHCH}_3$
- (B) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OCH}_3$
- (C) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
- (D) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl}$

13) Which reaction sequence is preferred for this conversion?



- (A) $\xrightarrow{\text{CH}_3\text{MgBr}} \xrightarrow[\text{H}^+]{\text{H}_2\text{O}}$
- (B) $\xrightarrow{\text{SOCl}_2} \xrightarrow{(\text{CH}_3)_2\text{CuLi}}$
- (C) $\xrightarrow{\text{SOCl}_2} \xrightarrow{\text{CH}_3\text{Li}} \xrightarrow[\text{H}^+]{\text{H}_2\text{O}}$
- (D) $\xrightarrow{\text{SOCl}_2} \xrightarrow{\text{CH}_3\text{MgBr}} \xrightarrow[\text{H}^+]{\text{H}_2\text{O}}$

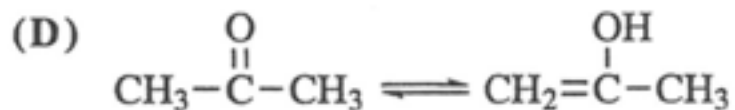
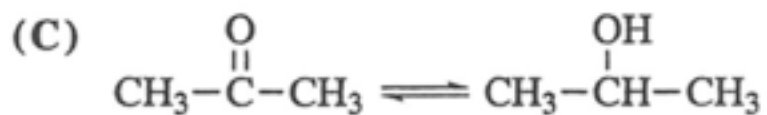
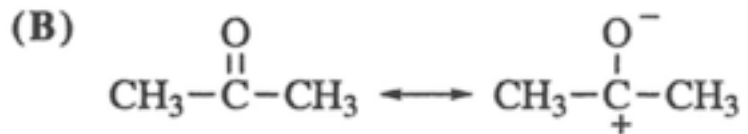
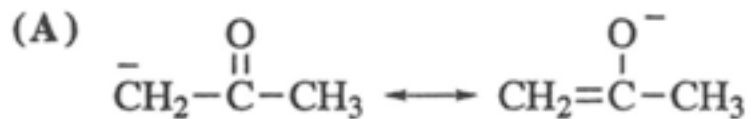
Answer: 1, c, 3, a, 13, b.

Enols and Enolate Ion Reactions pg. 97

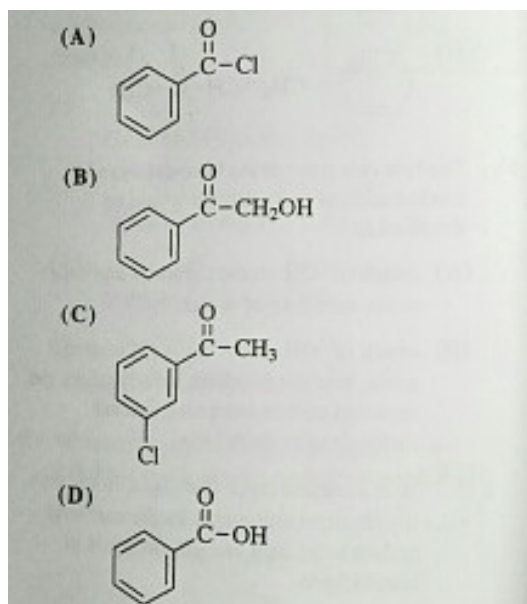
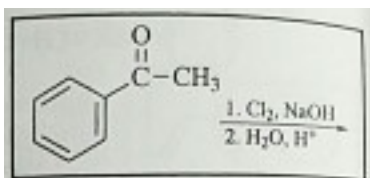
16) The first two steps in the base-catalyzed condensation of acetaldehyde would be described as:

- A) attack of OH^- on the carbonyl carbon atom, then loss of water.
- B) attack of OH^- on the carbonyl carbon atom, then the resultant anion attacks the carbonyl atom on a second molecule of acetaldehyde.
- C) OH^- abstracts an α -hydrogen, then the resultant anion attacks the carbonyl carbon atom on a second molecule acetaldehyde.
- D) OH^- abstracts the hydrogen atom from the carbonyl carbon, the then resultant anion attacks the carbonyl carbon atom on a second molecule of acetaldehyde.

20) Which represents a keto-enol tautomerization?



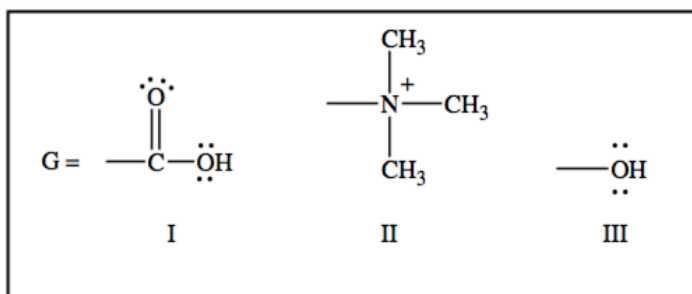
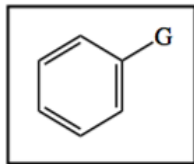
24) What is the product formed from this reaction?



Answer: 16, c; 20, d; 24, d.

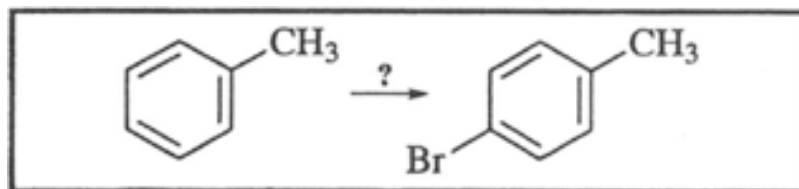
Electrophilic and Nucleophilic Aromatic Substitutions pg.114

1. Which substituents would deactivate benzene toward electrophilic aromatic substitution reaction?



- A) I, II, III B) I and II only
(C) II only D) I and III only

4. Which set of reagents would most likely bring about this transformation?

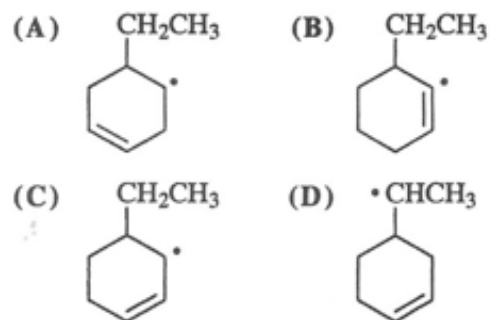


- (A) Br₂ with FeBr₃
(B) Br₂ in CCl₄
(C) Br₂ with UV light
(D) NaBr with H₂SO₄

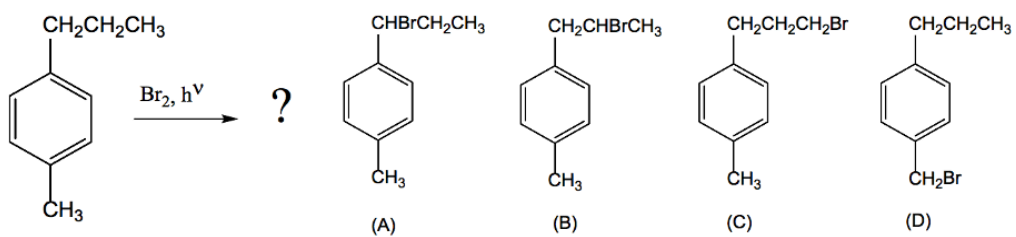
Answer: 1, b; 4, a.

Free-Radicals Substitution and Additions

1. Which radical is the least stable?



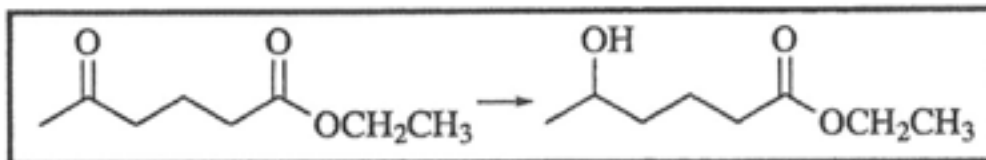
5. What is the expected product of this reaction?



Answer: 1, b; 5, c.

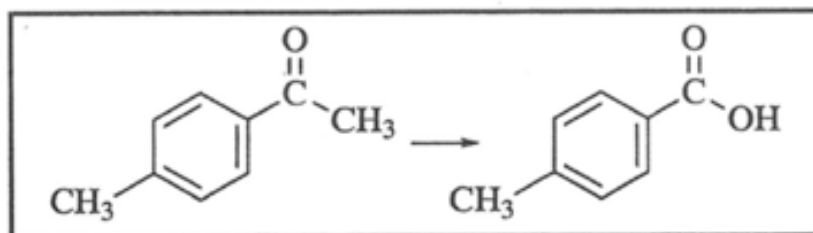
Oxydation and Reduction pg. 138

1. which reagents are best for carrying out this reaction?



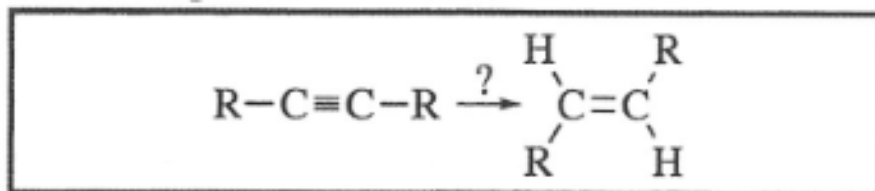
- (A) NaBH_4 , then H_3O^+
- (B) $\text{Zn}(\text{Hg})$, conc. HCl
- (C) LiAlH_4 , ether; then aqueous workup
- (D) NH_2NH_2 , KOH

3. Which reagents would best accomplish this transformation?



- (A) $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4$
- (B) KMnO_4 , KOH , then neutralization
- (C) I_2 , KOH , then neutralization
- (D) H_2O_2 , KOH , then neutralization

6. reduction of a triple bond to a E (trans) double bond can be accomplished with which set of reagents?

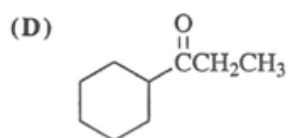
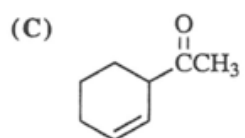
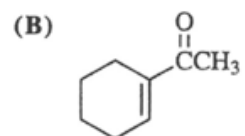
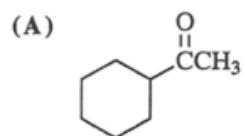


- (A) Na, NH₃
- (B) H₂, deactivated Pd
- (C) NaBH₄, methanol
- (D) NaH, then H₃O⁺

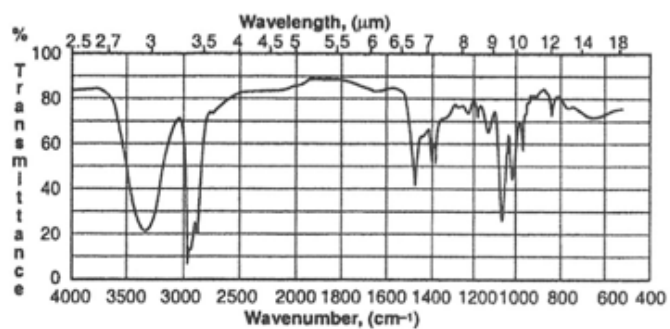
Answer: 1, a; 3, c; 6, a.

Spectroscopy

1. Which ketone will show a carbonyl absorption at the lower frequency (cm^{-1}) in the infrared?

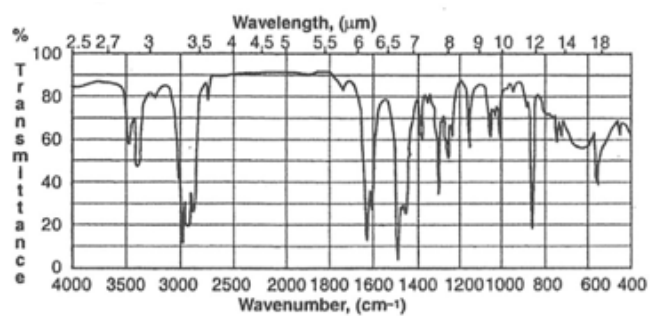


3. Which is the reasonable structure for a compared with this IR spectrum?



- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\overset{\text{O}}{\parallel}\text{CCH}_3$
- (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\overset{\text{O}}{\parallel}\text{CH}$
- (C) $\text{CH}_3\text{CH}_2\text{CH}_2\overset{\text{OH}}{\mid}\text{CHCH}_3$
- (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\overset{\text{O}}{\parallel}\text{COCH}_3$

5. Which structure is most consistent with this IR spectrum?



- (A) C1CCCCC1N
- (B) Nc1ccccc1
- (C) CNc1ccccc1
- (D) Cc1ccc(N)cc1

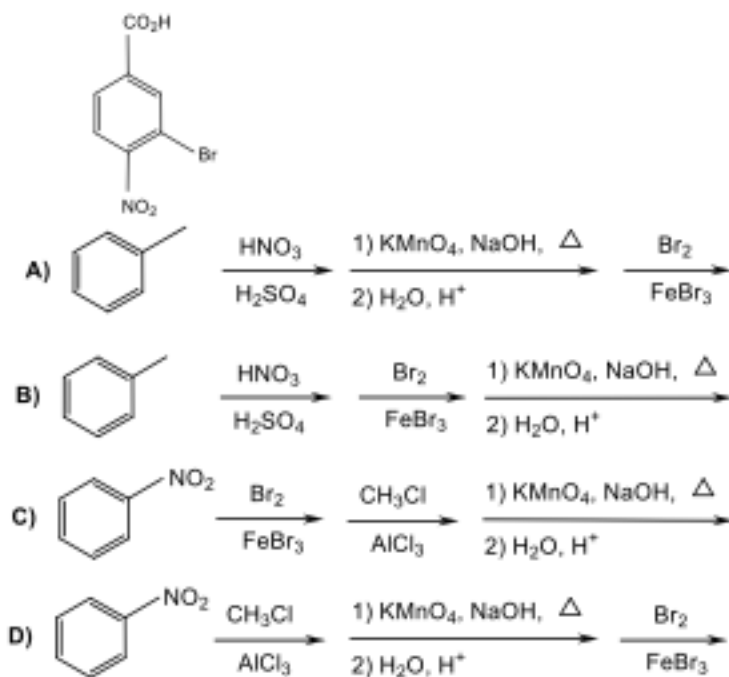
Answer: 1, b; 3, a; 5, d.

Synthesis and Qualitative Analysis

12. Which would be a suitable solvent for the preparation of ethyl-magnesium bromide from ethyl bromide and magnesium?

- a) $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$
- b) $\text{CH}_3\text{CH}_2\text{OH}$
- c) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$
- d) $\text{CH}_3\text{CO}_2\text{H}$

14. Which reaction sequence might be used to synthesize this compound?



Answer: 12, c; 14, a.