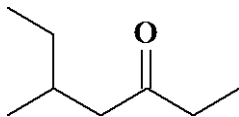
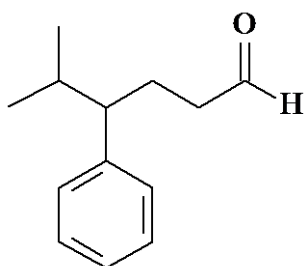


# ACS Review Aldehydes and Ketones - Nucleophilic Addition to the Carbonyl Group

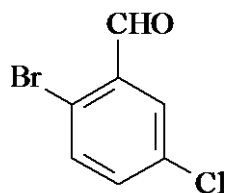
1. What is the IUPAC name of the following compound?



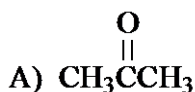
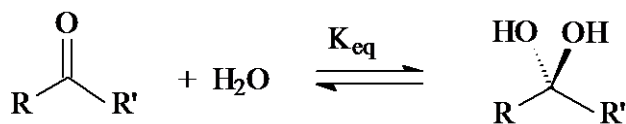
- A. 3-methyl-5-heptanone  
B. 5-ethyl-3-hexanone  
C. 5-methyl-3-heptanone  
D. 2-ethyl-4-hexanone
2. Identify the correct IUPAC name of the compound below.

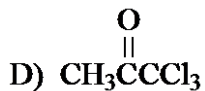
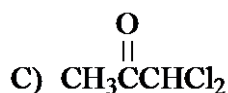
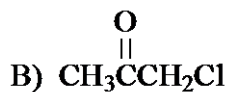


- A. 4-benzyl-5-methylhexanal  
B. 5-isopropyl-5-phenylbutanal  
C. 2-methyl-3-phenylhexanal  
D. 5-methyl-4-phenylhexanal
3. Which of the following is an acceptable IUPAC name for the compound below?



- A. *o*-bromo-*m*-chlorobenzaldehyde  
B. 6-bromo-3-chlorobenzaldehyde  
C. 2-bromo-5-chlorobenzaldehyde  
D. 1-bromo-4-chlorobenzaldehyde
4. Which of the following has the largest  $K_{eq}$  for the formation of the hydrate (as shown below)?





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

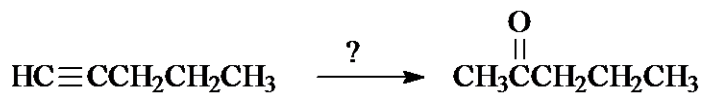
5. The carbon-oxygen  $\pi$  bond of an aldehyde is formed by overlap of which two orbitals?

- A. sp-sp  
B.  $\text{sp}^2\text{-sp}^2$   
C.  $\text{sp}^2\text{-2p}$   
D. 2p-2p

6. Which of the reagents below will oxidize a secondary alcohol to a ketone?

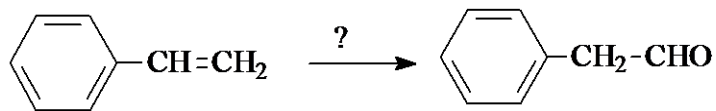
- A.  $\text{LiAlH}_4$   
B.  $\text{HIO}_4$   
C.  $\text{K}_2\text{Cr}_2\text{O}_7, \text{H}_2\text{SO}_4/\text{H}_2\text{O}$   
D.  $\text{HgSO}_4, \text{H}_2\text{SO}_4/\text{H}_2\text{O}$

7. Identify the reagents needed to carry out the following conversion.



- A.  $\text{H}_2/\text{Lindlar Pd}$  followed by  $\text{H}_2\text{SO}_4/\text{H}_2\text{O}$   
B.  $\text{O}_3$  followed by  $\text{H}_2\text{O}$   
C.  $\text{H}_2\text{O}, \text{HgSO}_4/\text{H}_2\text{SO}_4$   
D.  $\text{LiAlH}_4$  followed by  $\text{H}_2\text{O}$

8. Which one of the following works best as the reaction steps to carry out the conversion below?



A) (1)  $\text{Br}_2$  (2)  $\text{NaNH}_2(\text{xs})$  (3)  $\text{H}_2\text{O}, \text{HgSO}_4/\text{H}_2\text{SO}_4$

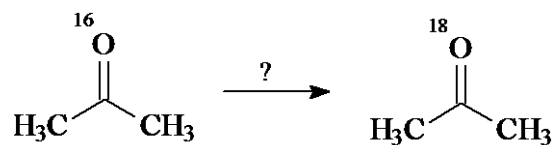
B) (1)  $\text{B}_2\text{H}_6/\text{diglyme}$  (2)  $\text{H}_2\text{O}_2, \text{NaOH}$  (3)  $\text{PCC}/\text{CH}_2\text{Cl}_2$

C) (1)  $\text{H}_2\text{O}, \text{H}_2\text{SO}_4$  (2)  $\text{CrO}_3/\text{H}_2\text{SO}_4$

D) (1)  $\text{CH}_3\overset{\text{O}}{\parallel}\text{COOH}$  (2)  $\text{NaOH}, \text{H}_2\text{O}$

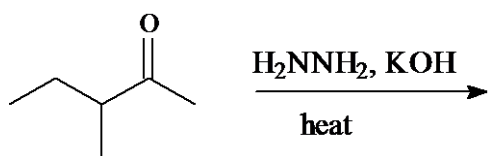
- A. A
- B. B
- C. C
- D. D

9. Which of the following reagents would carry out the isotopic substitution reaction shown below?



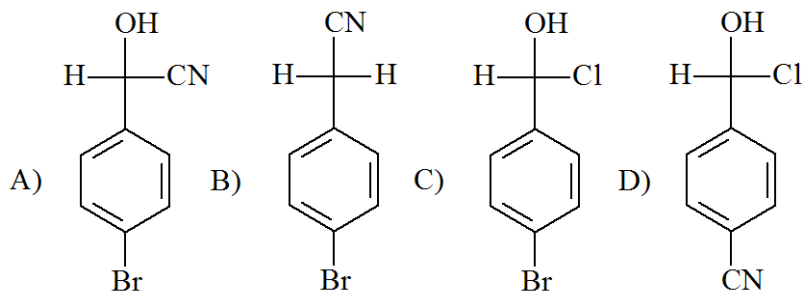
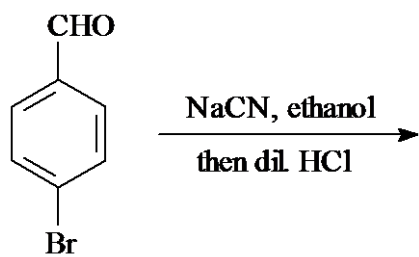
- A.  $^{18}\text{O}_2/\text{Ni}$  (cat.)
- B.  $\text{H}_2^{18}\text{O}/\text{HCl}$  (cat.)
- C.  $\text{Cr}^{18}\text{O}_3/\text{pyridine}$
- D.  $^{18}\text{O}_3$

10. What is the product of the following reaction?



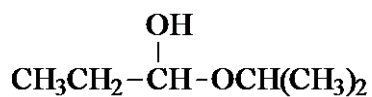
- A. 3-methylpentane
- B. 3-methyl-2-pentanol
- C. 3-methyl-2-pentene
- D. 3-methyl-1-pentyne

11. What is the product of the reaction below?

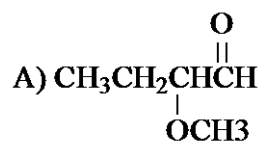


- A. A
- B. B
- C. C
- D. D

12. The compound shown below is the hemiacetal formed between:

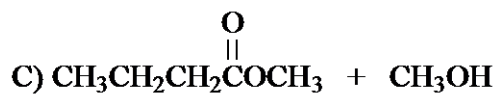
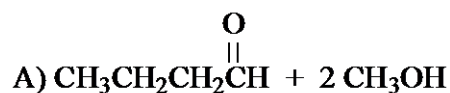


- A. propanal and 2-propanol
  - B. 2-methylpropanal and ethanol
  - C. acetone and 1-propanol
  - D. ethanal and 2-methyl-1-propanol
13. What is the product of the reaction of butanal with excess methanol and catalytic sulfuric acid?



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

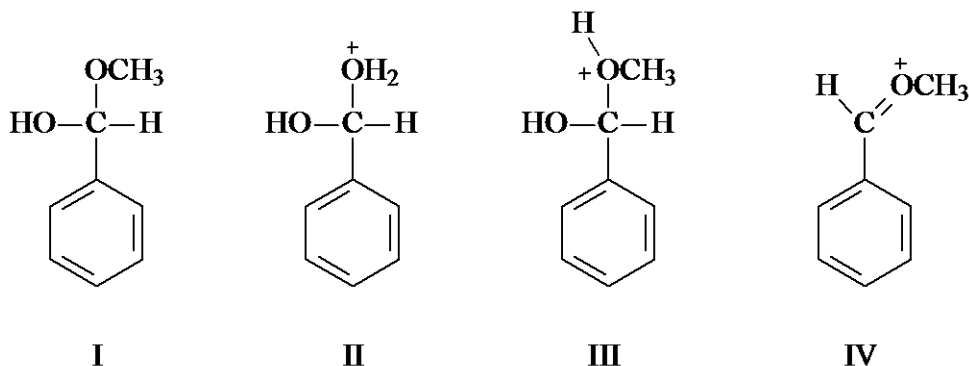
14. Identify the products of the hydrolysis of the following compound.





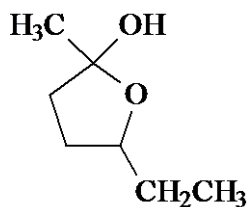
- A. A
- B. B
- C. C
- D. D

15. Which one of the following is not an intermediate in the acid-catalyzed reaction of benzaldehyde with 2 equivalents of methanol to give benzaldehyde dimethyl acetal?



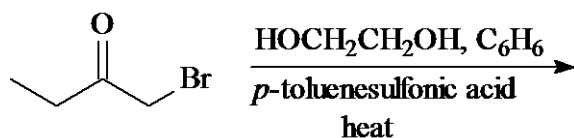
- A. I
- B. II
- C. III
- D. IV

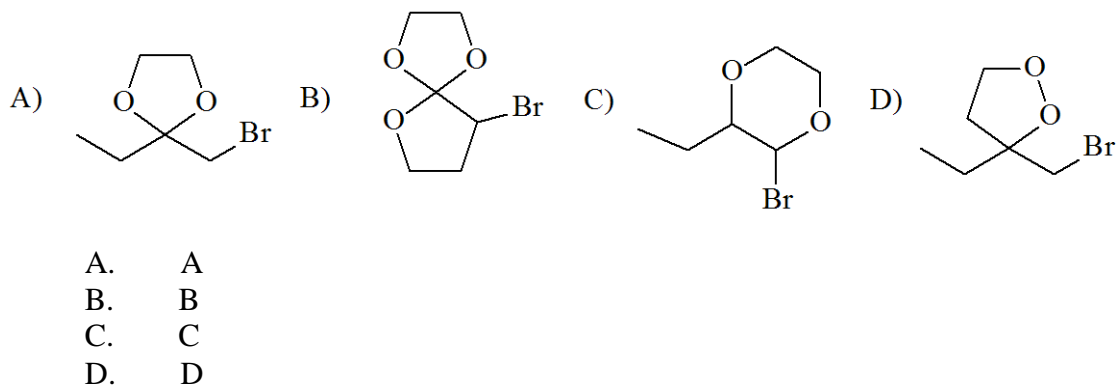
16. The compound shown below is the cyclic hemiacetal of:



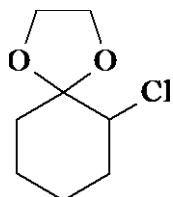
- A. 5-hydroxyheptanal
- B. 5-hydroxy-2-heptanone
- C. 6-hydroxy-3-heptanone
- D. 6-hydroxyheptanal

17. What is the product of the reaction shown?



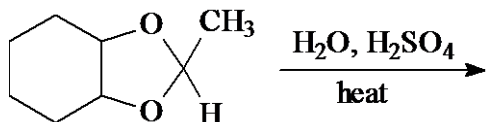


18. Acid-catalyzed hydrolysis of the cyclic acetal below gives:



- A. ethanal and 2-chlorocyclohexanol  
B. 1,2-ethanediol and 2-chlorocyclohexanol  
C. ethanol and 2-chlorocyclohexanol  
D. 1,2-ethanediol and 2-chlorocyclohexanone

19. What are the products of the following reaction?

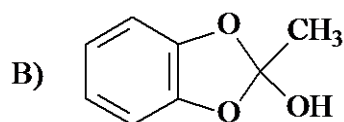
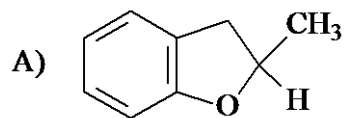


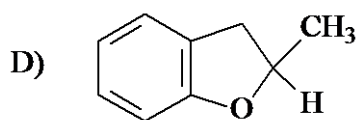
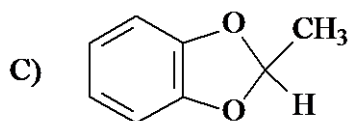
- A. cyclohexanone and ethanol  
B. cyclohexanone and ethanal  
C. 1,2-cyclohexanediol and ethanal  
D. 1,2-cyclohexanediol and ethanol

20. The acid-catalyzed reaction of propanal with 2 equivalents of methanol forms an acetal. This can mechanistically be thought of as:

- A. an addition reaction followed by a substitution reaction  
B. a substitution reaction followed by an addition reaction  
C. an elimination reaction followed by a substitution reaction  
D. an addition reaction followed by an elimination reaction

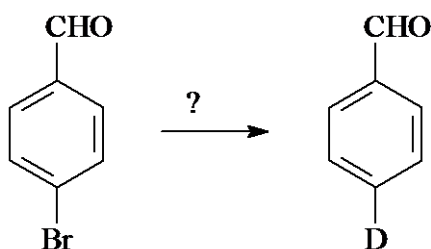
21. Which one of the following gives ethanal,  $\text{CH}_3\text{CH}=\text{O}$ , (as one of two products) when added to an aqueous solution of HCl?





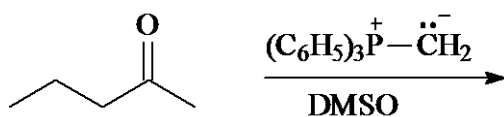
- A. A  
B. B  
C. C  
D. D

22. Which synthetic method below correctly does the following conversion?



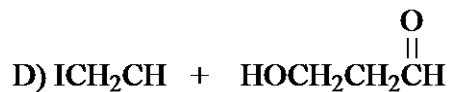
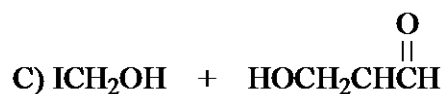
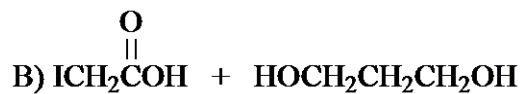
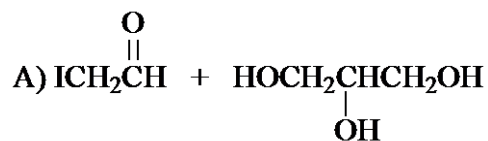
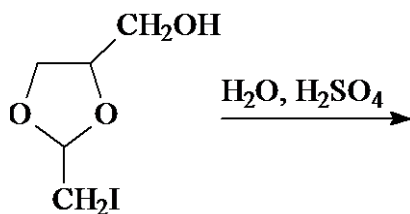
- A) (1) Mg, diethyl ether      (2) D<sub>2</sub>O  
B) (1) LiAlD<sub>4</sub>, diethyl ether      (2) D<sub>2</sub>O  
C) (1) HOCH<sub>2</sub>CH<sub>2</sub>OH, H<sup>+</sup>      (2) Mg, diethyl ether      (3) D<sub>2</sub>O      (4) H<sub>2</sub>O, H<sup>+</sup>  
D) (1) HOCH<sub>2</sub>CH<sub>2</sub>OH, H<sup>+</sup>      (2) DCl      (3) H<sub>2</sub>O, H<sup>+</sup>
- A. A  
B. B  
C. C  
D. D

23. What is the product of the reaction below?



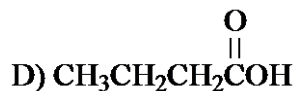
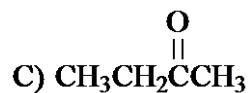
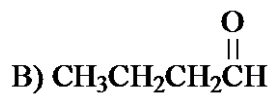
- A. 2-methyl-1-pentene  
B. 2-methyl-2-propyloxirane  
C. 4-methyl-1-pentene  
D. 1-pentene

24. Domiodol, shown below, is used medicinally as a mucolytic agent. What are the acid-catalyzed hydrolysis products of Domiodol?



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

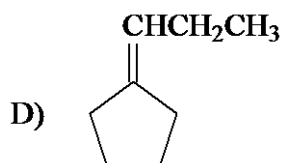
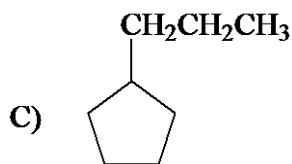
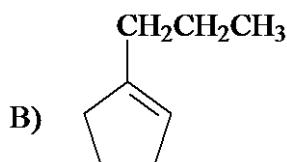
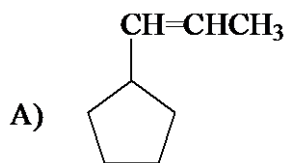
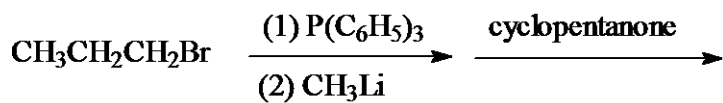
25. Which of the following reacts with  $(\text{CH}_3\text{CH}_2)_2\text{NH}$  to give the compound shown below?



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

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



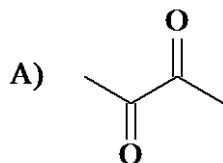
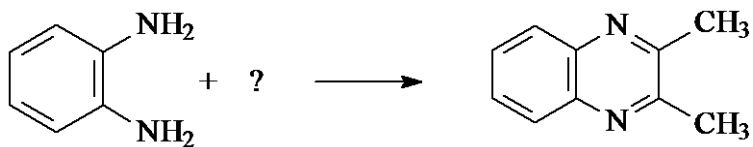


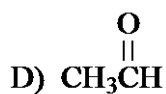
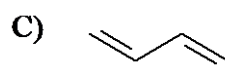
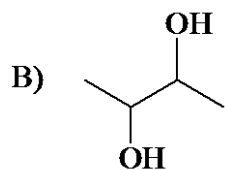
- A. A  
B. B  
C. C  
D. D

27. Baeyer-Villiger oxidation reactions can use peroxycarboxylic acids to convert ketones to:

- A. carboxylic acids  
B. esters  
C. epoxides  
D.  $\alpha$ -hydroxy ketones

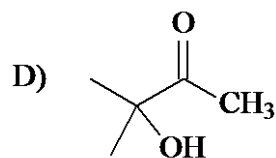
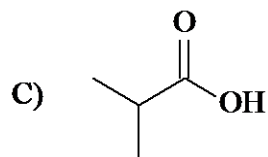
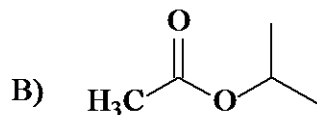
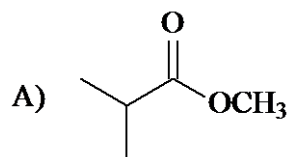
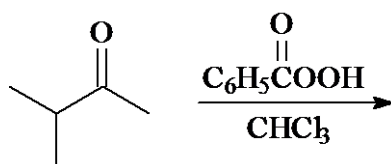
28. Identify the missing reagent for the reaction below.





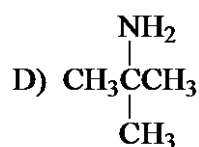
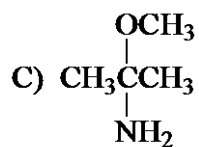
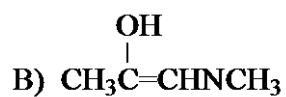
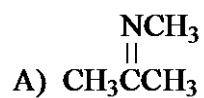
- A. A  
B. B  
C. C  
D. D

29. What is the product of the following Baeyer-Villiger oxidation reaction?



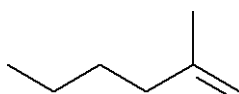
- A. A  
B. B  
C. C  
D. D

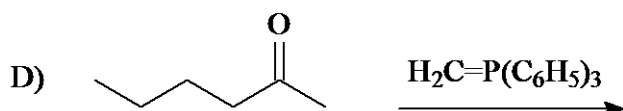
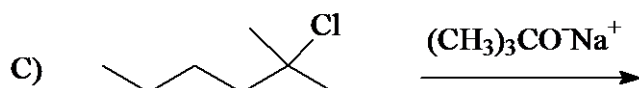
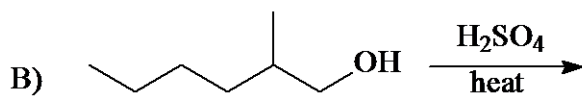
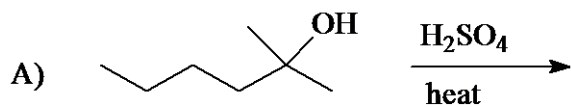
30. Which of the following is the product of the reaction between acetone,  $\text{CH}_3\text{COCH}_3$ , and methylamine,  $\text{CH}_3\text{NH}_2$ ?



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

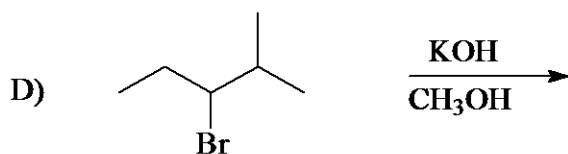
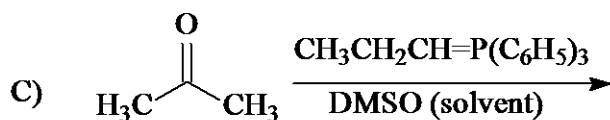
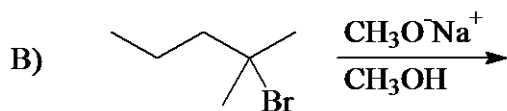
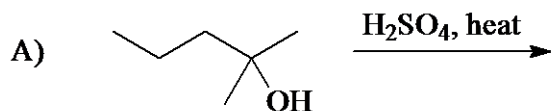
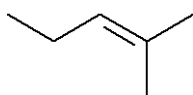
31. Which of the following reacts with methylamine at the fastest rate?
- A. 1-pentene  
B. pentanal  
C. 2-pentanone  
D. 3-pentanone
32. Which of the following gives the greatest percentage of hydrate (*gem*-diol) when dissolved in water?
- A. butanal  
B. 2,2-dichlorobutanal  
C. 3,3-dichlorobutanal  
D. 4,4-dichlorobutanal
33. Which of the following methods can be used to synthesize 2-methyl-1-hexene, shown below, with no formation of isomeric by-products?





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

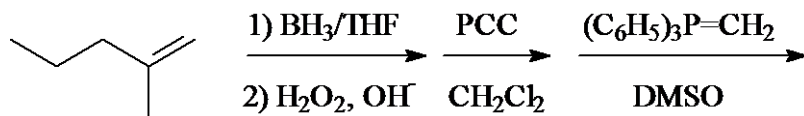
34. Which of the following is the best method to synthesize 2-methyl-3-pentene, shown below, with little or no by-product formation?



- A. A  
B. B  
C. C

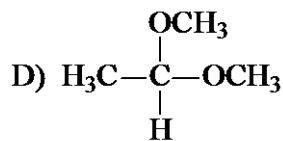
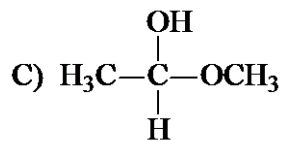
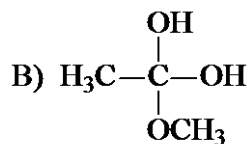
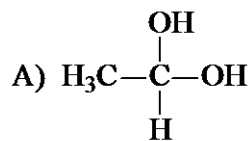
D. D

35. What is the product of the reaction sequence below?



- A. 2-methyl-1-hexene
- B. 2,3-dimethyl-2-pentene
- C. 2-methyl-2-hexene
- D. 3-methyl-1-hexene

36. Which of the following is a hemiacetal?



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

# ACS Review Aldehydes and Ketones - Nucleophilic Addition to the Carbonyl Group KEY

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