

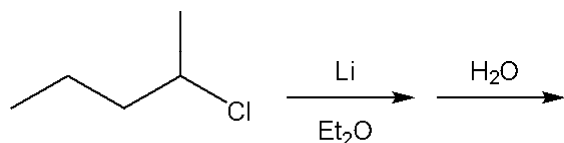
N_HW1

N_HW1

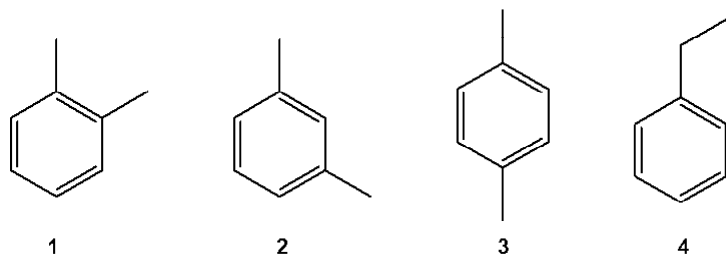
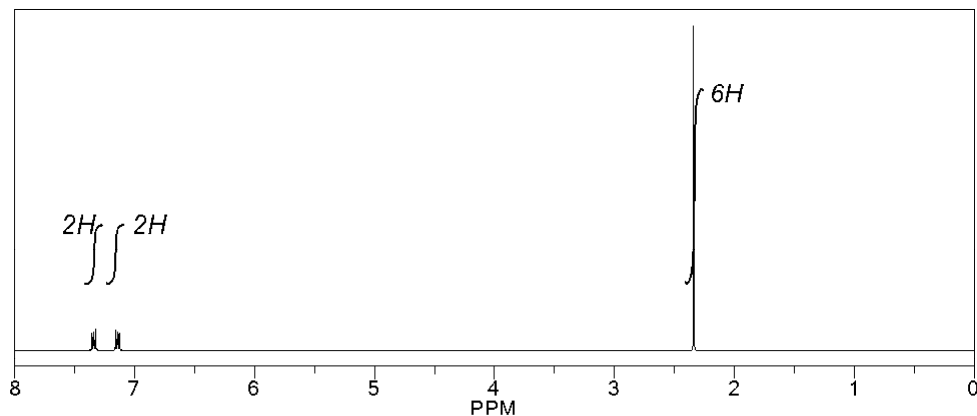
Multiple Choice

Identify the choice that best completes the statement or answers the question. There is only one correct response for each question.

1. What is the **purpose** of the H₂O in this sequence?

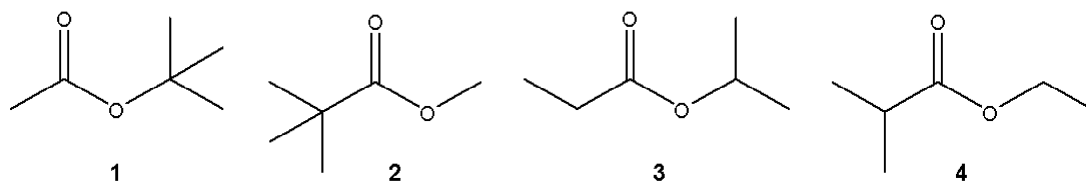
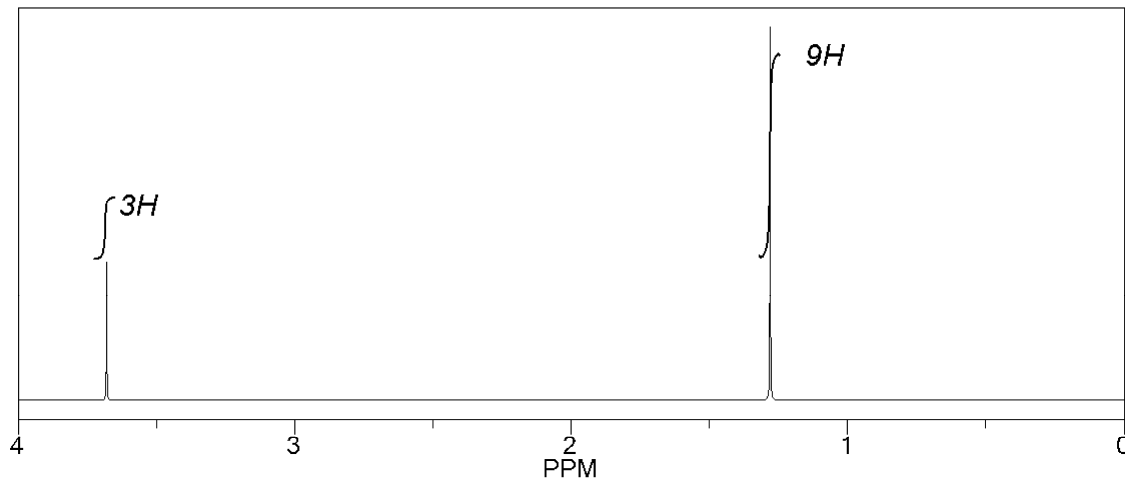


- a. To form the alcohol product
 - b. To dissolve the lithium metal
 - c. To hydrolyze the lithium carbon bond
 - d. To dissolve the ether
2. Which C₈H₁₀ compound gives the following ¹H NMR spectrum?



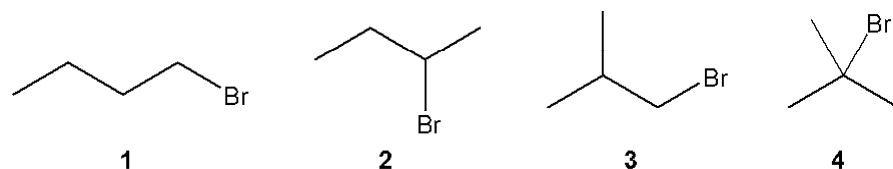
- a. **1**
- b. **2**
- c. **3**
- d. **4**

3. Which $C_6H_{12}O_2$ compound gives the following 1H NMR spectrum?



- a. **1**
- b. **2**
- c. **3**
- d. **4**

4. Which C_4H_9Br compound gives a doublet at approximately 3.3 ppm in the 1H NMR spectrum?

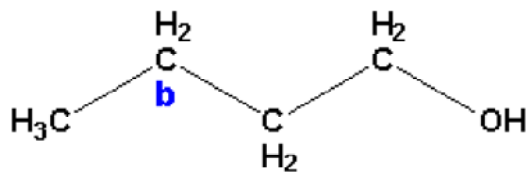


- a. **1**
- b. **2**
- c. **3**
- d. **4**

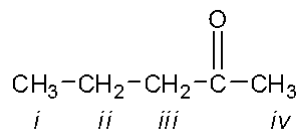
5. Which feature in the 1H NMR spectrum provides information about the relative number of each type of proton in a compound?

- a. number of signals
- b. integral
- c. splitting
- d. chemical shift

6. The multiplicity of protons "b" are:

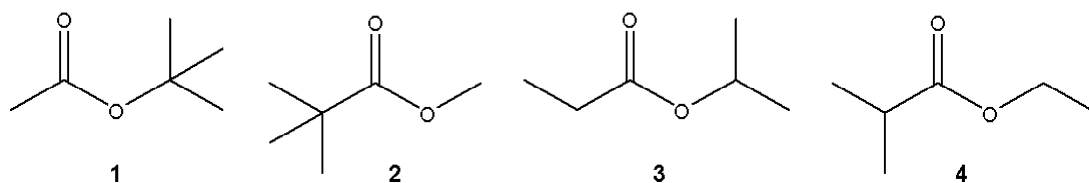
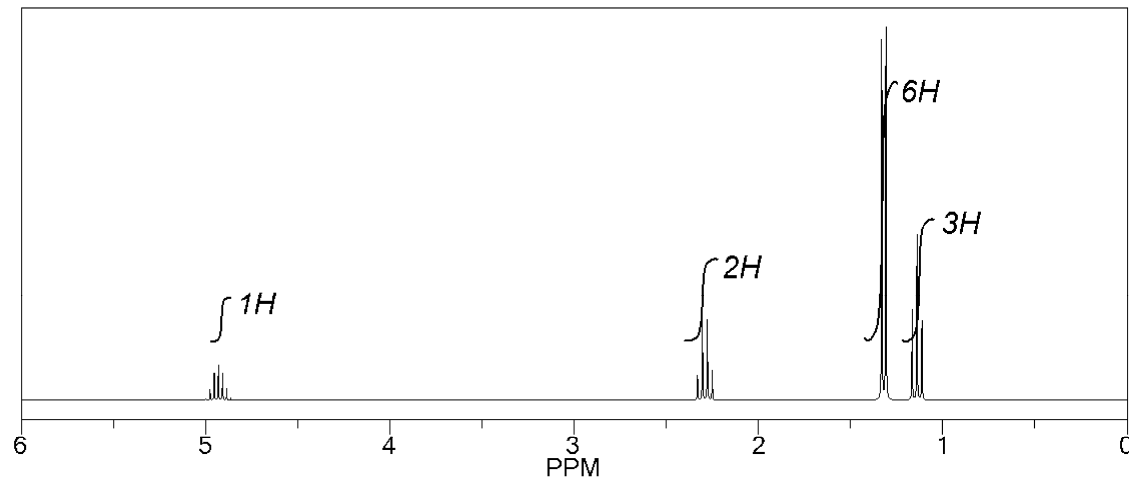


- a. sextet
 - b. pentet
 - c. triplet of triplets
 - d. triplet of quartets
7. Which feature in the ^1H NMR spectrum provides information about the number of types of different protons in a compound?
- a. number of signals
 - b. integral
 - c. splitting
 - d. chemical shift
8. What is the splitting of the signal in the ^1H NMR spectrum for the methyl protons of ethane?
- a. singlet
 - b. doublet
 - c. triplet
 - d. quartet
9. Which of the protons in the following molecule appear at the highest δ -value in the ^1H NMR spectrum?



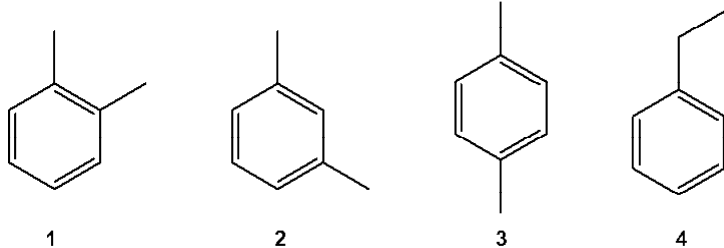
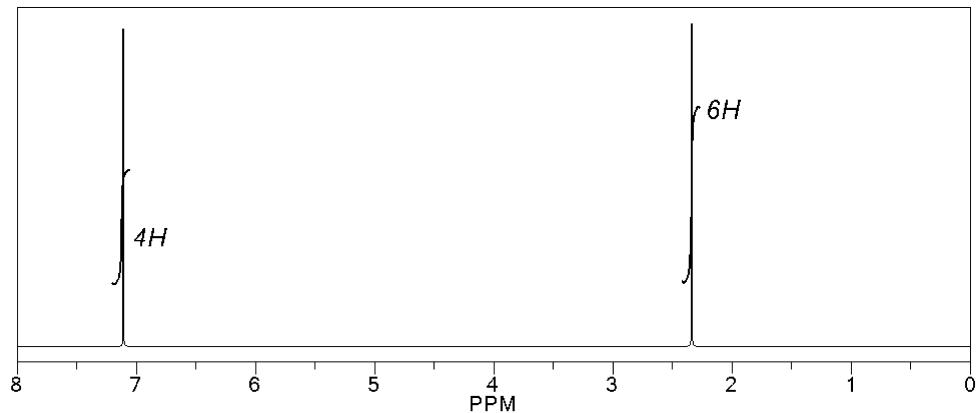
- a. *i*
- b. *ii*
- c. *iii*
- d. *iv*

10. Which $C_6H_{12}O_2$ compound gives the following 1H NMR spectrum?



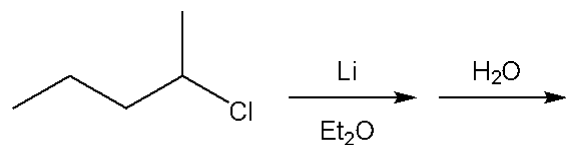
- a. **1**
 b. **2**
 c. **3**
 d. **4**
11. What is the splitting of the signal in the 1H NMR spectrum for the methyl protons of 1-bromo-2-methylpropane?
- a. singlet
 b. doublet
 c. triplet
 d. nonet
12. Which of the following compounds gives a 1H NMR spectrum consisting of only a singlet?
- a. 1,1-dibromopropane
 b. 1,2-dibromopropane
 c. 1,3-dibromopropane
 d. 2,2-dibromopropane
13. Which of the following combinations of peaks appears in the 1H NMR spectrum of diethyl ether, $CH_3CH_2OCH_2CH_3$?
- a. a triplet and a doublet
 b. a quartet and a sextet
 c. two singlets
 d. a triplet and a quartet

14. Which C_8H_{10} compound gives the following 1H NMR spectrum?



- a. **1**
- b. **2**
- c. **3**
- d. **4**

15. What is the **major** organic product obtained from the following sequence of reactions?

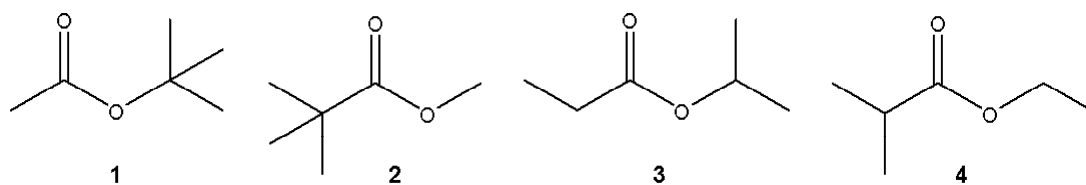
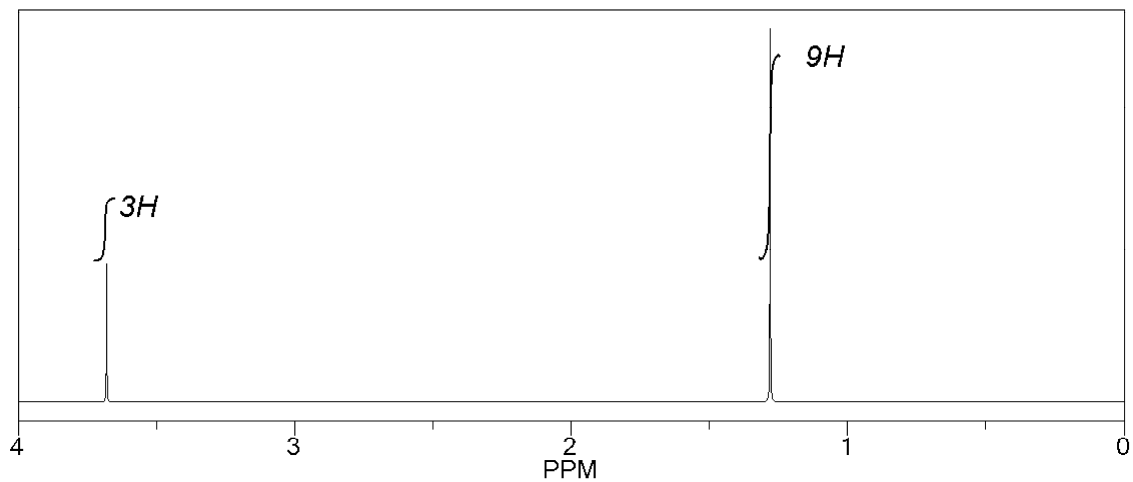


- a. 2-pentanol
- b. pentane
- c. 1-pentene
- d. (*E*)-2-pentene

16. What is the hydrogen deficiency index for a compound with a molecular formula of $C_{12}H_{16}O$?

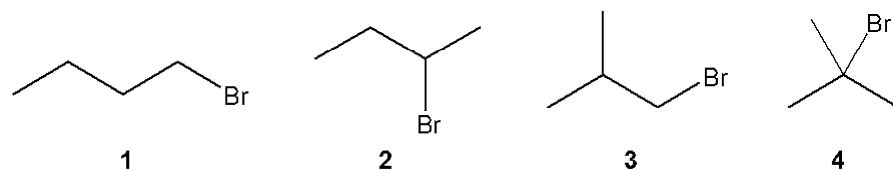
- a. 2
- b. 4
- c. 5
- d. 6

17. Which $C_6H_{12}O_2$ compound gives the following 1H NMR spectrum?



- a. 1
- b. 2
- c. 3
- d. 4

18. Which C_4H_9Br compound gives a singlet at approximately 1.8 ppm in the 1H NMR spectrum?

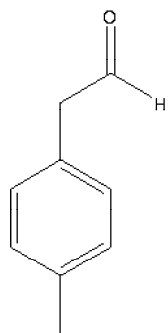
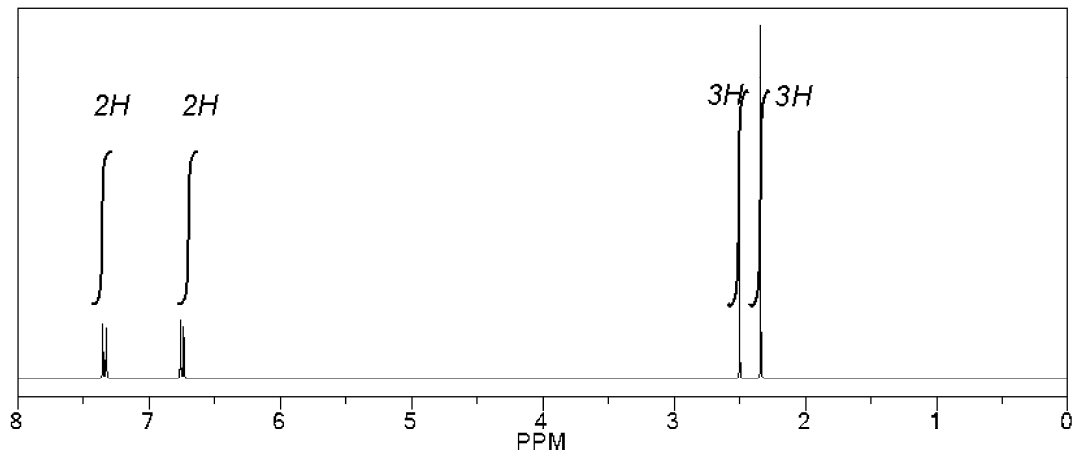


- a. 1
- b. 2
- c. 3
- d. 4

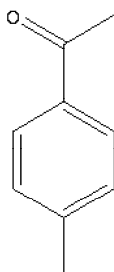
19. How many sets of equivalent protons are there in hexane?

- a. 2
- b. 3
- c. 6
- d. 7

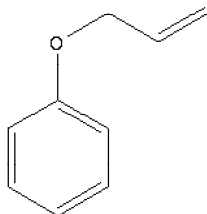
20. Which C₉H₁₀O compound gives the following ¹H NMR spectrum?



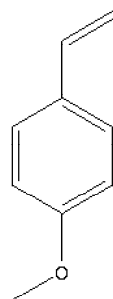
1



2



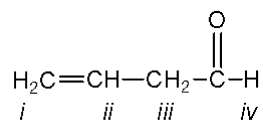
3



4

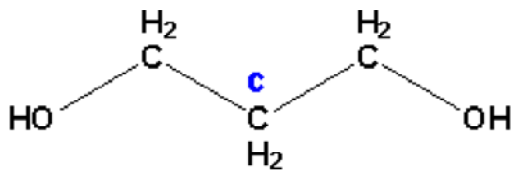
- a. 1
- b. 2
- c. 3
- d. 4

21. Which of the protons in the following molecule appear at the highest δ -value in the ¹H NMR spectrum?



- a. *i*
- b. *ii*
- c. *iii*
- d. *iv*

22. The multiplicity of protons "c" are:



- a. sextet
 - b. pentet
 - c. triplet of triplets
 - d. triplet of quartets
23. Which feature in the ¹H NMR spectrum provides information about the number of neighboring protons of each proton in the compound?
- a. number of signals
 - b. integral
 - c. multiplicity
 - d. chemical shift
24. Which of the following bonds has the **most** ionic character?
- a. C–Si
 - b. C–Cu
 - c. C–Zn
 - d. C–Li
25. Which of the following is the **best choice of solvent** for the formation of phenylmagnesium bromide by the reaction of bromobenzene with magnesium?
- a. water
 - b. methanol
 - c. diethyl ether
 - d. acetic acid

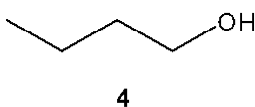
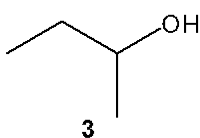
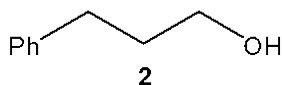
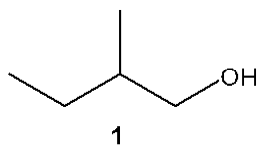
N_HW2

N_HW2

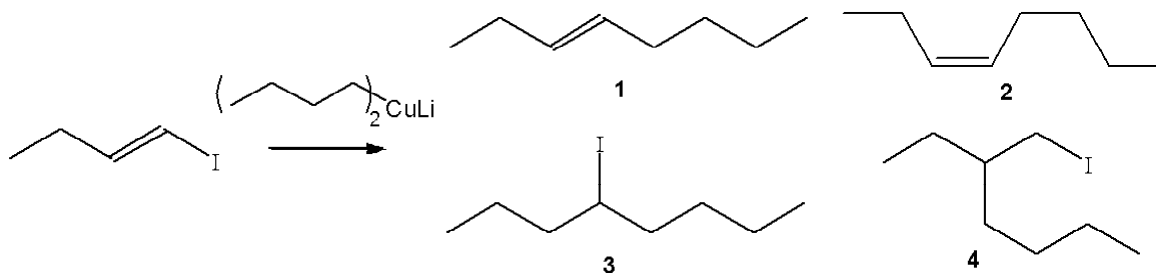
Multiple Choice

Identify the choice that best completes the statement or answers the question. There is only one correct response for each question.

1. Which of the following alcohols can be prepared from a Grignard reagent and ethylene oxide?

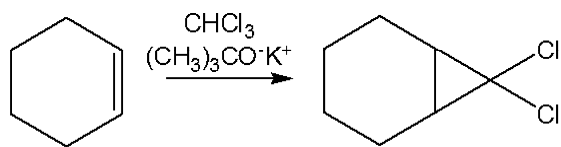


- a. only 1 and 2
b. only 1 and 4
c. only 1, 2 and 3
d. only 2 and 4
2. What is the major organic product obtained from the following reaction?



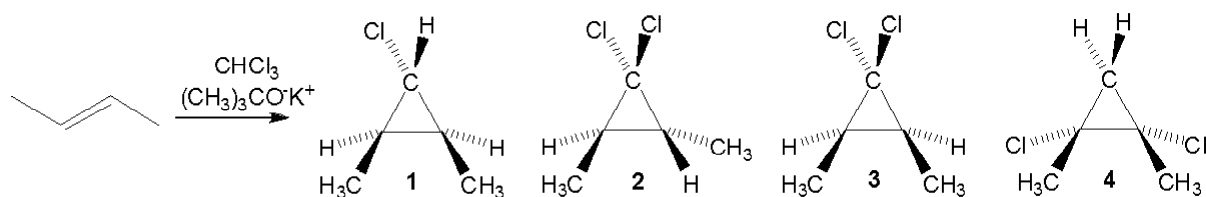
- a. 1
b. 2
c. 3
d. 4

3. What reactive intermediates are involved in the following reaction?



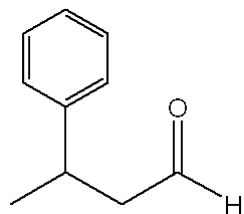
- the trichloromethyl anion (Cl_3C^-) and dichlorocarbene ($\text{Cl}_2\text{C}:$)
- the trichloromethyl cation (Cl_3C^+)
- the cyclohexyl carbocation
- the cyclic chloronium ion derived from cyclohexene

4. What is the major organic product obtained from the following reaction?



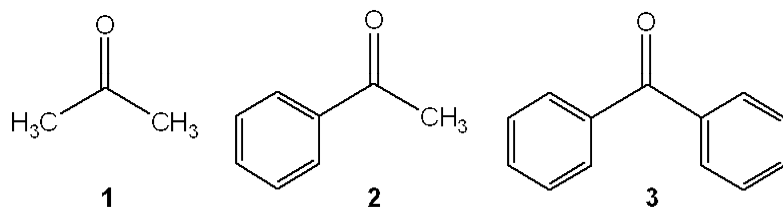
- 1
- 2
- 3
- 4

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



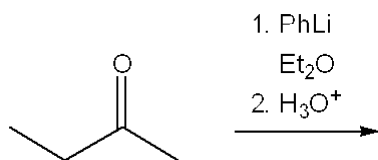
- 3-methyl-3-phenylpropanol
- 3-phenylbutanal
- 3-phenyl-1-butanone
- 3-phenylbutanoic acid

6. What is the correct assignment of the names of the following ketones?



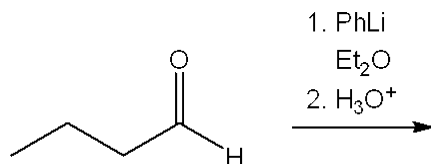
- a. **1** = acetone; **2** = phenol; **3** = benzaldehyde
- b. **1** = acetone; **2** = acetophenone; **3** = benzophenone
- c. **1** = formaldehyde; **2** = benzaldehyde; **3** = acetophenone
- d. **1** = acetaldehyde; **2** = acetophenone; **3** = benzaldehyde

7. What is the major organic product obtained from the following reaction?



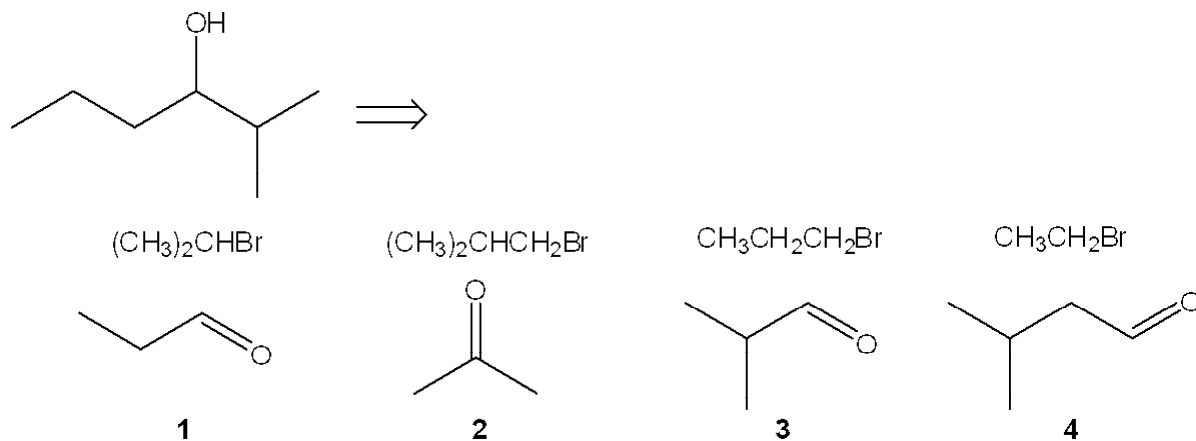
- a. 2-phenyl-2-butanol
- b. 3-phenyl-2-butanol
- c. 3-phenylbutanone
- d. propiophenone, PhCOCH₂CH₃

8. What is the major organic product obtained from the following reaction?



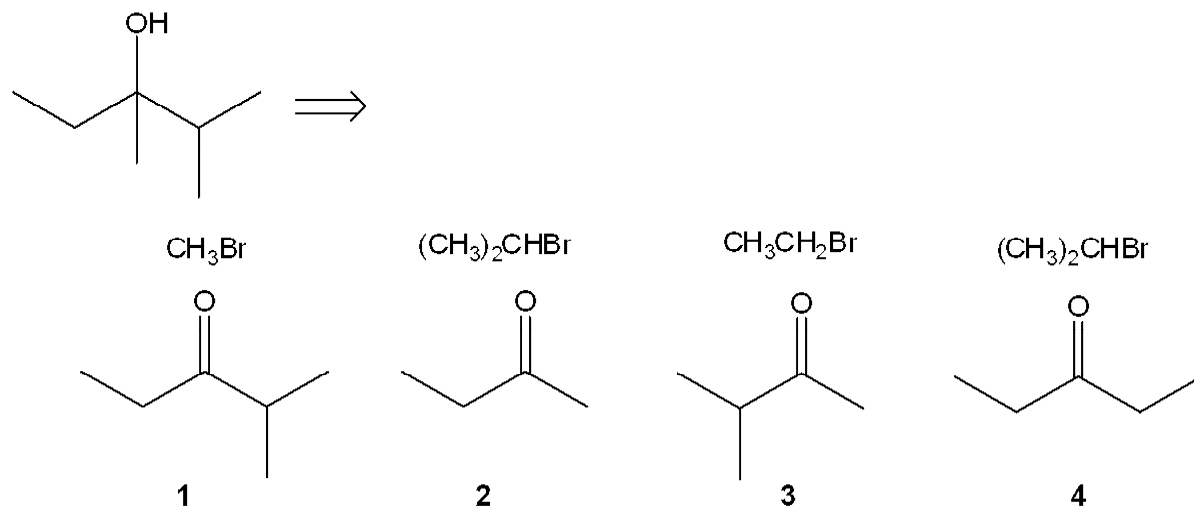
- a. 1-phenyl-1-butanol
- b. 1-phenyl-2-butanol
- c. 2-phenyl-1-butanol
- d. butyrophenone, PhCOCH₂CH₂CH₃

9. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?



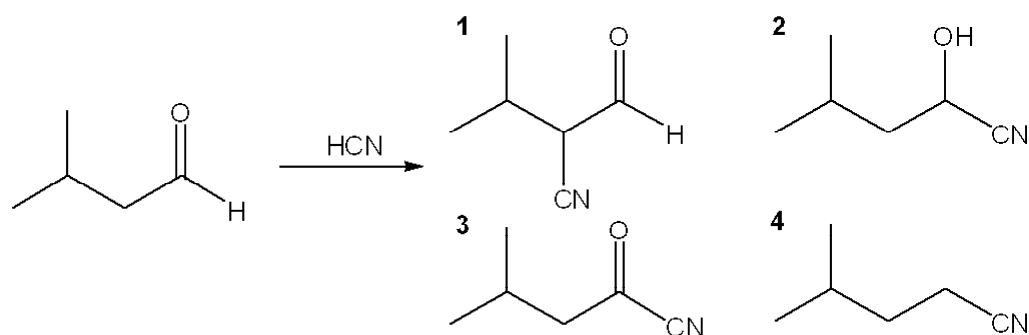
- a. only **1**
 b. only **3**
 c. only **1** and **3**
 d. only **2** and **4**

10. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?



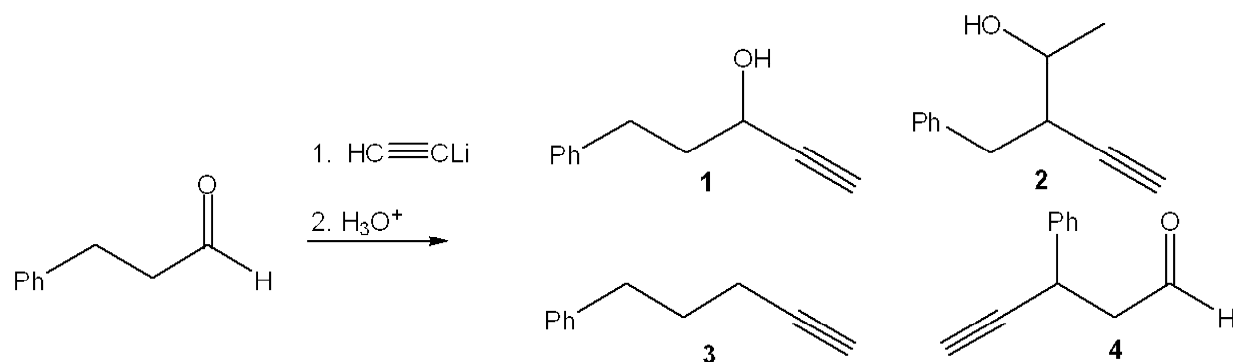
- a. only **1** and **2**
 b. only **3** and **4**
 c. only **2** and **3**
 d. only **1**, **2** and **3**

11. What is the major organic product obtained from the following reaction?



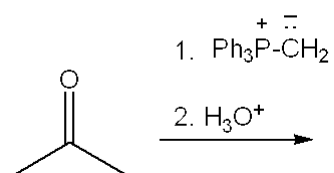
- a. **1**
- b. **2**
- c. **3**
- d. **4**

12. What is the major organic product obtained from the following reaction?



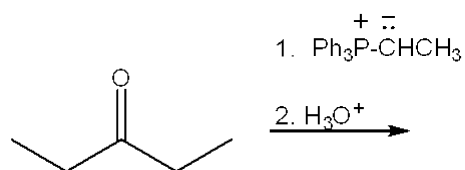
- a. **1**
- b. **2**
- c. **3**
- d. **4**

13. What is the major organic product obtained from the following reaction?



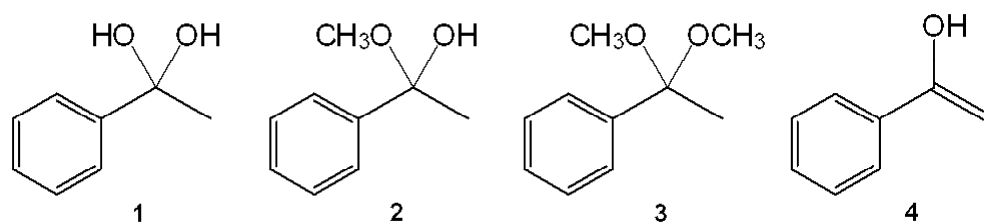
- a. 1-butene
- b. 2-butene
- c. 2-methylpropene
- d. 2-methyl-1-propanol

14. What is the major organic product obtained from the following reaction?



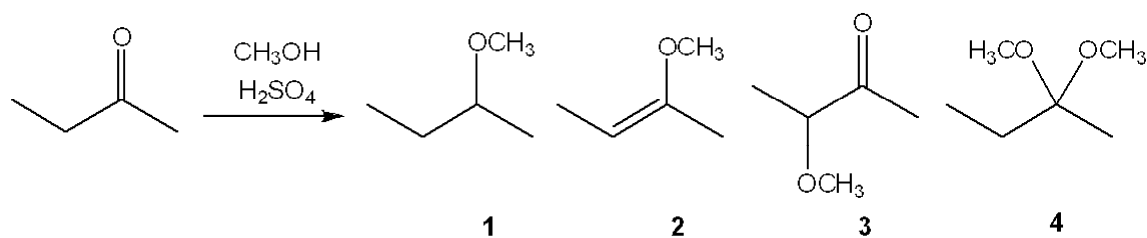
- 2-methyl-2-heptene
- 3-ethyl-2-pentene
- (*Z*) 2-methyl-3-heptene
- (*E*) 2-methyl-3-heptene

15. What is the correct assignment of the names of the following functional groups?



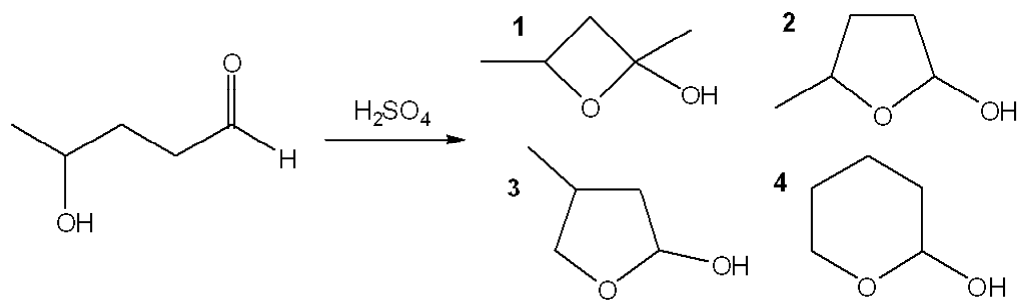
- 1 = enol; 2 = hydrate; 3 = acetal; 4 = hemiacetal
- 1 = acetal; 2 = hydrate; 3 = enol; 4 = hemiacetal
- 1 = hydrate; 2 = hemiacetal; 3 = acetal; 4 = enol
- 1 = enol; 2 = hydrate; 3 = hemiacetal; 4 = enol

16. What is the major organic product obtained from the following reaction?



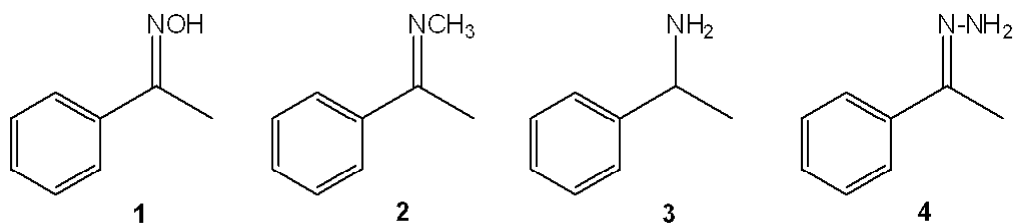
- 1
- 2
- 3
- 4

17. What is the major organic product obtained from the following reaction?



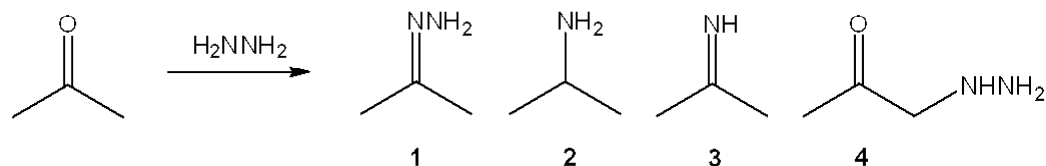
- 1
- 2
- 3
- 4

18. What is the correct assignment of the names of the following functional groups?



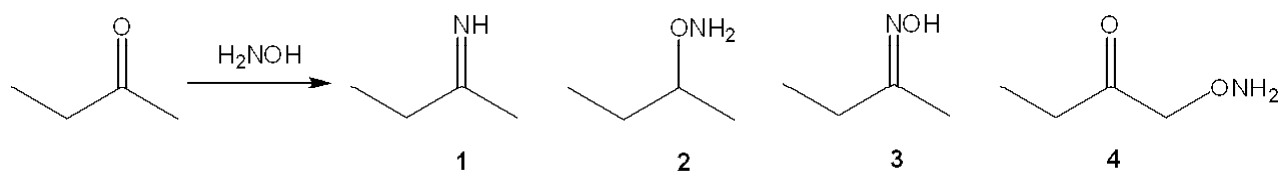
- 1 = imine; 2 = amine; 3 = hydrazone; 4 = oxime
- 1 = hydrazone; 2 = amine; 3 = imine; 4 = oxime
- 1 = oxime; 2 = imine; 3 = amine; 4 = hydrazone
- 1 = imine; 2 = hydrazone; 3 = oxime; 4 = amine

19. What is the major organic product obtained from the following reaction?



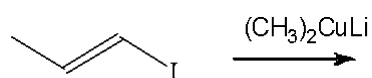
- 1
- 2
- 3
- 4

20. What is the major organic product obtained from the following reaction?



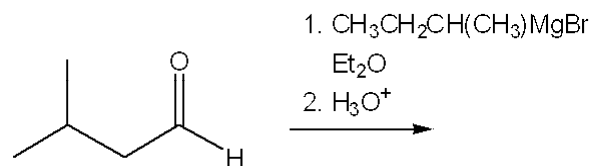
- a. 1
- b. 2
- c. 3
- d. 4

21. What is the major organic product obtained from the following reaction?



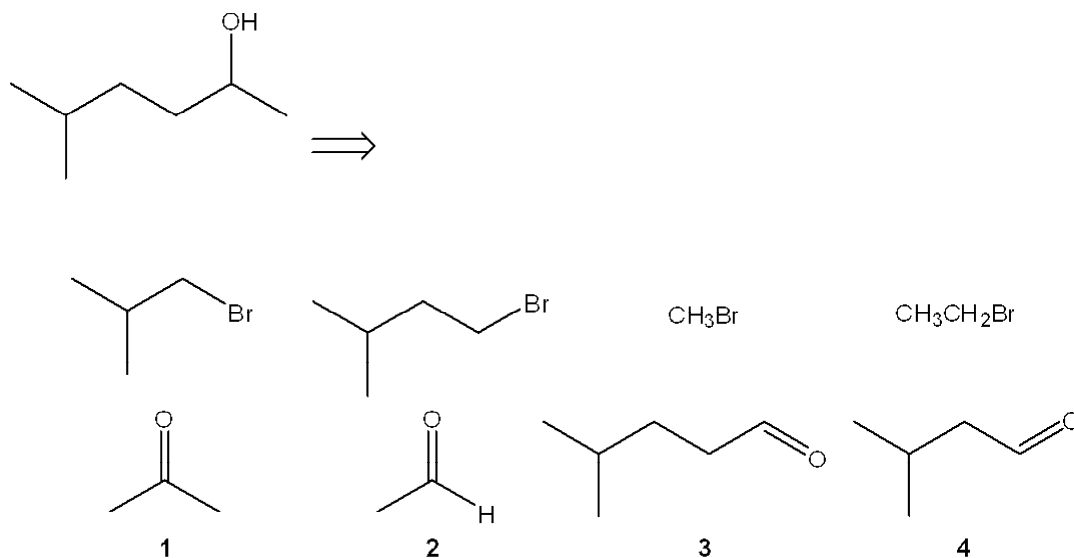
- a. (E) 2-iodo-2-butene
- b. 1-iodo-2-methylpropene
- c. methylcyclopropane
- d. (E) 2-butene

22. What is the major organic product obtained from the following reaction?



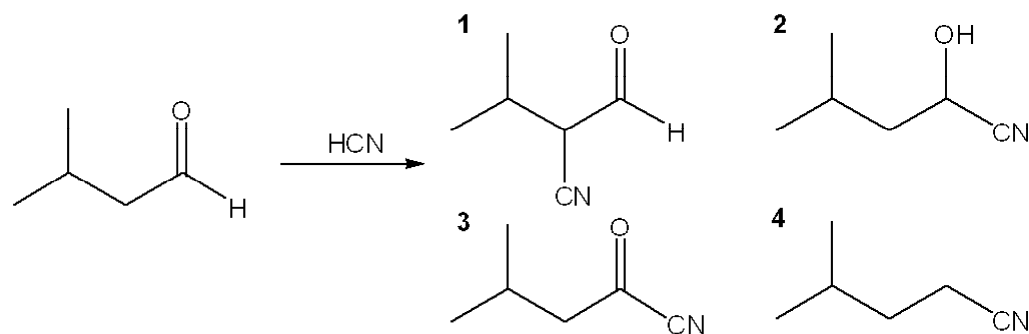
- a. 2,3-dimethyl-3-heptanol
- b. 2,4-dimethyl-4-heptanol
- c. 2,5-dimethyl-4-heptanol
- d. 2,5-dimethyl-3-heptanol

23. Which combination(s) of alkyl bromide and carbonyl compound can be used to prepare the following product by addition of the Grignard reagent derived from the alkyl bromide to the carbonyl compound?



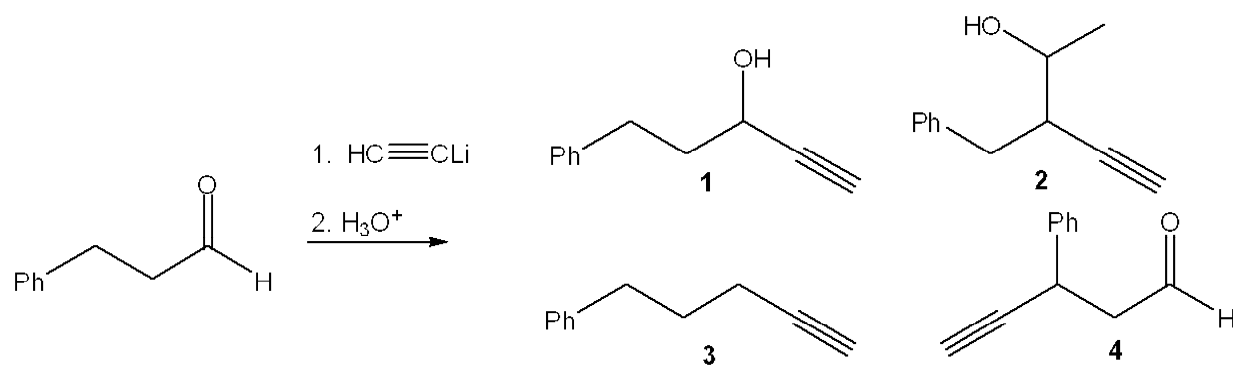
- a. only 1
 b. only 3
 c. only 1 and 4
 d. only 2 and 3

24. What is the major organic product obtained from the following reaction?



- a. 1
 b. 2
 c. 3
 d. 4

25. What is the **major** organic product obtained from the following reaction?



- a. **1**
- b. **2**
- c. **3**
- d. **4**

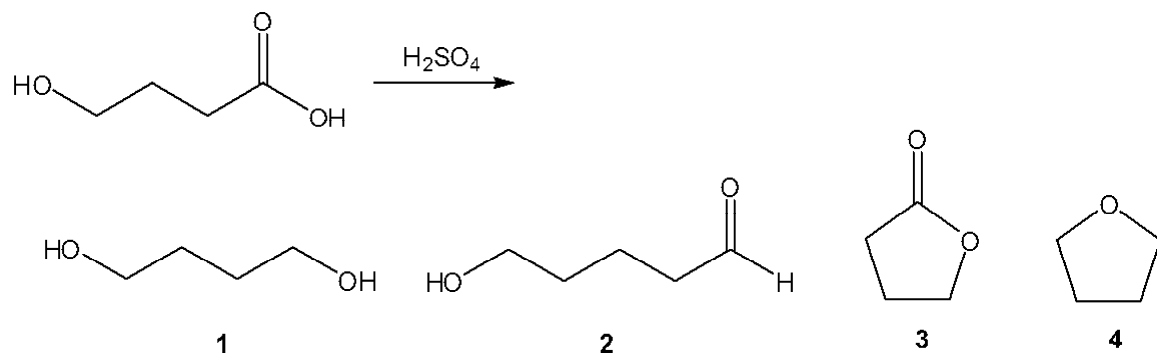
N_HW3

HW3

Multiple Choice

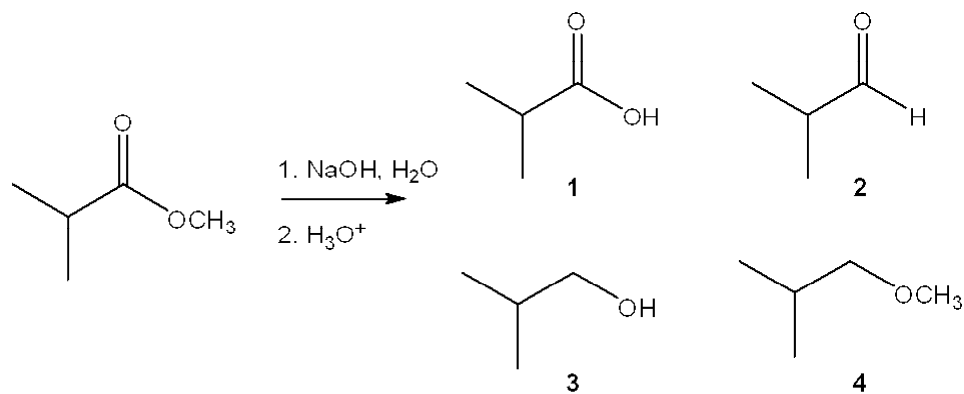
Identify the choice that best completes the statement or answers the question. There is only one correct response for each question.

1. What is the major organic product obtained from the following reaction?



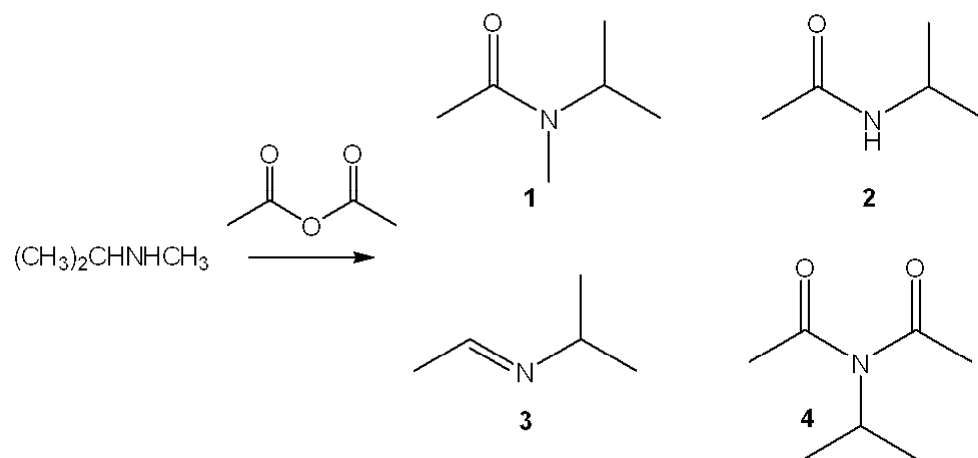
- a. 1
b. 2
c. 3
d. 4

2. What is the major organic product obtained from the following reaction?



- a. 1
b. 2
c. 3
d. 4

3. What is the major organic product obtained from the following reaction?

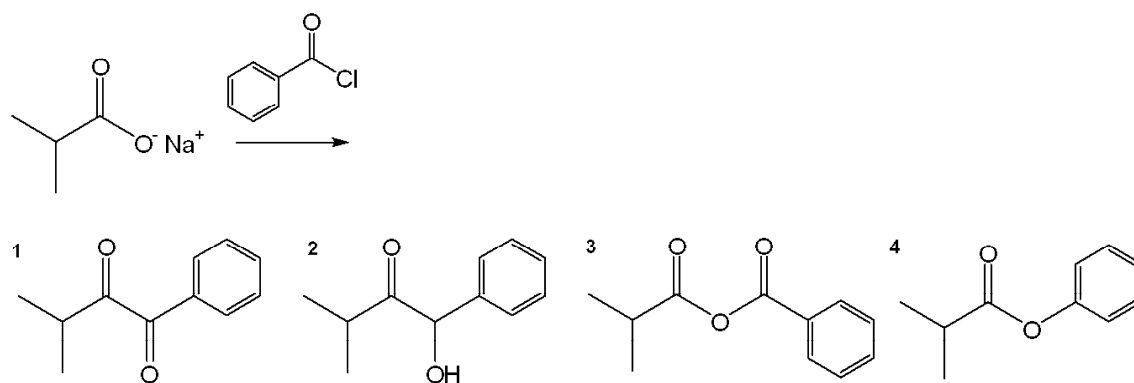


- 1
- 2
- 3
- 4

4. Which of the following is the most soluble in water?

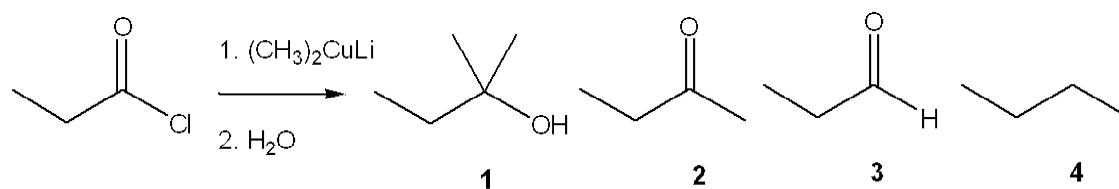
- acetic acid
- pentanol
- butanoic acid
- pentanal

5. What is the major organic product obtained from the following reaction?



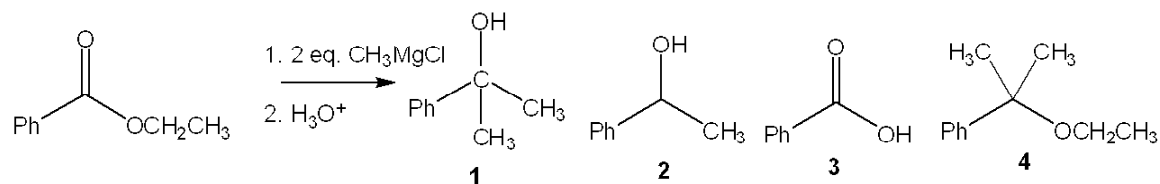
- 1
- 2
- 3
- 4

9. What is the major organic product obtained from the following reaction?



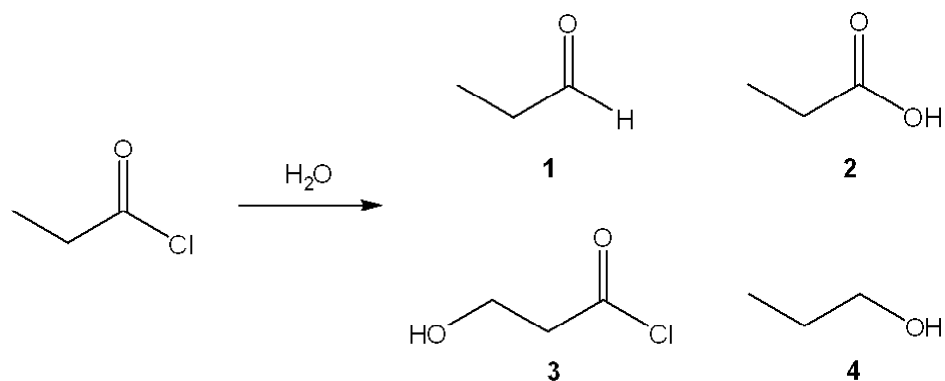
- a. **1**
- b. **2**
- c. **3**
- d. **4**

10. What is the major organic product obtained from the following reaction?



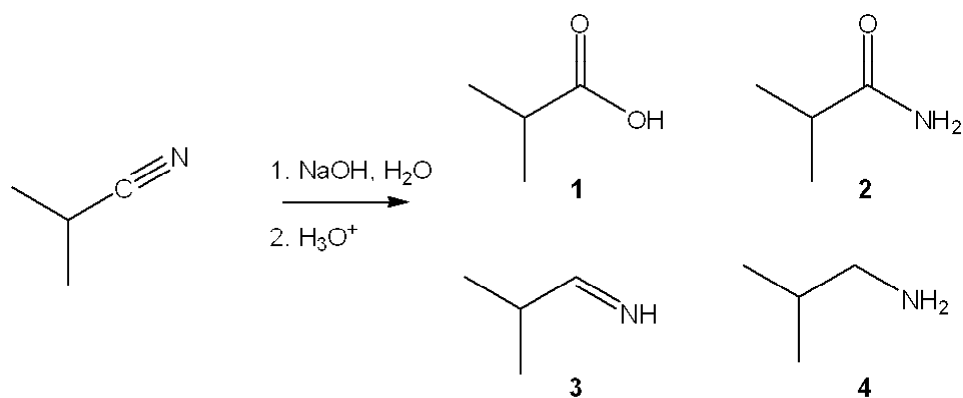
- a. **1**
- b. **2**
- c. **3**
- d. **4**

11. What is the major organic product obtained from the following reaction?



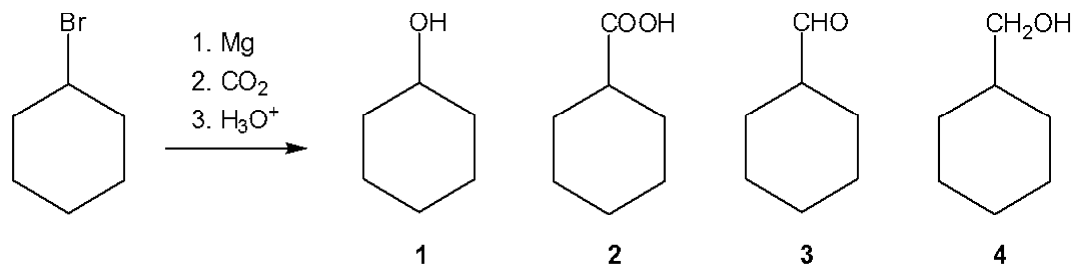
- a. **1**
- b. **2**
- c. **3**
- d. **4**

12. What is the major organic product obtained from the following reaction?



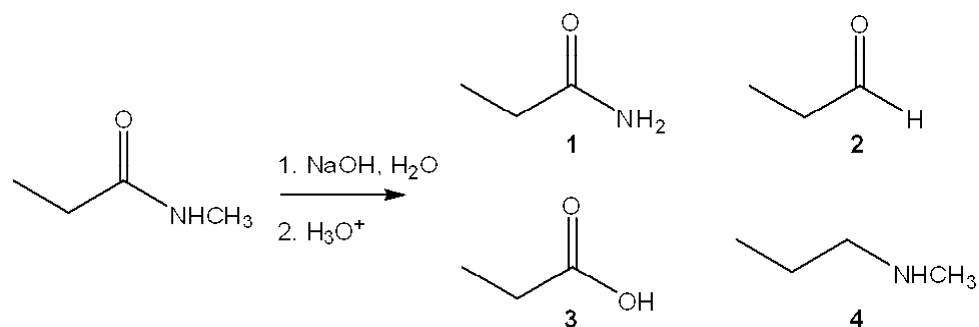
- a. 1
- b. 2
- c. 3
- d. 4

13. What is the major organic product obtained from the following reaction?



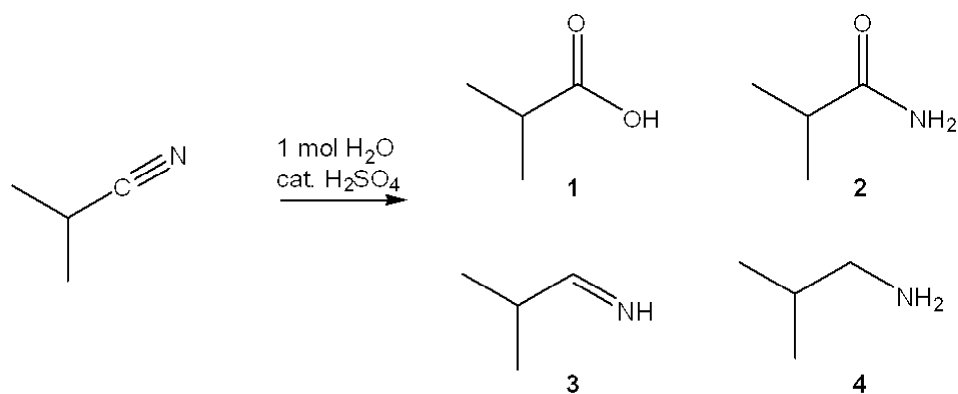
- a. 1
- b. 2
- c. 3
- d. 4

14. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

15. What is the major organic product obtained from the following reaction?

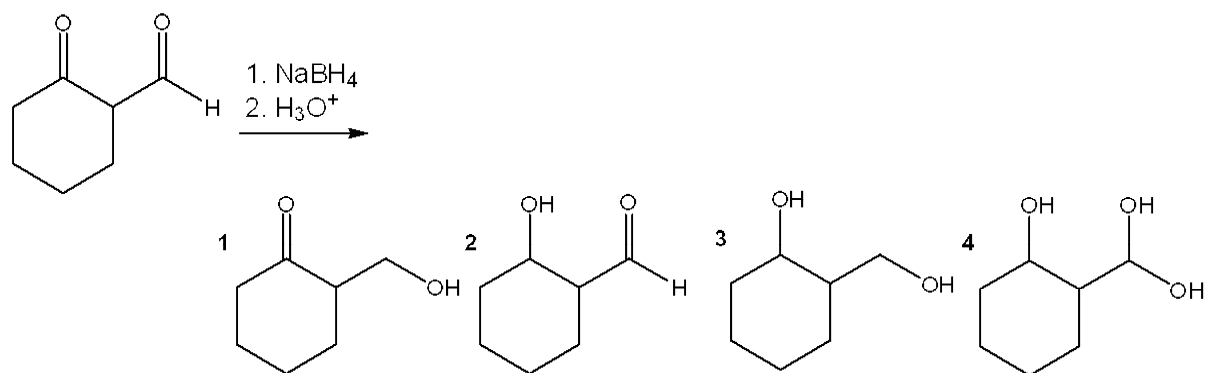


- a. 1
- b. 2
- c. 3
- d. 4

16. Which of the following is the correct order of decreasing reactivity in hydrolysis reactions (more reactive > less reactive)?

- a. esters > amides > acid chlorides
- b. amides > acid chlorides > esters
- c. acid chlorides > esters > amides
- d. esters > acid chlorides > amides

17. What is the major organic product obtained from the following reaction?

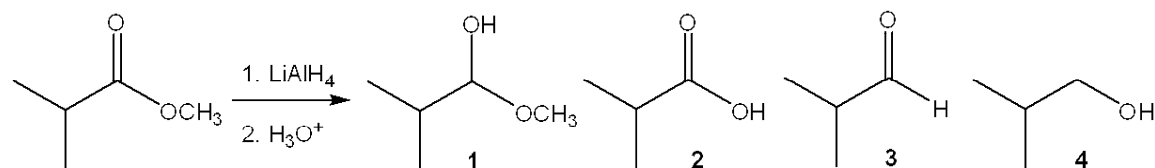


- a. 1
- b. 2
- c. 3
- d. 4

18. Which of the following can be made by acid-promoted hydrolysis of a nitrile?

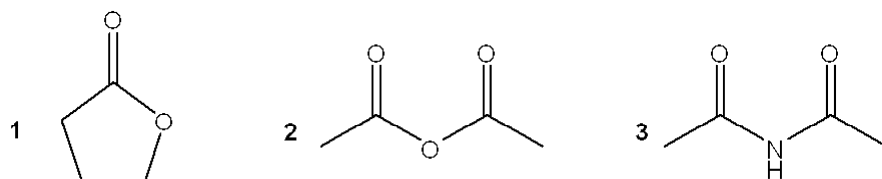
- 1. an acid
 - 2. an alcohol
 - 3. an imine
 - 4. an imide
-
- a. only 1
 - b. only 1 and 2
 - c. only 2 and 3
 - d. only 4

19. What is the major organic product obtained from the following reaction?



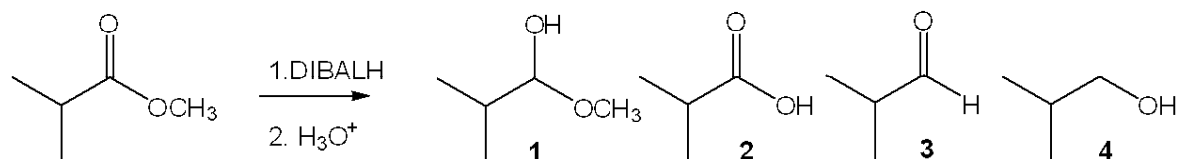
- a. 1
- b. 2
- c. 3
- d. 4

20. What of the following is the correct assignment of the classes of the following compounds?



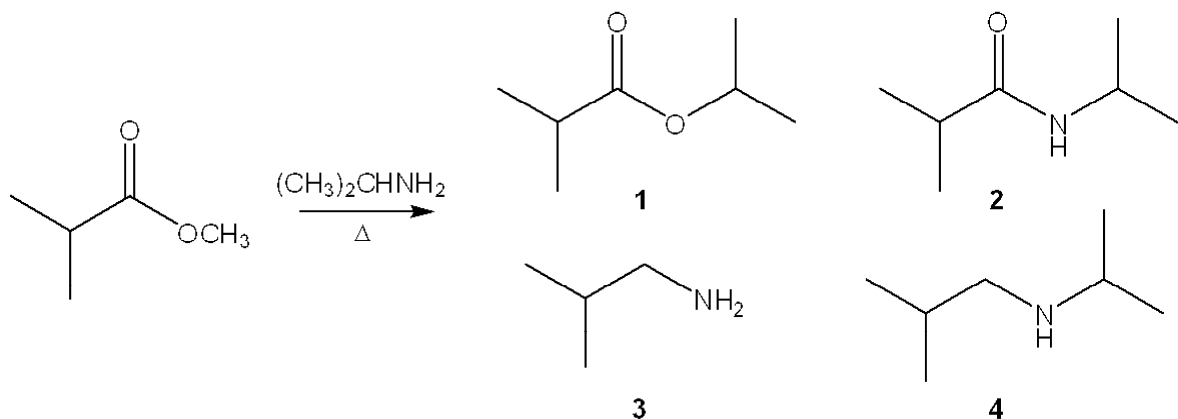
- a. 1 = lactone; 2 = ester; 3 = amide
 b. 1 = ester; 2 = ester; 3 = imide
 c. 1 = ester; 2 = imide; 3 = amide
 d. 1 = lactone; 2 = anhydride; 3 = imide

21. What is the major organic product obtained from the following reaction?



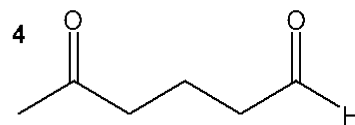
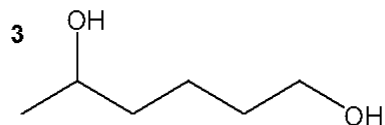
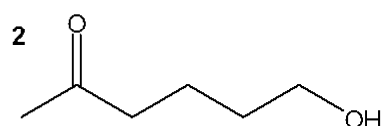
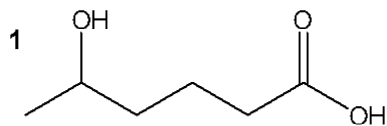
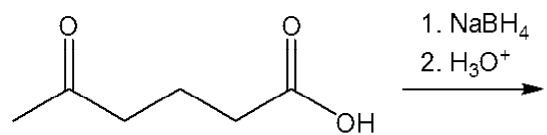
- a. 1
 b. 2
 c. 3
 d. 4

22. What is the major organic product obtained from the following reaction?



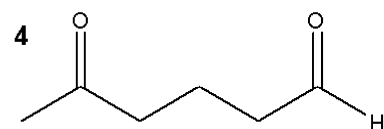
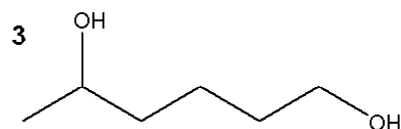
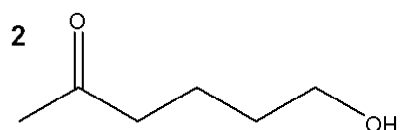
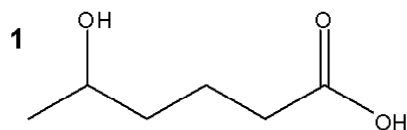
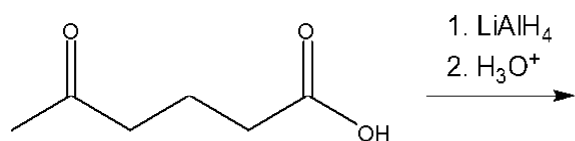
- a. 1
 b. 2
 c. 3
 d. 4

23. What is the major organic product obtained from the following reaction?



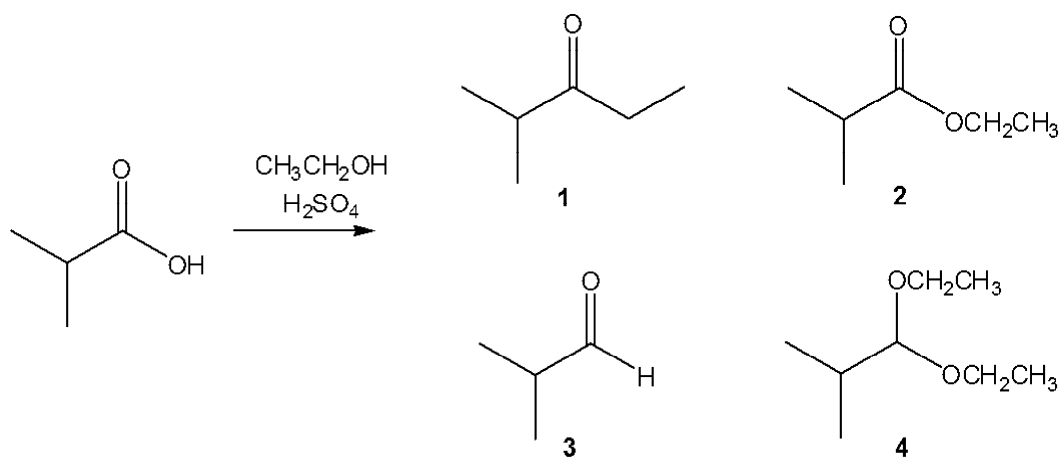
- a. 1
- b. 2
- c. 3
- d. 4

24. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

25. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

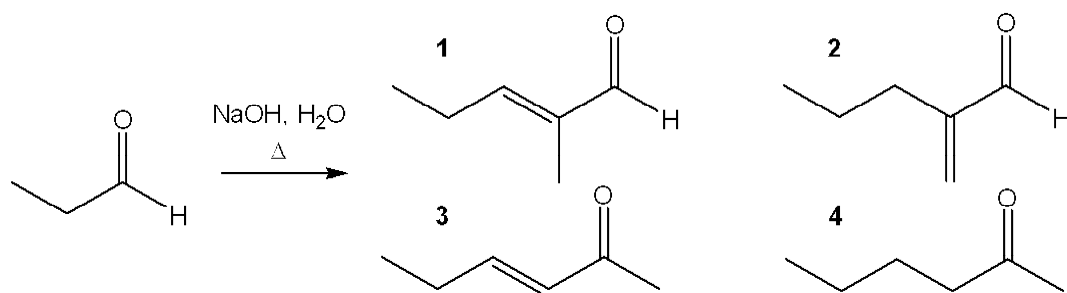
N_HW4

HW4

Multiple Choice

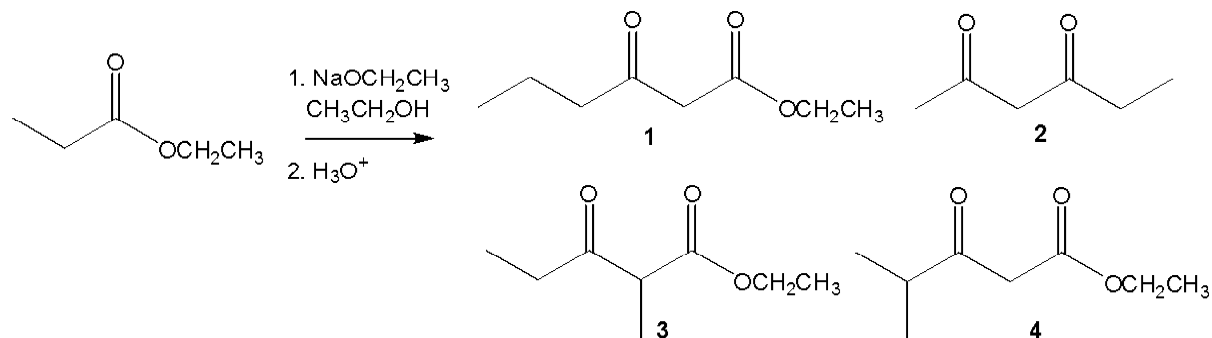
Identify the choice that best completes the statement or answers the question. There is only one correct response for each question.

1. What is the major organic product obtained from the following reaction?



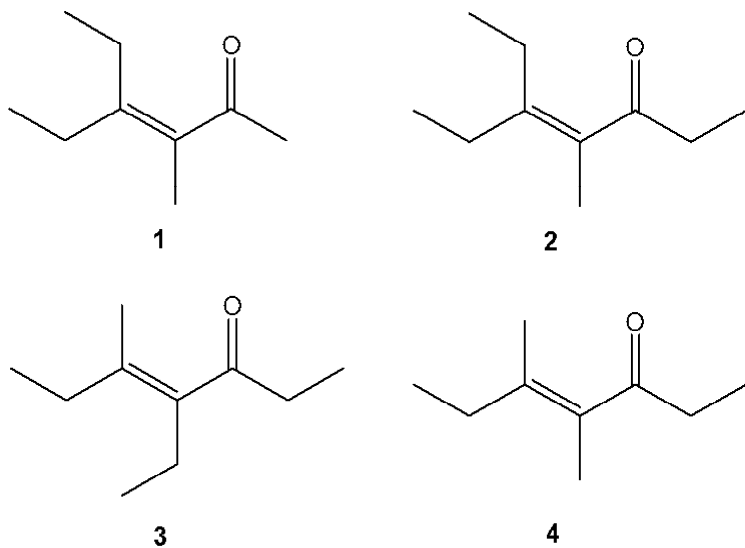
- a. 1
- b. 2
- c. 3
- d. 4

2. What is the major organic product obtained from the following reaction?



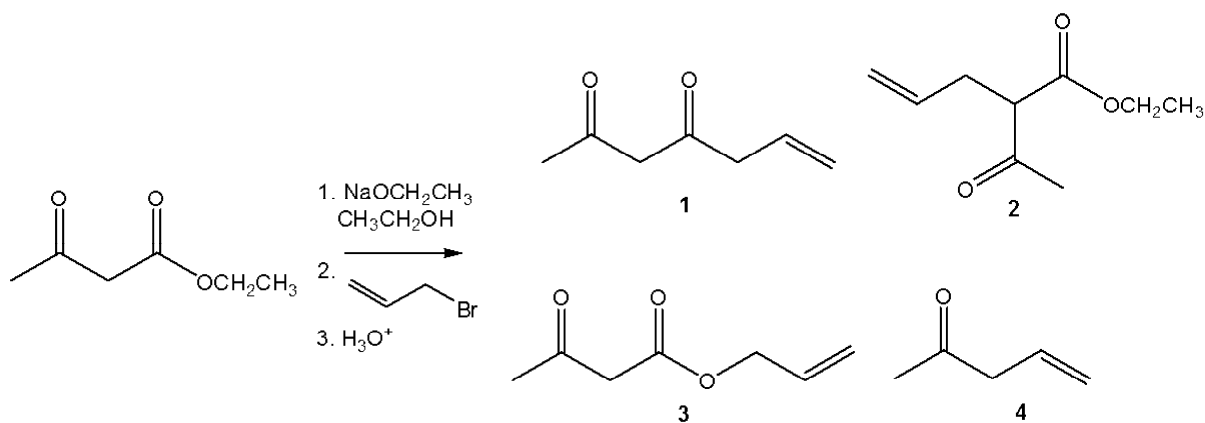
- a. 1
- b. 2
- c. 3
- d. 4

3. Which of the following compounds can be prepared by an aldol condensation by treating a single carbonyl compound with base?



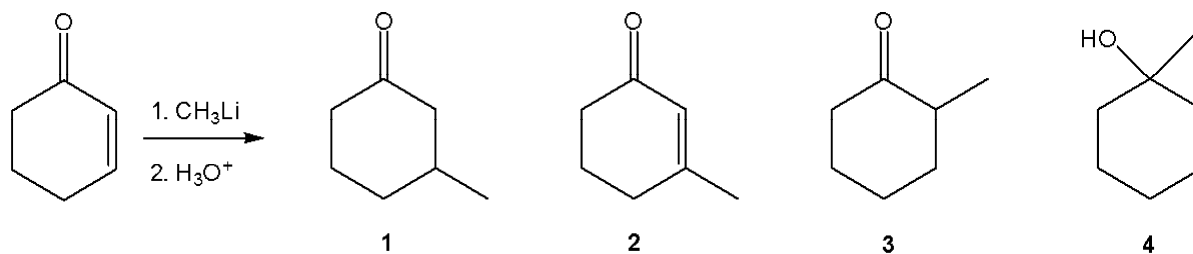
- a. 1
- b. 2
- c. 3
- d. 4

4. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

5. What is the major organic product obtained from the following reaction?



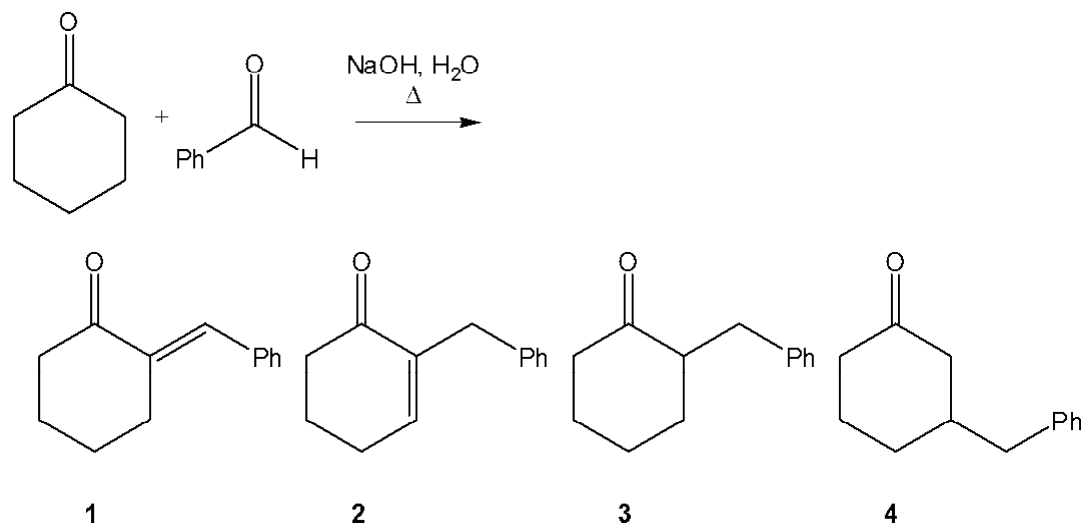
- a. 1
- b. 2
- c. 3
- d. 4

6. Which of the following are intermediates in the acid catalyzed aldol reaction of propanal to form 2-methyl-2-pentenal?

- 1. enol
- 2. enolate
- 3. tetrahedral carbonyl intermediate
- 4. aldol

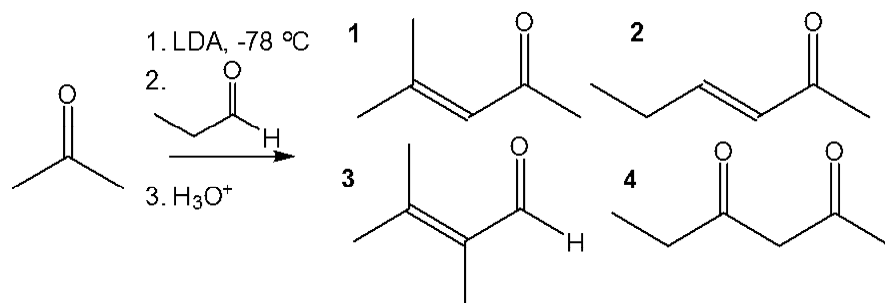
- a. only 1 and 2
- b. only 1, 3 and 4
- c. only 2, 3 and 4
- d. 1, 2, 3 and 4

7. What is the major organic product obtained from the following reaction?



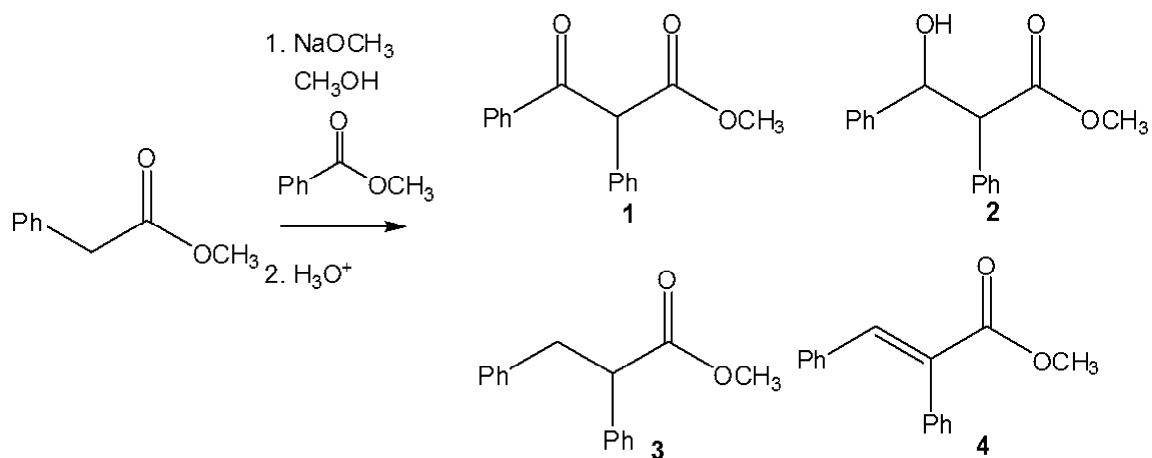
- a. 1
b. 2
c. 3
d. 4

8. What is the major organic product obtained from the following reaction?



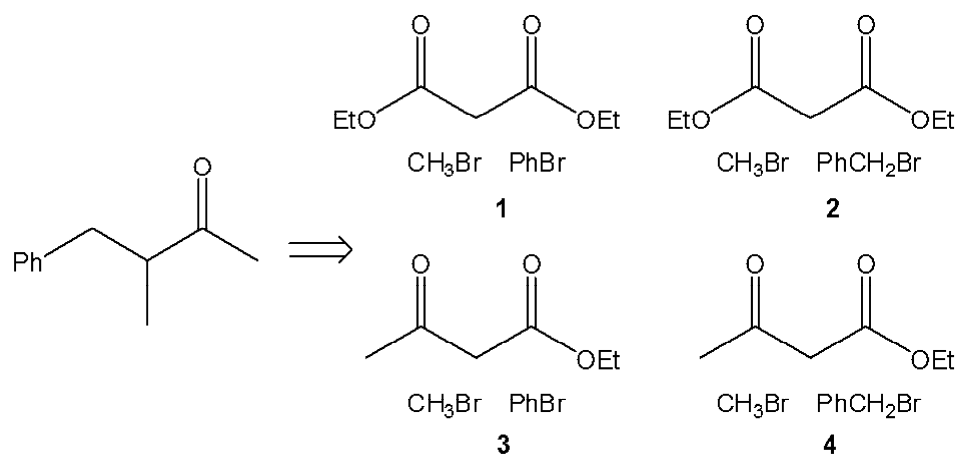
- a. 1
b. 2
c. 3
d. 4

9. What is the major organic product obtained from the following reaction?



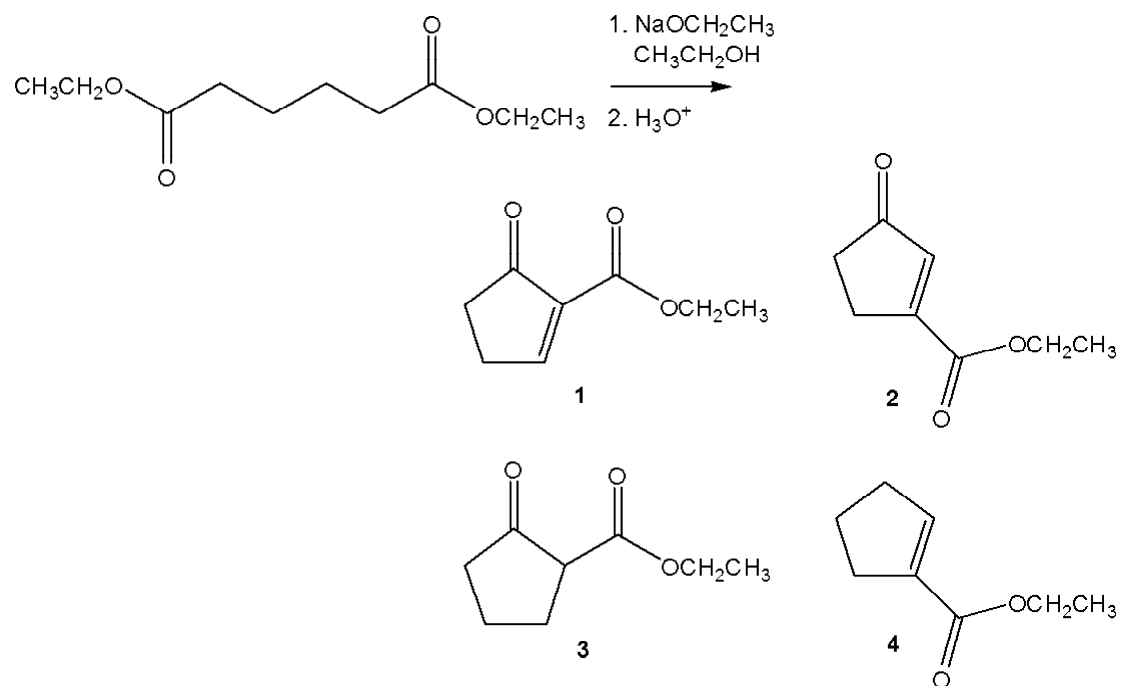
- a. **1**
- b. **2**
- c. **3**
- d. **4**

10. Which combination of organic bromide(s) and dicarbonyl compound can be used to prepare the following product (in a multistep synthesis)?



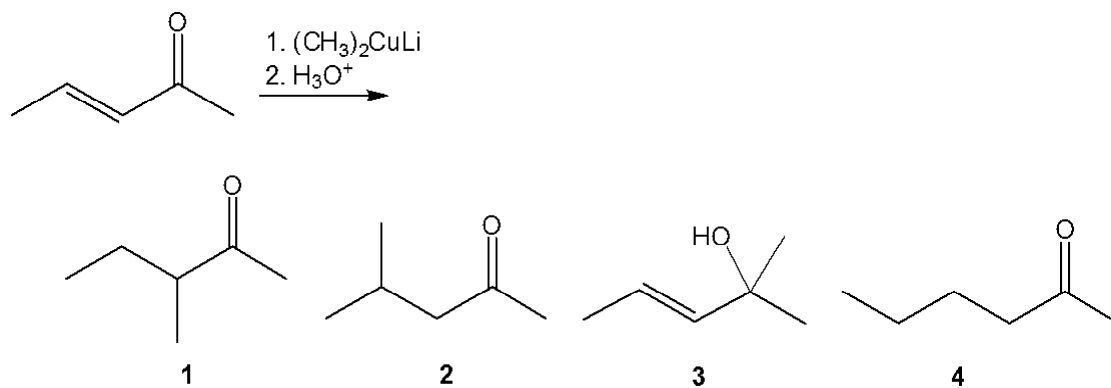
- a. **1**
- b. **2**
- c. **3**
- d. **4**

11. What is the major organic product obtained from the following reaction?



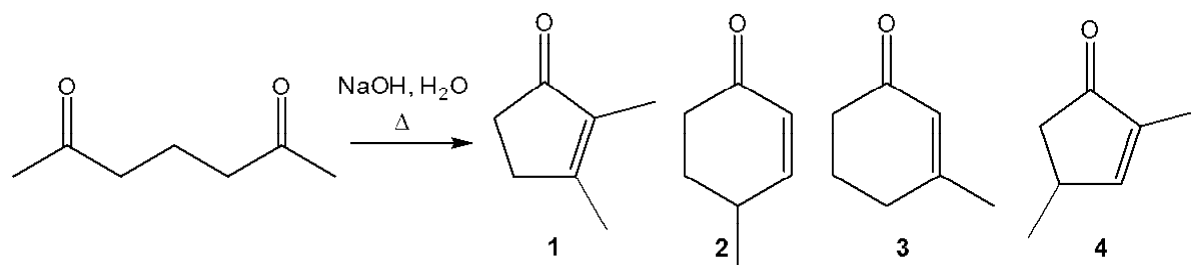
- a. 1
- b. 2
- c. 3
- d. 4

12. What is the major organic product obtained from the following reaction?



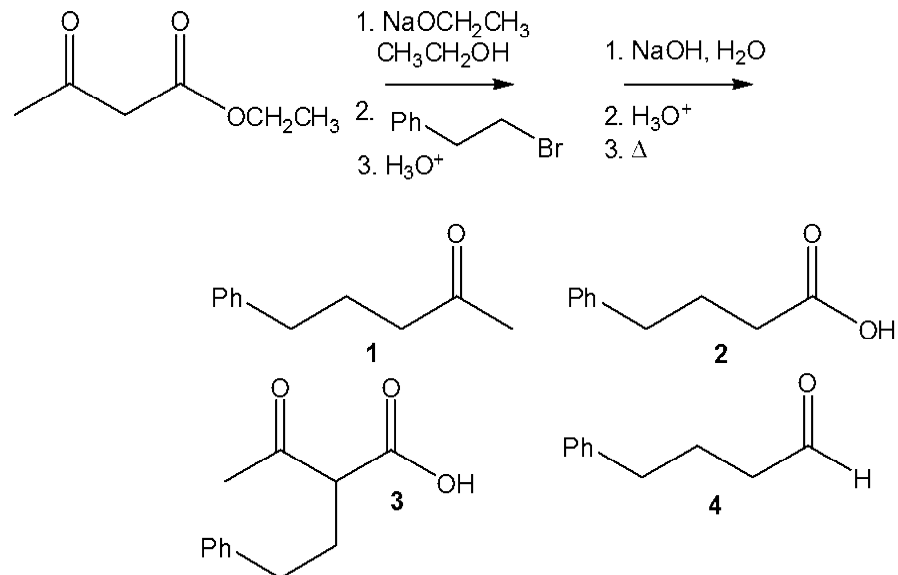
- a. 1
- b. 2
- c. 3
- d. 4

13. What is the major organic product obtained from the following reaction?



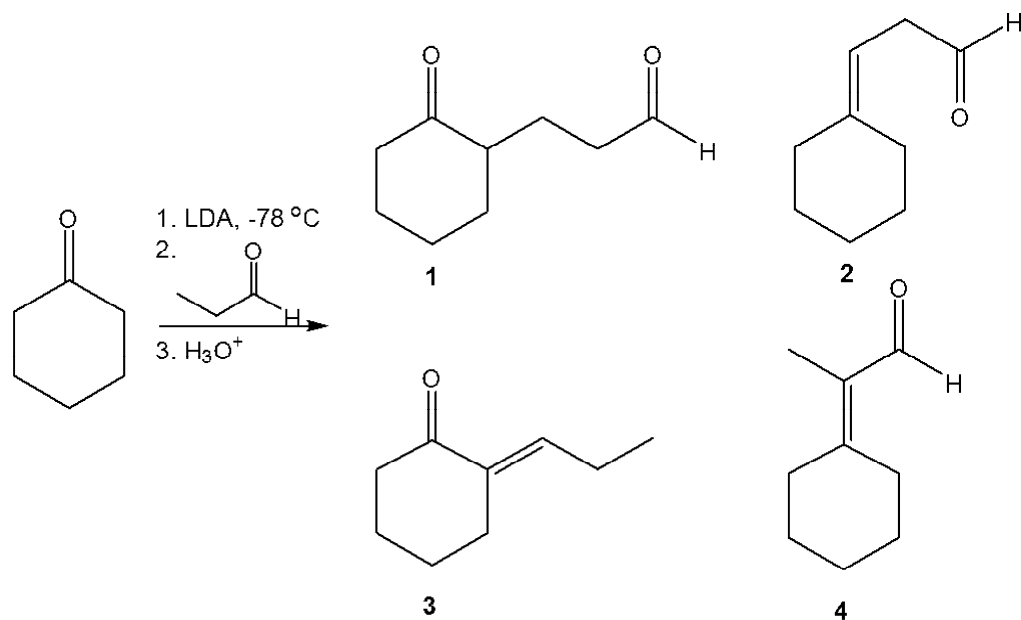
- a. 1
- b. 2
- c. 3
- d. 4

14. What is the major organic product obtained from the following sequence of reactions?



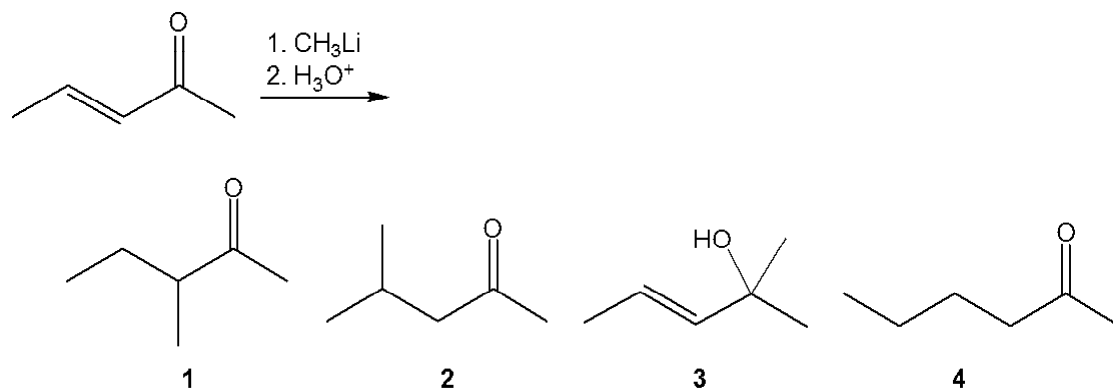
- a. 1
- b. 2
- c. 3
- d. 4

15. What is the major organic product obtained from the following reaction?



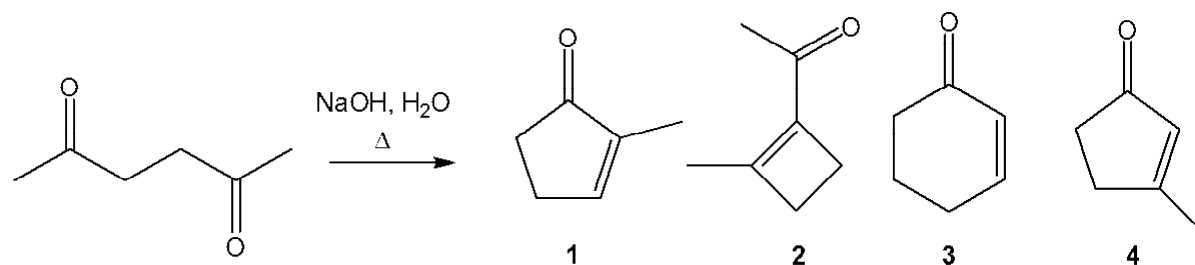
- a. 1
- b. 2
- c. 3
- d. 4

16. What is the major organic product obtained from the following reaction?



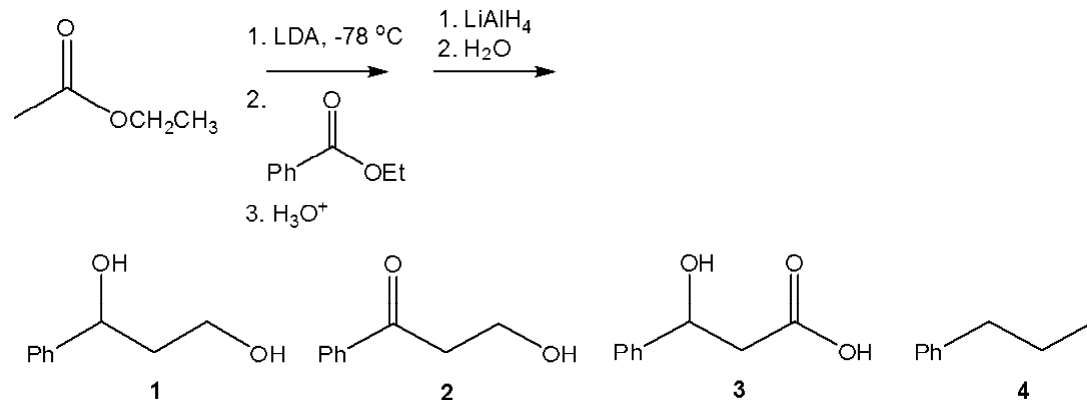
- a. 1
- b. 2
- c. 3
- d. 4

17. What is the major organic product obtained from the following reaction?



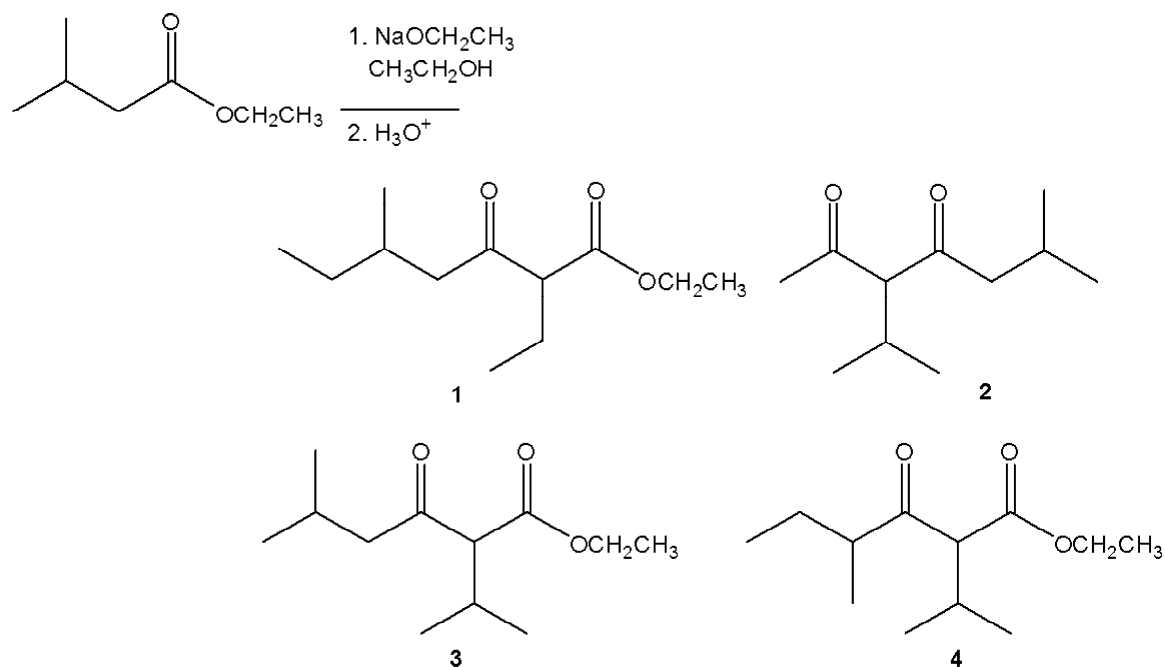
- a. 1
- b. 2
- c. 3
- d. 4

18. What is the major organic product obtained from the following sequence of reactions?



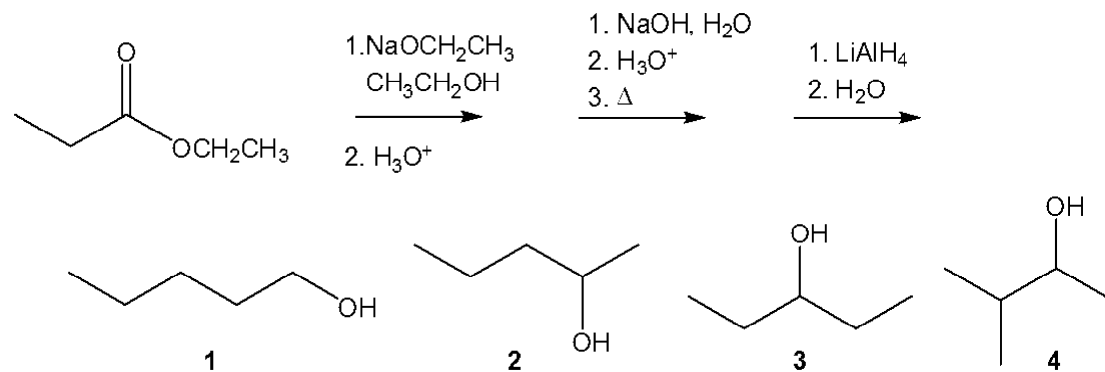
- a. 1
- b. 2
- c. 3
- d. 4

19. What is the major organic product obtained from the following reaction? (Hint: 2 moles of the ester are required)



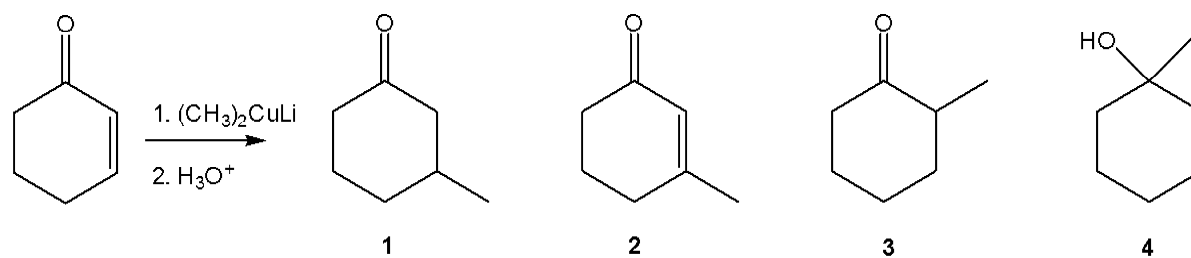
- a. 1
 b. 2
 c. 3
 d. 4

20. What is the major organic product obtained from the following sequence of reactions?



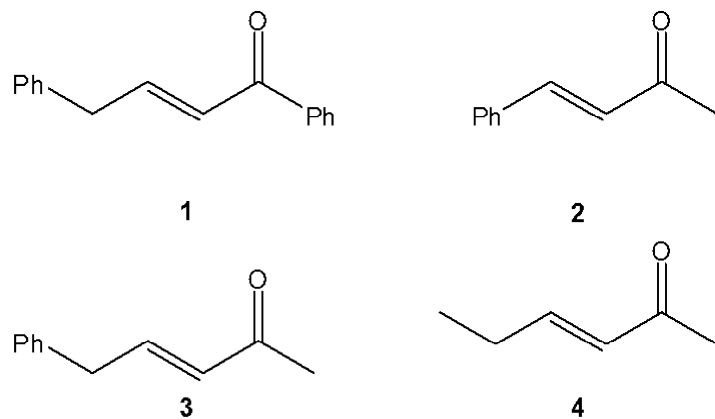
- a. 1
 b. 2
 c. 3
 d. 4

21. What is the major organic product obtained from the following reaction?



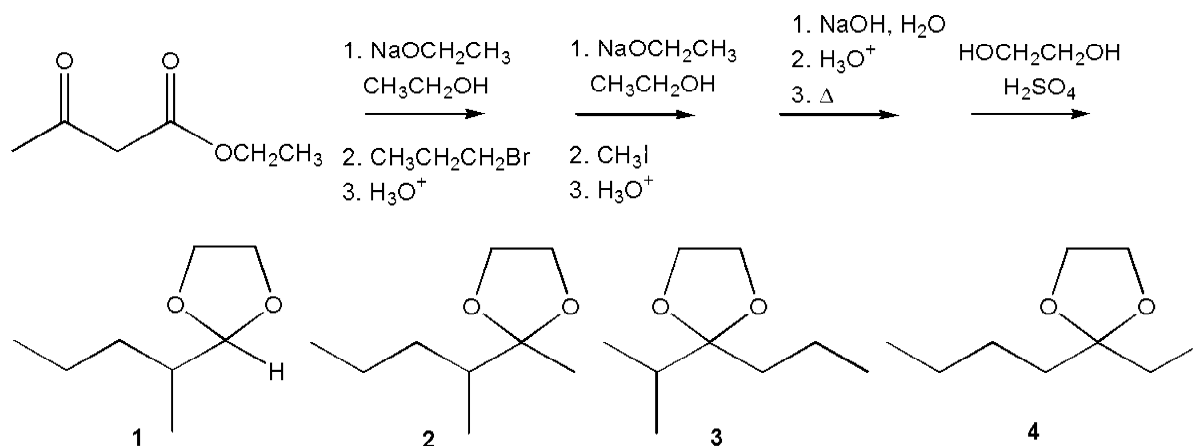
- a. 1
- b. 2
- c. 3
- d. 4

22. Which of the following compounds **will be the ONLY product** prepared by a mixed aldol condensation by treatment of a mixture of both carbonyl compounds with NaOH?



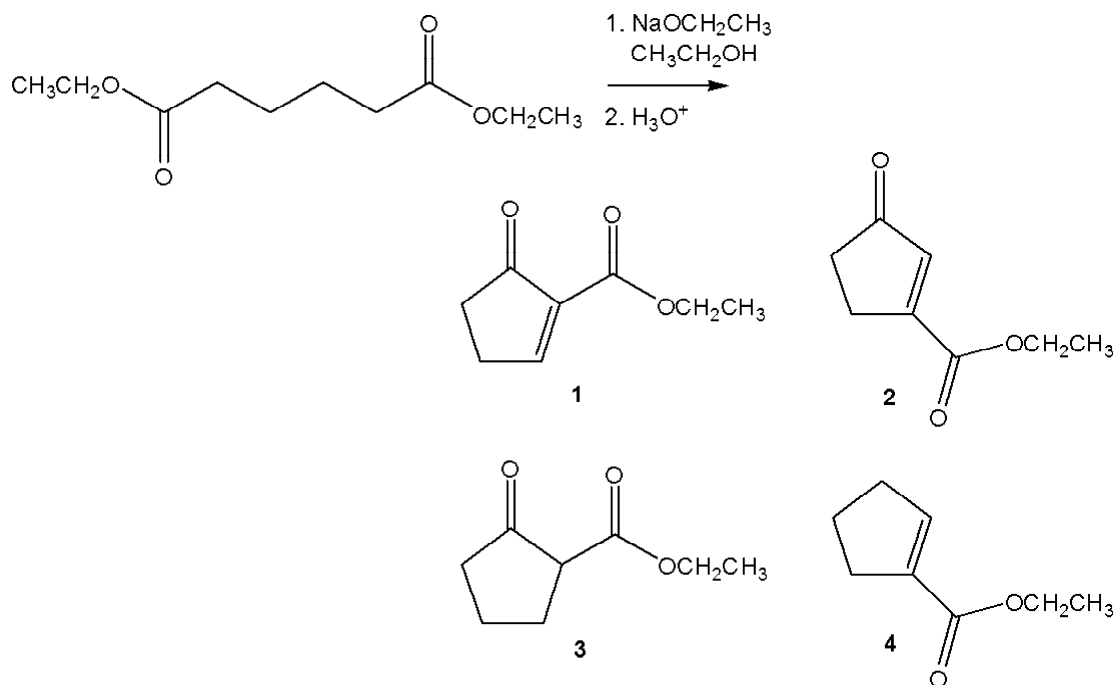
- a. 1
- b. 2
- c. 3
- d. 4

23. What is the major organic product obtained from the following sequence of reactions?



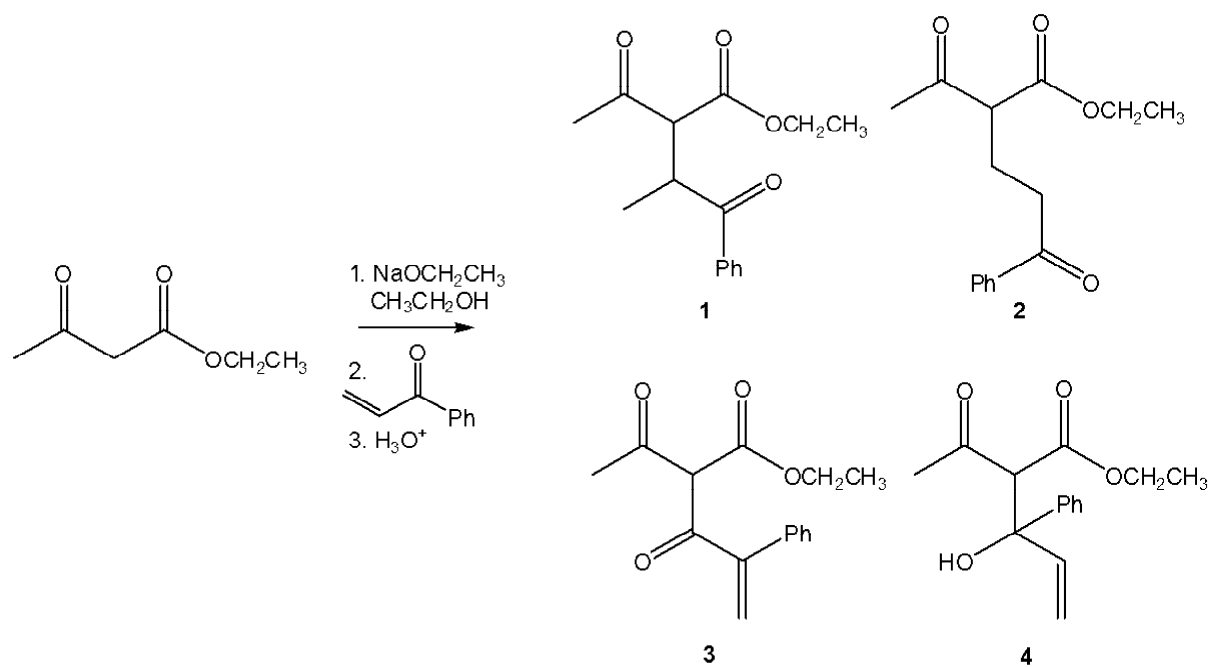
- a. 1
- b. 2
- c. 3
- d. 4

24. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

25. What is the major organic product obtained from the following reaction?



- a. **1**
- b. **2**
- c. **3**
- d. **4**

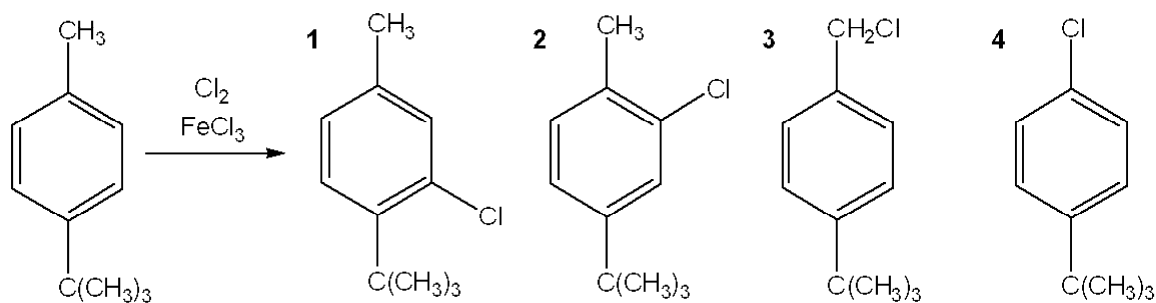
N_HW5

HW5

Multiple Choice

Identify the choice that best completes the statement or answers the question. There is only one correct response for each question.

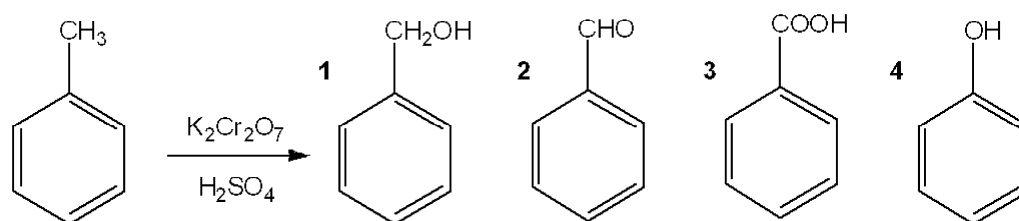
- Which of the following will remove aniline from a solution of aniline in diethyl ether?
 - aqueous KBr
 - aqueous HCl
 - aqueous NaOH
 - aqueous CH_3COONa
- What is the hybridization of the nitrogen atom of pyridine?
 - s
 - sp
 - sp²
 - sp³
- Which of the following sets of substituents are all *ortho/para* directing in electrophilic aromatic substitution reactions?
 - Cl, CH_3 , CN
 - CN, NO_2 , COCH_3
 - Br, OH, COCH_3
 - Cl, OH, CH_3
- What is the major organic product obtained from the following reaction? (*Hint: consider steric factors as well as electronic.*)



- 1**
- 2**
- 3**
- 4**

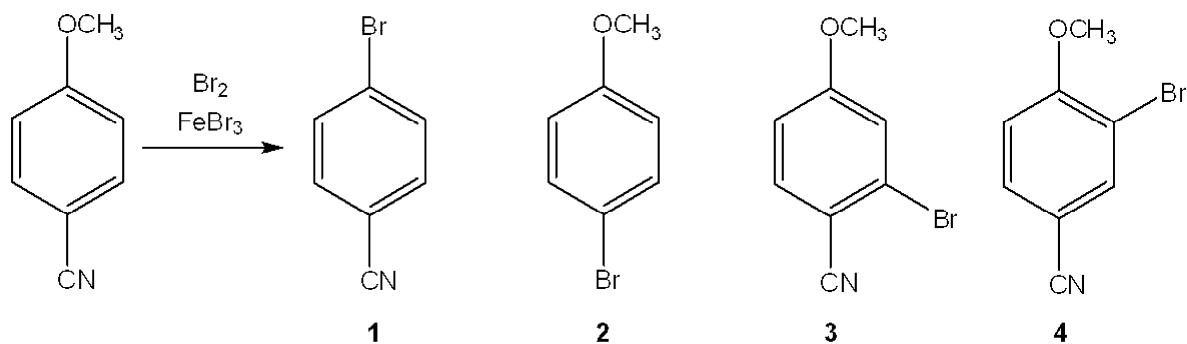
5. Which of the following is the weakest base?
- aniline
 - 3-nitroaniline
 - 4-nitroaniline
 - 4-methoxyaniline
6. Which of the following undergoes the *most rapid* sulfonation upon treatment with fuming sulfuric acid?
- benzene
 - benzoic acid
 - benzonitrile
 - nitrobenzene

7. What is the major organic product obtained from the following reaction?



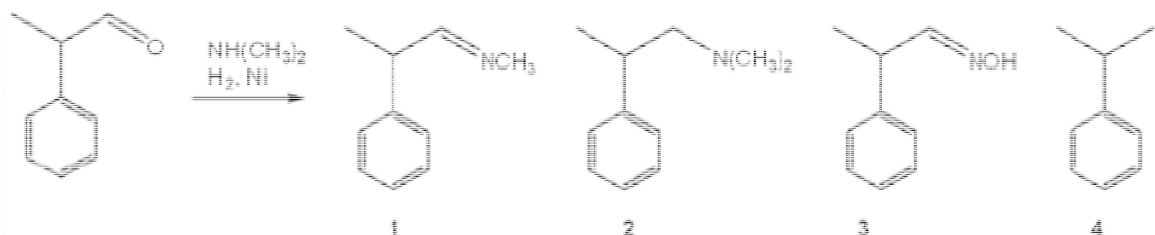
- 1
- 2
- 3
- 4

8. What is the **major** organic product obtained from the following reaction?



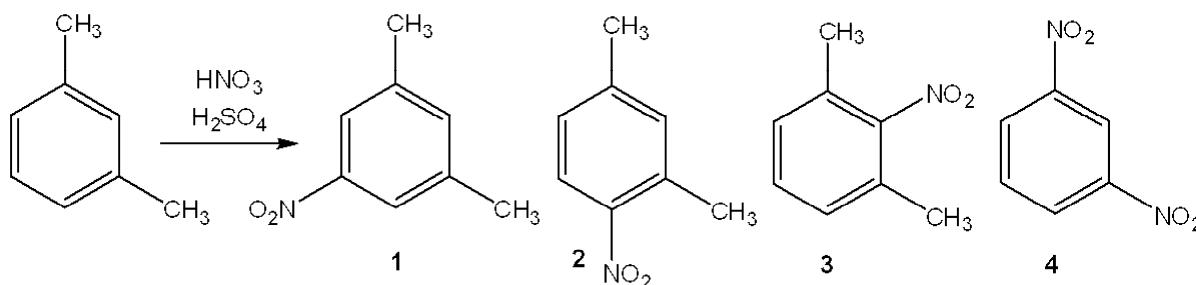
- 1
- 2
- 3
- 4

9. What is the major organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

10. What is the **major** organic product obtained from the following reaction? (*Hint: consider steric factors as well as electronic.*)



- a. 1
- b. 2
- c. 3
- d. 4

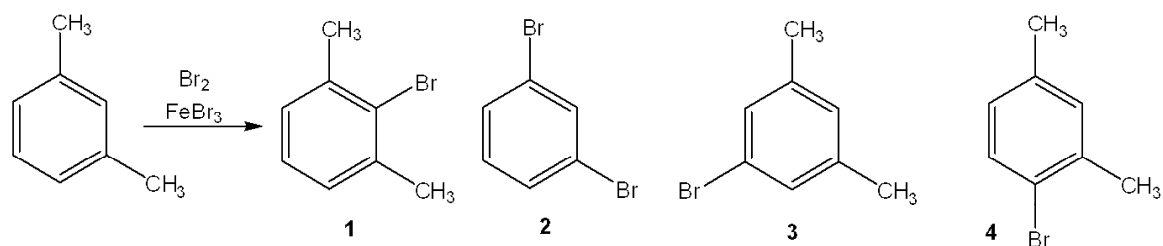
11. What is the intermediate in the reaction of ethylbenzene with NBS in the presence of benzoyl peroxide to give 1-bromo-1-phenylethane?

- a. Benzylic anion
- b. Benzylic cation
- c. Benzylic radical
- d. Benzylic carbene

12. Which of the following substituents is ortho/para directing *and* deactivating in electrophilic aromatic substitution reactions?

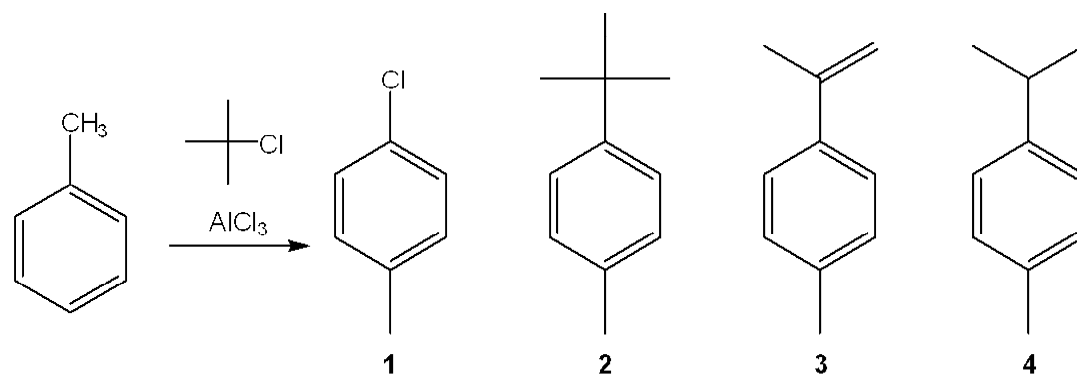
- a. NO_2
- b. OH
- c. CH_3
- d. Cl

13. What is the **major** organic product obtained from the following reaction?



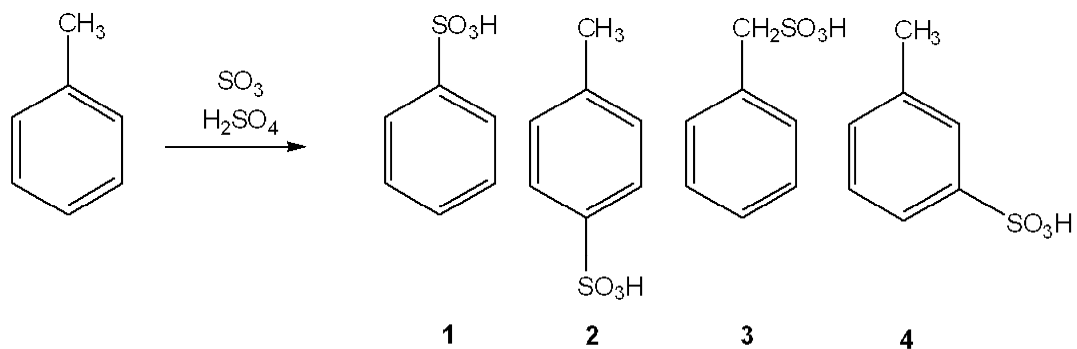
- a. 1
- b. 2
- c. 3
- d. 4

14. What is the **major** organic product obtained from the following reaction?



- a. 1
- b. 2
- c. 3
- d. 4

15. What is the **major** organic product obtained from the following reaction?

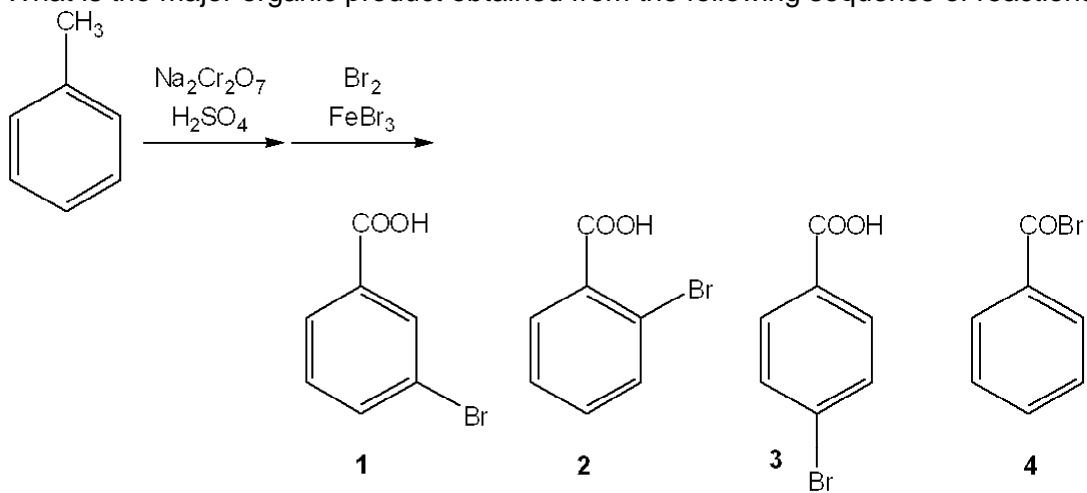


- 1
- 2
- 3
- 4

16. Which of the following sets of substituents are all *ortho/para* directing in electrophilic aromatic substitution reactions?

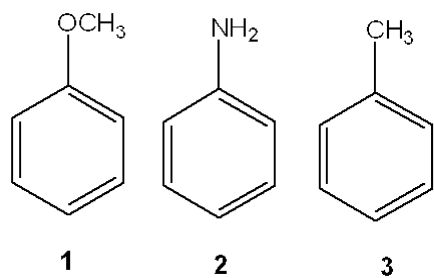
- Br , CH_3 , NO_2
- Cl , OCH_3 , COCH_3
- CH_3 , NH_2 , Br
- NO_2 , COCH_3 , COOH

17. What is the major organic product obtained from the following sequence of reactions?



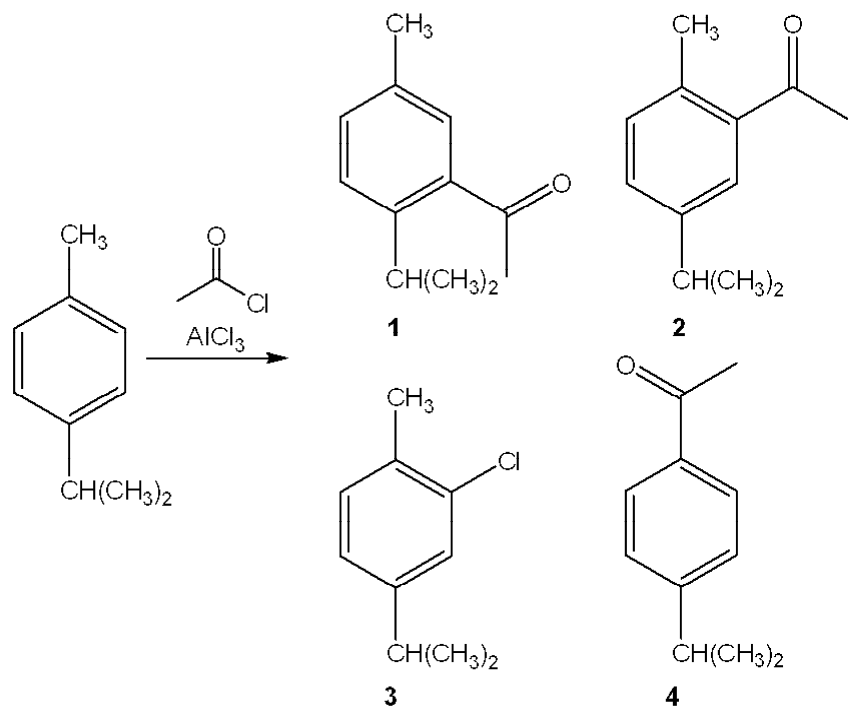
- 1
- 2
- 3
- 4

18. What is the correct assignment of the names of the following substituted benzenes?



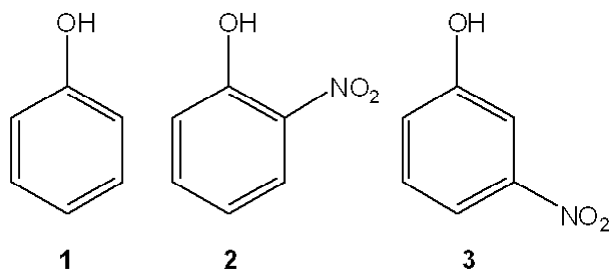
- a. 1 = anisole; 2 = aniline; 3 = toluene
b. 1 = benzaldehyde; 2 = anisole; 3 = toluene
c. 1 = anisole; 2 = xylene; 3 = toluene
d. 1 = phenol; 2 = aniline; 3 = anisole

19. What is the **major** organic product obtained from the following reaction?

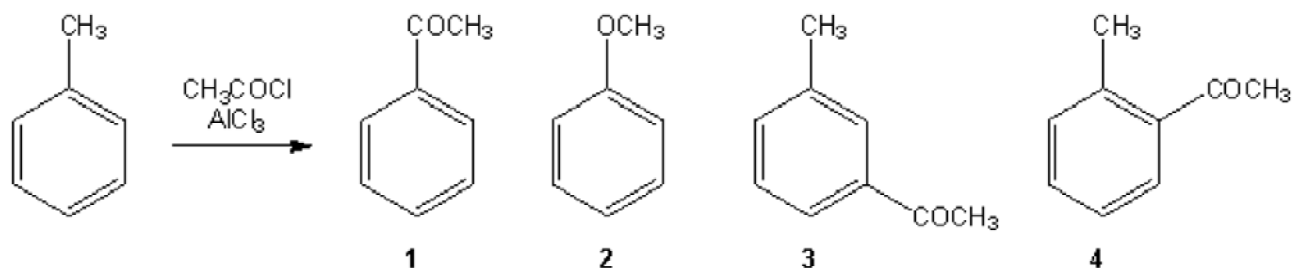


- a. 1
b. 2
c. 3
d. 4

20. Which of the following is the strongest base?
- ammonia
 - dimethylamine
 - aniline
 - 4-nitroaniline
21. Which of the following sets of substituents are all *deactivating groups* in electrophilic aromatic substitution reactions?
- CH₃, NH₂, OH
 - CH₃, Br, COCH₃
 - COCH₃, NO₂, Br
 - Cl, OH, CH₂CH₃
22. Which of the following has the compounds shown in the correct order of **decreasing** acidity (i.e., more acidic > less acidic)?

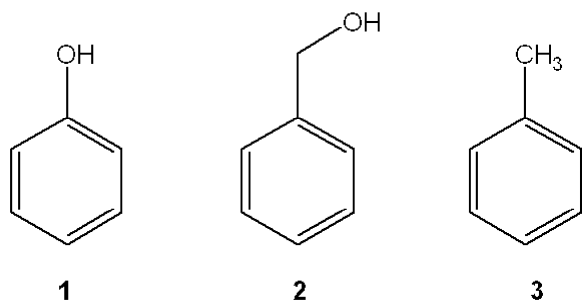


- 1 > 3 > 2
 - 1 > 2 > 3
 - 2 > 3 > 1
 - 3 > 2 > 1
23. What is the **major** organic product obtained from the following reaction?



- 1
- 2
- 3
- 4

24. Which of the following has the compounds shown in the correct order of **decreasing** acidity (i.e., more acidic > less acidic)?



- a. 1 > 2 > 3
b. 2 > 1 > 3
c. 3 > 2 > 1
d. 1 > 3 > 2
25. Which of the following substituents is ortho/para directing *and* deactivating in electrophilic aromatic substitution reactions?
- a. CH_2CH_3
b. COCH_3
c. Br
d. NH_3