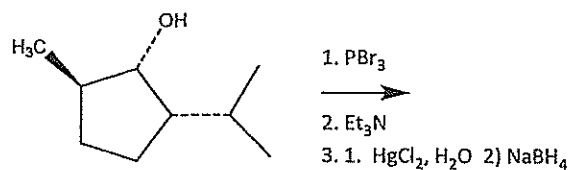
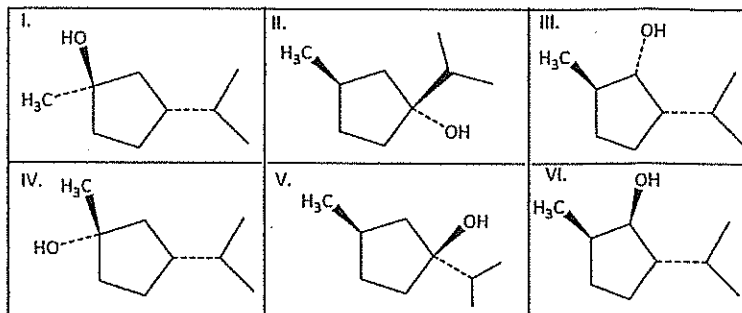


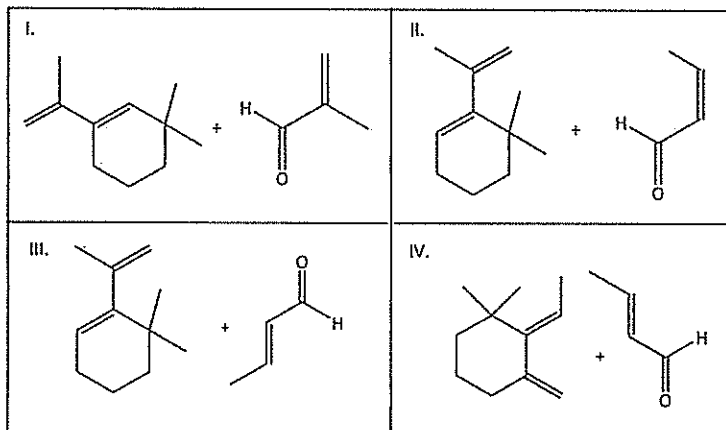
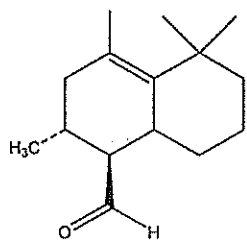
1. The major final product(s) of the reactions below is (are): **C**



- a) III & VI  
 b) VI  
 c) I & IV  
 d) II & V  
 e) I, II, IV & V

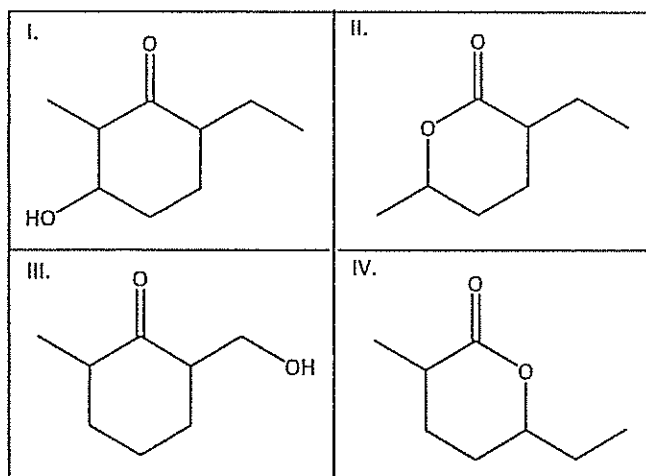


2. Which diene and which dienophile could be used to prepare the compound shown below in a Diels-Alder reaction? **D**



- a) I only  
 b) II only  
 c) II & IV  
 d) III only  
 e) I & III

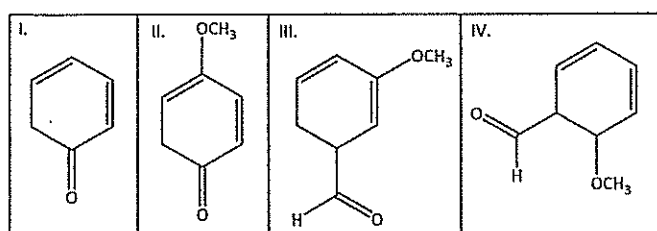
3. Which of the following starting materials will provide 2-methyl-1,5-heptanediol upon reaction with 1.  $\text{LiAlH}_4$  2.  $\text{H}_2\text{O}$ ? **D**



- a) I  
 b) II  
 c) III  
 d) IV  
 e) II & IV

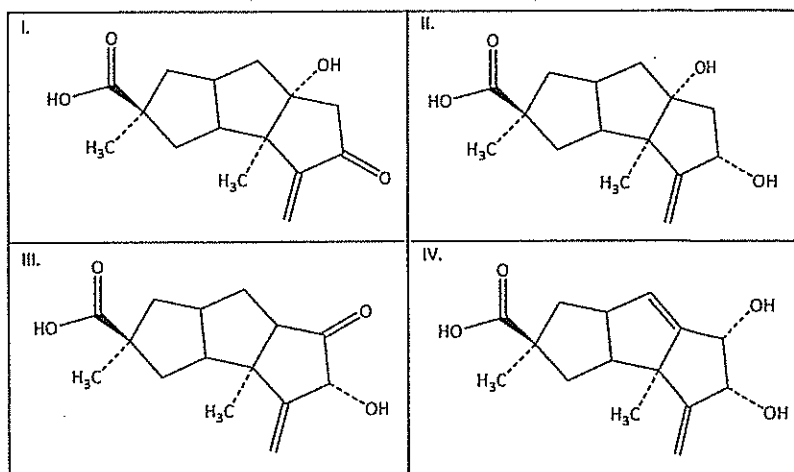
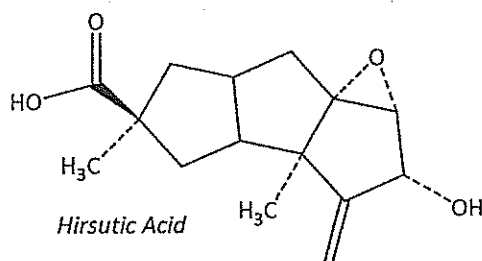
4. The major kinetic product(s) of the reaction of 3R-bromo-1-phenylcyclopentene with 1 equivalent of  $\text{H}_3\text{O}^+$  is (are): **A**  
(Assume no rearrangements)
- A racemic mixture
  - A mixture of diastereomers
  - A mixture of positional isomers
  - A single product with no chiral centers
  - A single product with one chiral center

5. Rank the dienes below from most reactive to least reactive (most > least) in a Diels-Alder reaction. **B**



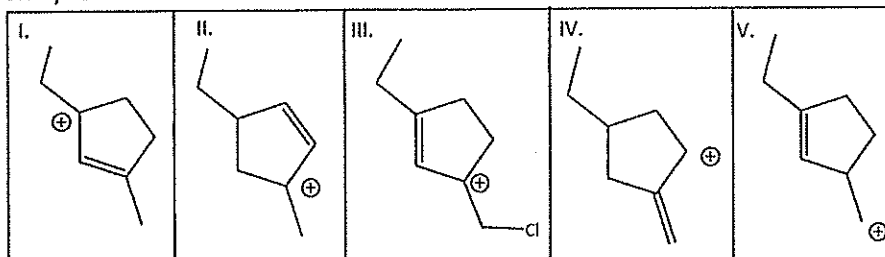
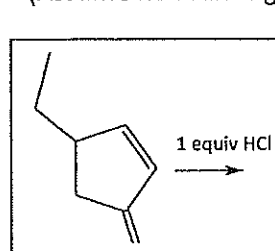
- |                      |
|----------------------|
| a) III > IV > I > II |
| b) III > IV > II > I |
| c) IV > III > II > I |
| d) II > III > IV > I |
| e) II > IV > III > I |

6. Hirsutic acid is an antibiotic metabolite isolated from the fungus *Stereum hirsutum*. The major product(s) of the reaction of hirsutic acid with  $\text{Et}_3\text{N}$  then  $\text{H}_2\text{O}$  is (are): **C**



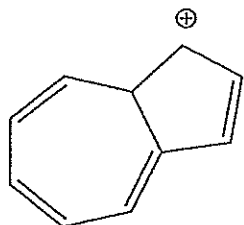
- I, II & III
- I & IV
- I, III & IV
- I & III
- II & IV

7. Which of the following reaction intermediate(s) give rise to the major kinetic product(s) of the reaction given below? (Assume no rearrangements) **C**



- |           |
|-----------|
| a) I      |
| b) II & V |
| c) II     |
| d) III    |
| e) IV     |

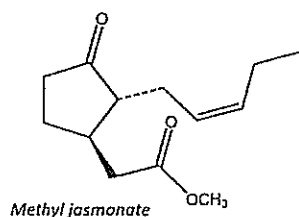
8. Which criteria for aromaticity *is not* met for the compound given below? **D**



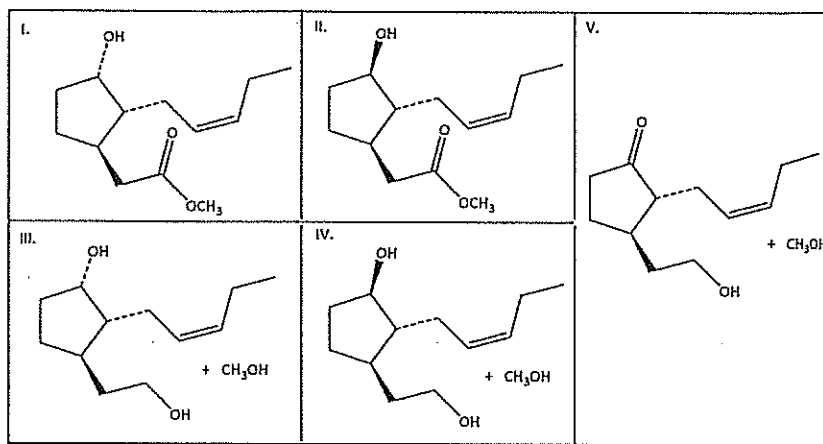
- I. cyclic
- II. planar
- III. continuous pi system
- IV. Huckel rule

- a) I & II
- b) II & III
- c) III & IV
- d) II, III & IV
- e) IV

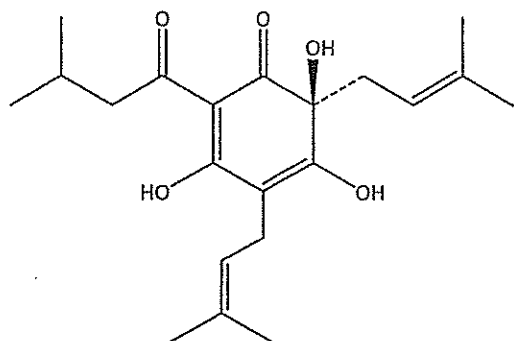
9. Reaction of methyl jasmonate with  $\text{NaBH}_4$ ,  $\text{CH}_3\text{OH}$  provides: **E**



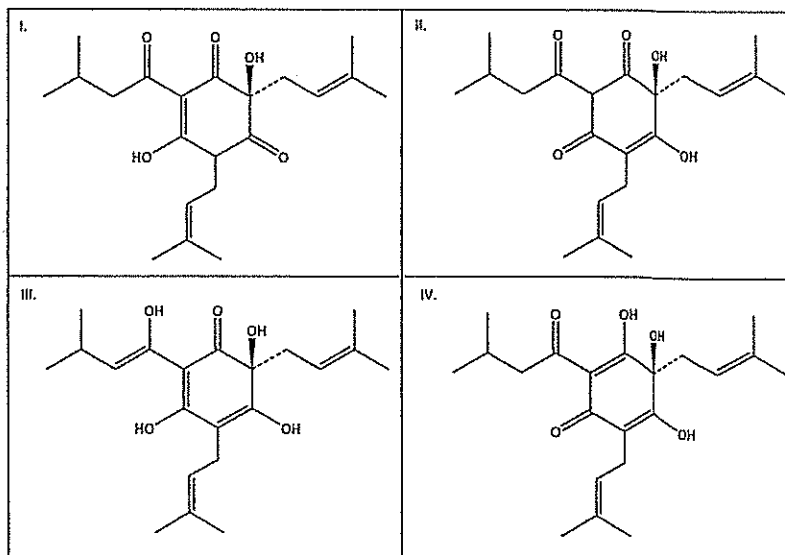
- a) II
- b) III & IV
- c) V
- d) I, II, V
- e) I & II



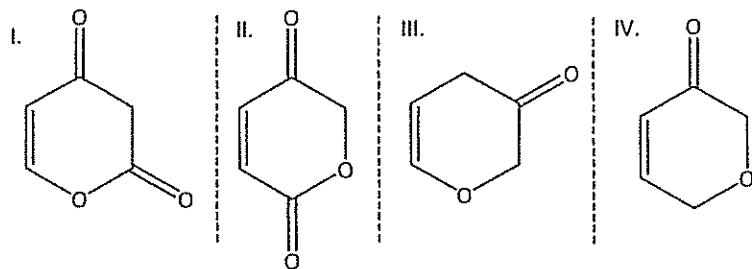
10. Humulone, a component of hops used in beer manufacturing can undergo tautomerization. Which of the following structures is formed when humulone tautomerizes? **D**



- a) I
- b) I & III
- c) I, III & IV
- d) I, II, III & IV
- e) I & II

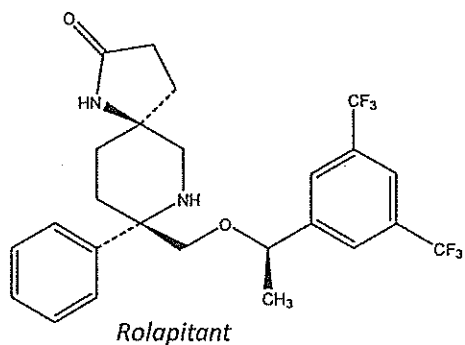


11. Rank the dienophiles below, most reactive to least reactive (most > least), in a Diels Alder reaction. **C**



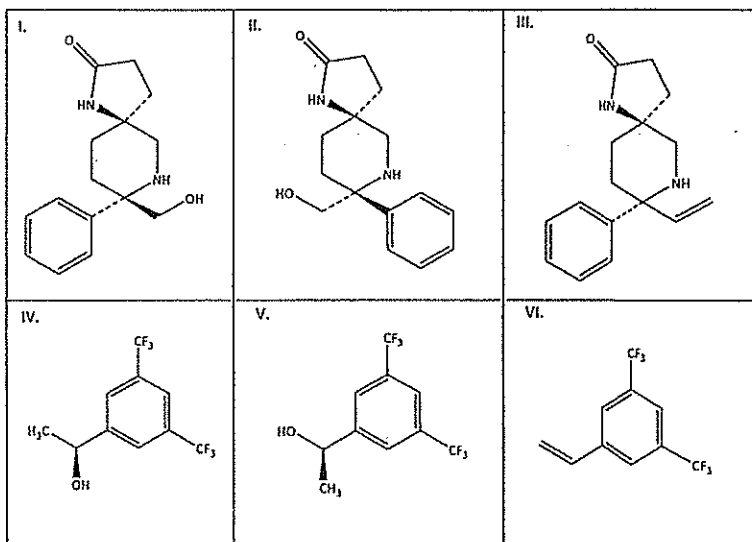
- a) I > II > IV > III  
b) III > I > IV > II  
c) II > IV > I > III  
d) II > III > IV > I  
e) IV > I > III > II

12. Rolapitant is a recently approved drug used to treat chemotherapy-induced nausea and vomiting (emesis). Cleavage of the ether functional group of rolapitant results in formation of two or more of the compounds shown below (I-VI). Match the reagent with the major product(s) of the ether cleavage reaction of rolapitant. Assume no rearrangements. **D**



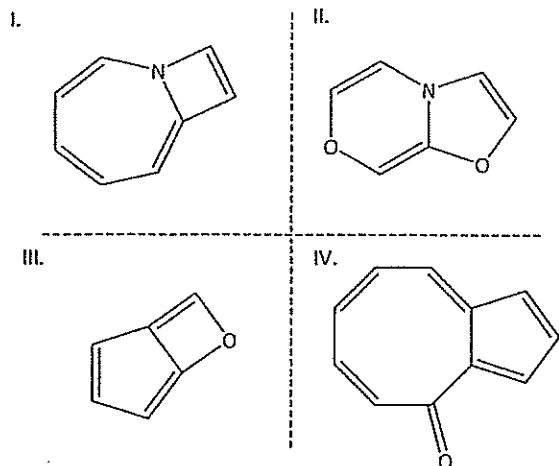
Reagents

- A. 1. Et<sub>3</sub>N 2. H<sub>2</sub>O  
B. H<sub>3</sub>O<sup>+</sup>  
C. NaOH  
D. H<sub>3</sub>PO<sub>4</sub>



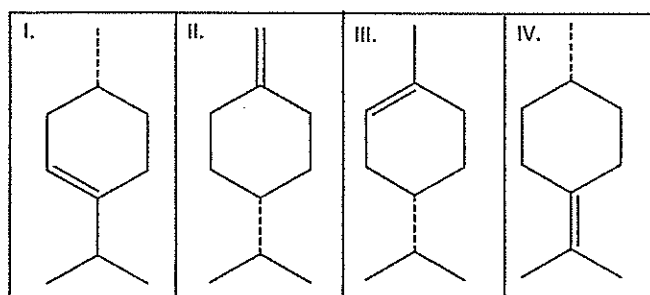
- |  |   |
|--|---|
| a) A = I & VI<br>B = I, IV & V<br>C = I, V & VI<br>D = I, II, IV & V | d) A = I & VI<br>B = I, IV & V<br>C = I & V<br>D = I & VI                         |
| b) A = II & VI<br>B = I, IV & V<br>C = I, II & IV<br>D = III & VI    | e) A = I, III, IV, V & VI<br>B = I, II, IV & V<br>C = I & IV<br>D = I, II, IV & V |
| c) A = III & VI<br>B = I, II, IV & V<br>C = II & V<br>D = I & VI     |   |

13. Which of the following compounds contains an aromatic system? **E**



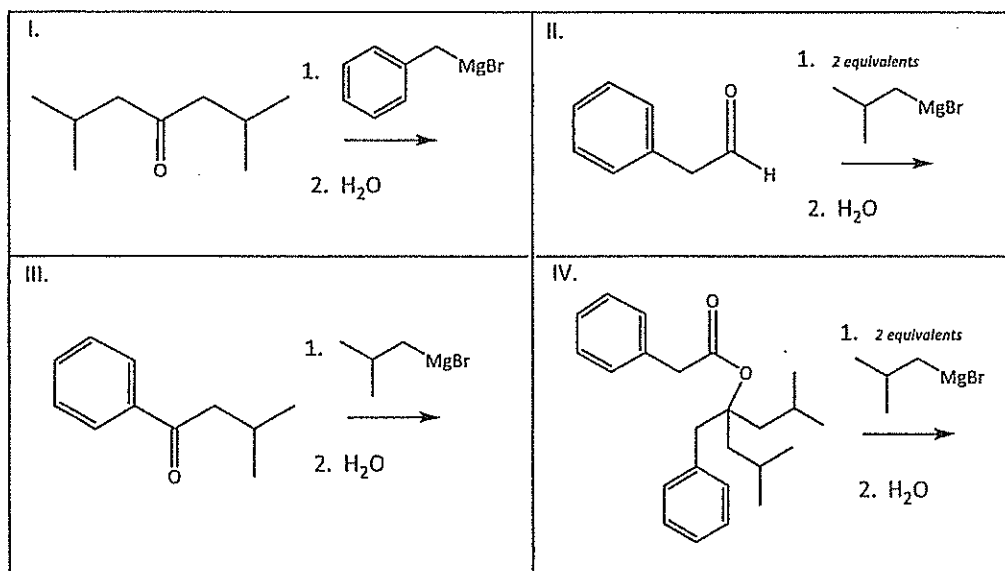
- a) I  
b) II  
c) II & III  
d) IV  
e) I & IV

14. Reaction of which of the compounds below with 1.  $\text{BH}_3$  2.  $\text{H}_2\text{O}_2$ ,  $\text{NaOH}$  will provide a mixture of diastereomers? **A**



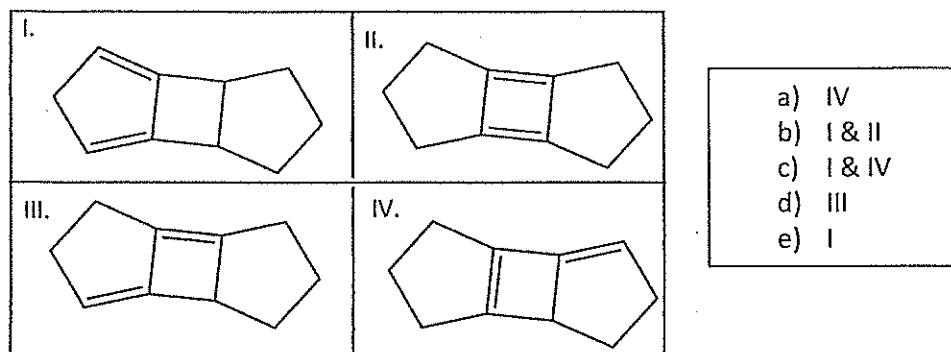
- a) I & III  
b) II & IV  
c) I  
d) I, II, III  
e) I, II, III & IV

15. Which of the following starting material/reagent combinations could be used to prepare 4-benzyl-2,6-dimethyl-4-heptanol? **D**

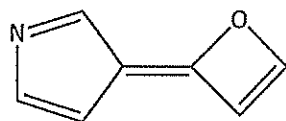


- a) I  
b) I & III  
c) II & IV  
d) I & IV  
e) I, II & IV

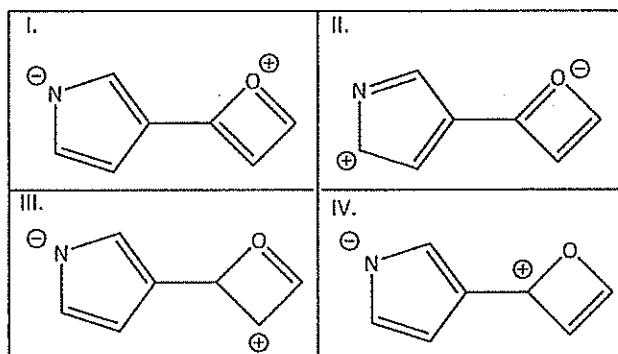
16. For which of the following dienes will only one kinetic and one thermodynamic product form in the reaction with 1 equivalent of HCl? **E**



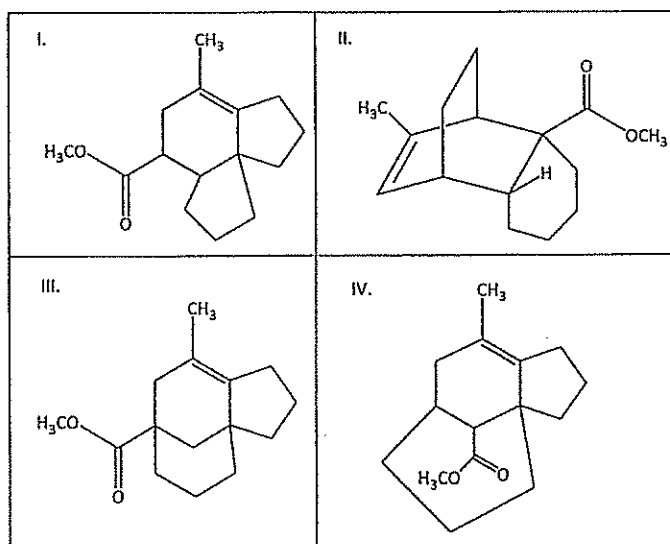
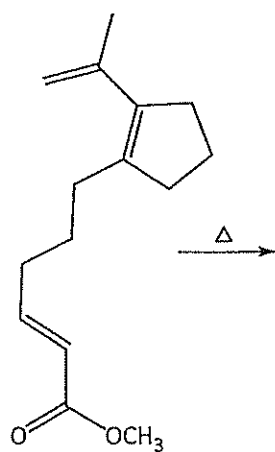
17. Which of the following is a resonance form of the compound below? **E**



- a) I & II  
b) III & IV  
c) I, III & IV  
d) IV  
e) I & IV

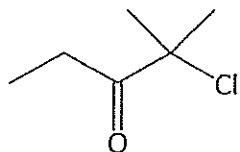


18. Intramolecular Diels-Alder reactions can occur where the diene and dienophile is within the same molecule. The major product(s) of the intramolecular Diels-Alder reaction of the starting material below is (are): **C**



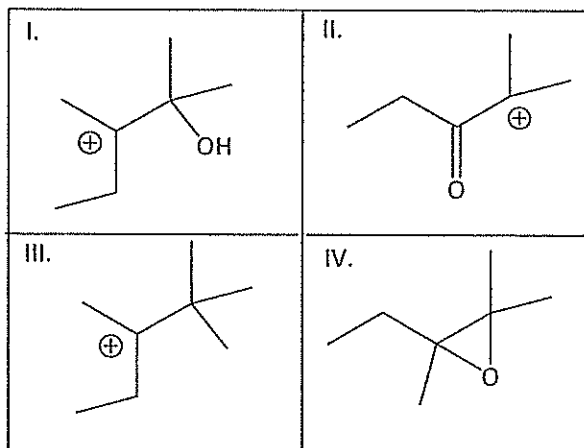
- |            |
|------------|
| a) I & III |
| b) II & IV |
| c) I & IV  |
| d) I       |
| e) III     |

19. Treatment of 2-chloro-2-methyl-3-pentanone with methylmagnesium bromide followed by treatment with  $\text{H}_2\text{SO}_4$  provides 2-hydroxy-2,3-dimethyl-3-pentene as a major *thermodynamic* product. Which of the following represents an intermediate that could be involved in the formation of this product? **B**

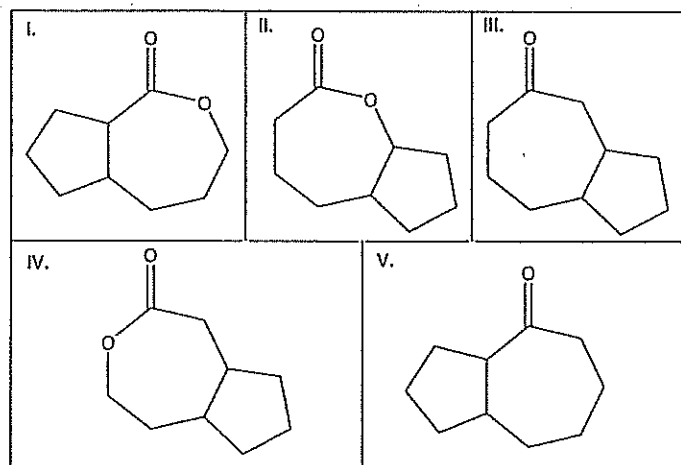


2-chloro-2-methyl-3-pentanone

- |             |
|-------------|
| a) I        |
| b) I & IV   |
| c) I & II   |
| d) III & IV |
| e) II & III |

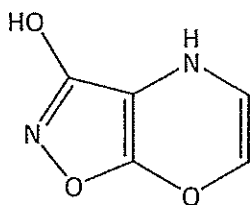


20. Rank the following compounds from most reactive to least reactive (most > least) with 1.  $\text{LiAlH}_4$ , THF 2.  $\text{H}_2\text{O}$ . **A**



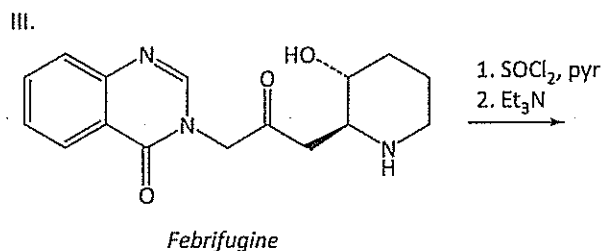
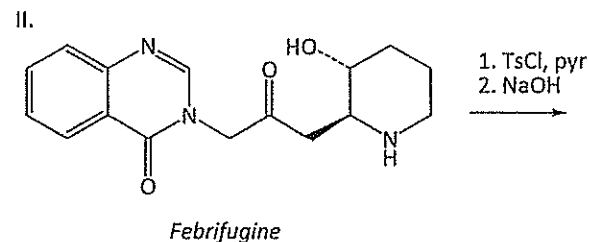
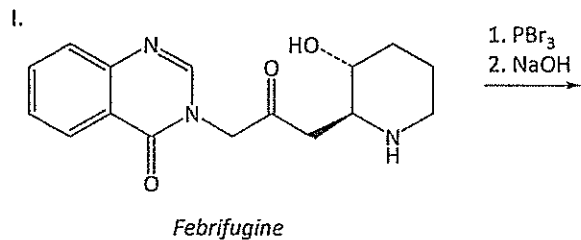
- |                          |
|--------------------------|
| a) III > V > II > IV > I |
| b) V > III > II > IV > I |
| c) III > V > IV > I > II |
| d) V > III > IV > II > I |
| e) III > I > V > II > IV |

21. How many  $\pi$  electrons are associated with the aromatic system in the compound below? **B**



- |           |
|-----------|
| a) 2      |
| b) 6      |
| c) 12     |
| d) 14     |
| e) b or c |

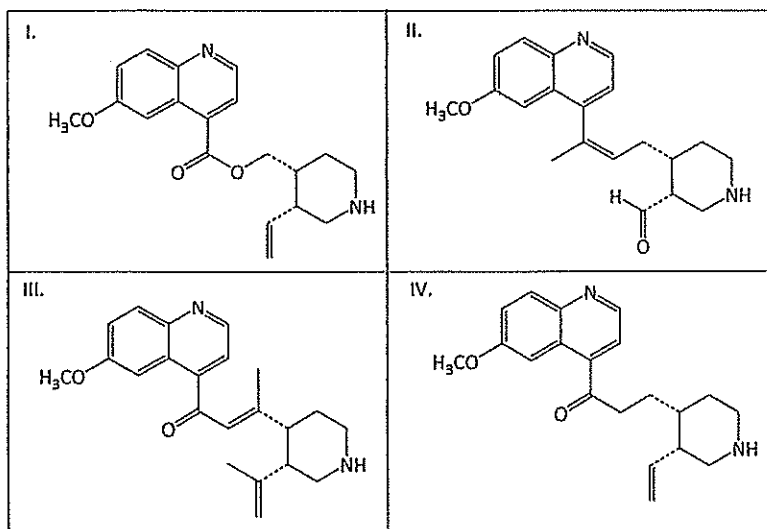
22. Which of the following statements is true regarding the reactions given below? A



- I. Reactions I & II will provide the same major *final* product.  
 II. Reaction III will provide a trisubstituted alkene as a major final thermodynamic product.  
 III. Reaction II will provide a product that is a diastereomer of the final product of I.  
 IV. The first step in all three reactions occurs via an  $\text{S}_{\text{N}}2$  mechanism.

- a) II & III  
 b) II  
 c) III & IV  
 d) III  
 e) I & IV

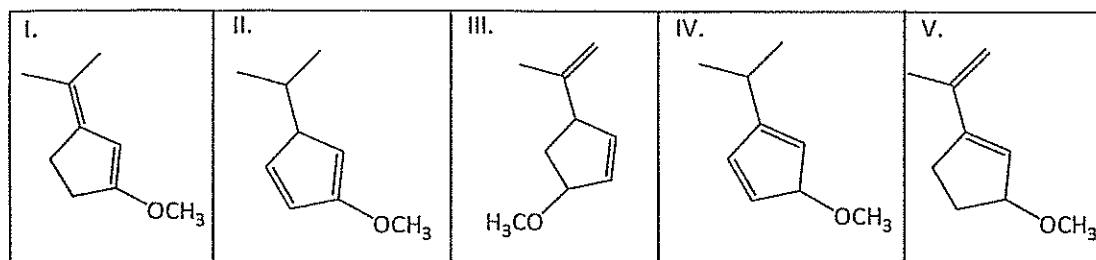
23. Viquidil, a vasodilator reacts with 1)  $\text{BH}_3$  and 2)  $\text{H}_2\text{O}_2$ ,  $\text{NaOH}$  to generate a primary alcohol. Treatment with  $\text{NaBH}_4$  in methanol or 1)  $\text{LiAlH}_4$  and 2)  $\text{H}_2\text{O}$  or 1)  $\text{HgCl}_2$ ,  $\text{H}_2\text{O}$  2)  $\text{NaBH}_4$  gives a secondary alcohol. Which of the following structures represents viquidil?  $\blacktriangleright$



- a) I  
 b) II  
 c) III  
 d) IV  
 e) None of these

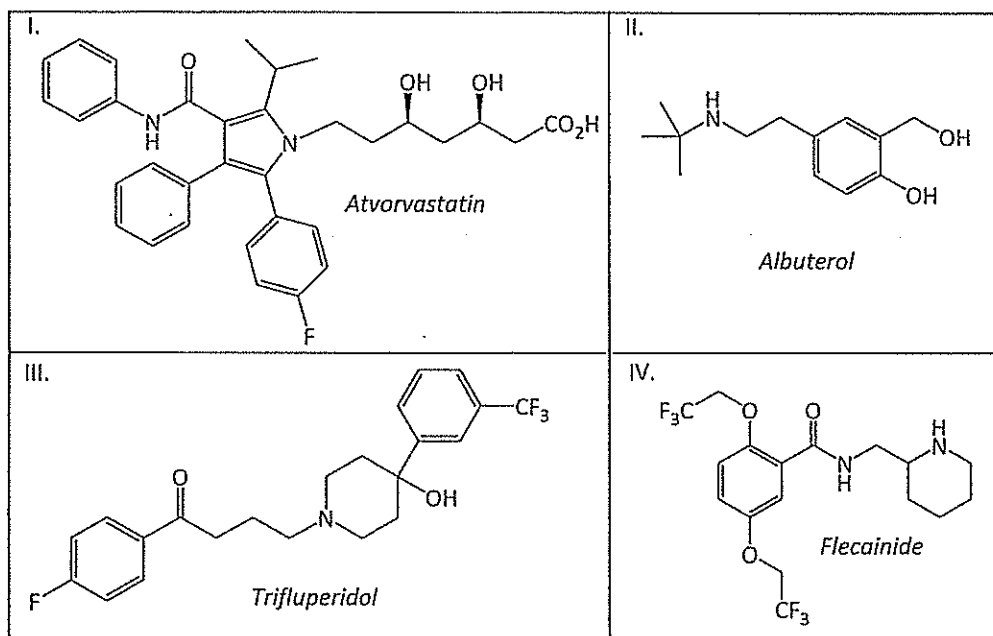


24. The stability order, going from most stable to least stable (MOST>>LEAST), of the dienes given below is: E



- |                          |
|--------------------------|
| a) I > II > III = IV > V |
| b) IV > V > II > I > III |
| c) I > II = V = IV = III |
| d) I > II = IV = V > III |
| e) I > II > IV = V > III |

25. Which of the following drugs contains a benzene ring that is meta substituted? B



- |                |
|----------------|
| a) II & III    |
| b) III         |
| c) I & IV      |
| d) II          |
| e) I, II & III |

