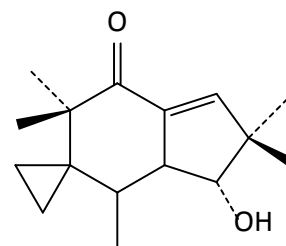


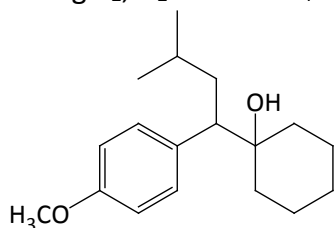
1. The major kinetic product(s) of the reaction the illudin derivative given below with 1 equivalent of HCl contain(s): **A**
- a 3° alkyl chloride and a 2° alcohol
  - a 3° alkyl chloride and a 2° allylic alcohol
  - a 2° allylic chloride and a trisubstituted alkene
  - a 2° alkyl chloride and a trisubstituted alkene
  - a 2° alkyl chloride and a 2° alcohol



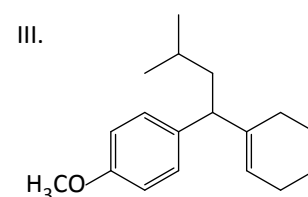
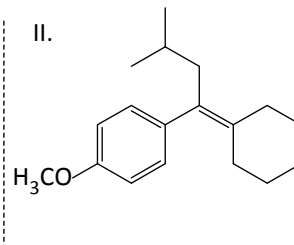
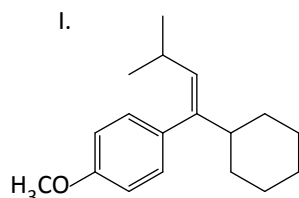
Illudin Derivative

- I
- II
- III
- IV
- V

2. Which of the following alkenes generates venlafaxine as the only major product upon reaction with 1. HgCl<sub>2</sub>, H<sub>2</sub>O 2. NaBH<sub>4</sub>? **D**

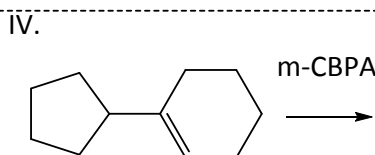
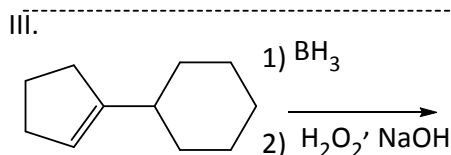
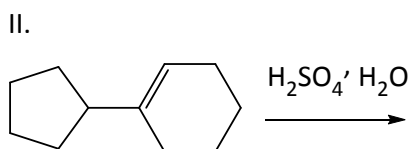
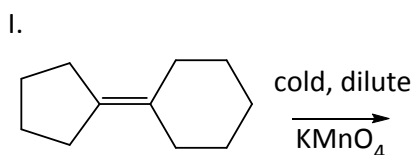


Venlafaxine



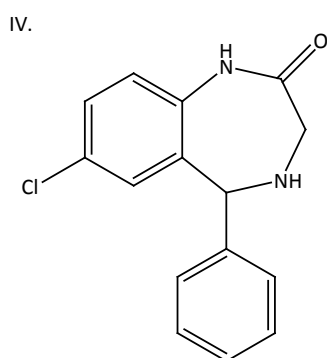
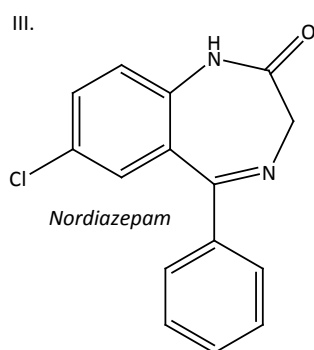
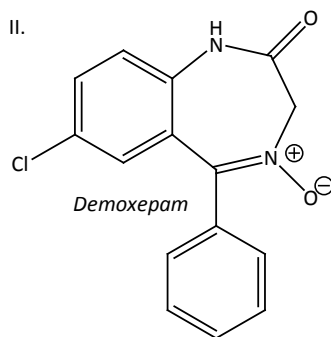
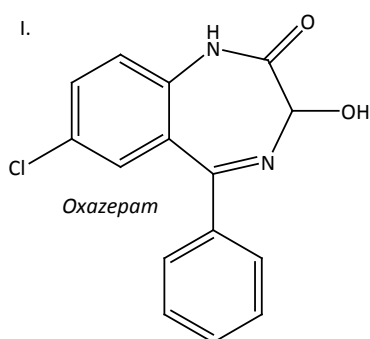
- I only
- II only
- II & III
- III only
- I, II, & III

3. Which of the following reactions will provide a mixture of enantiomers as the major products of the reaction? **E**



- |  |
|--|
| <ol style="list-style-type: none"> <li>IV only</li> <li>II only</li> <li>I &amp; II</li> <li>III only</li> <li>III &amp; IV</li> </ol> |
|--|

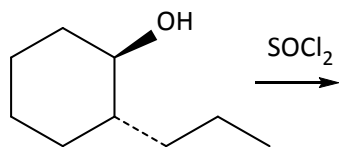
4. Benzodiazepines undergo metabolism in the body through a variety of oxidations and reductions. Identify each of the following conversion as an oxidation, a reduction or neither. **E**



A: I → III  
B: III → II  
C: IV → III

- a) A = Oxidation  
B = Reduction  
C = Oxidation  
b) A = Reduction  
B = Oxidation  
C = Neither  
c) A = Reduction  
B = Reduction  
C = Neither  
d) A = Oxidation  
B = Reduction  
C = Reduction  
e) A = Reduction  
B = Oxidation  
C = Oxidation

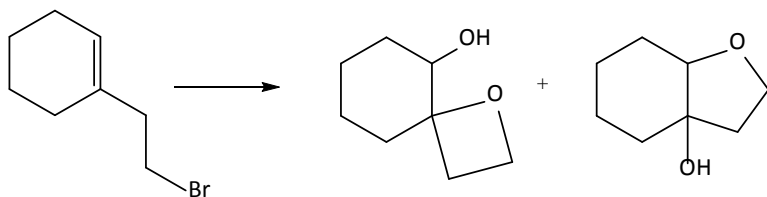
5. The product(s) of the reaction given below is (are): **E**



- I. 1R-chloro-2R-propylcyclohexane  
II. 1S-chloro-2S-propylcyclohexane  
III. 1R-chloro-2S-propylcyclohexane  
IV. 1S-chloro-2R-propylcyclohexane

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

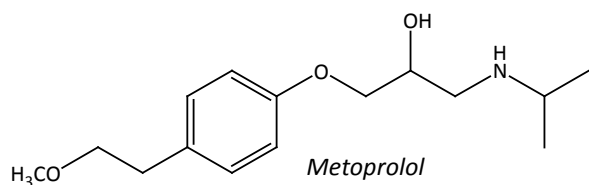
6. Which reagent(s) will provide the products shown as the major kinetic products of the reaction? **C**



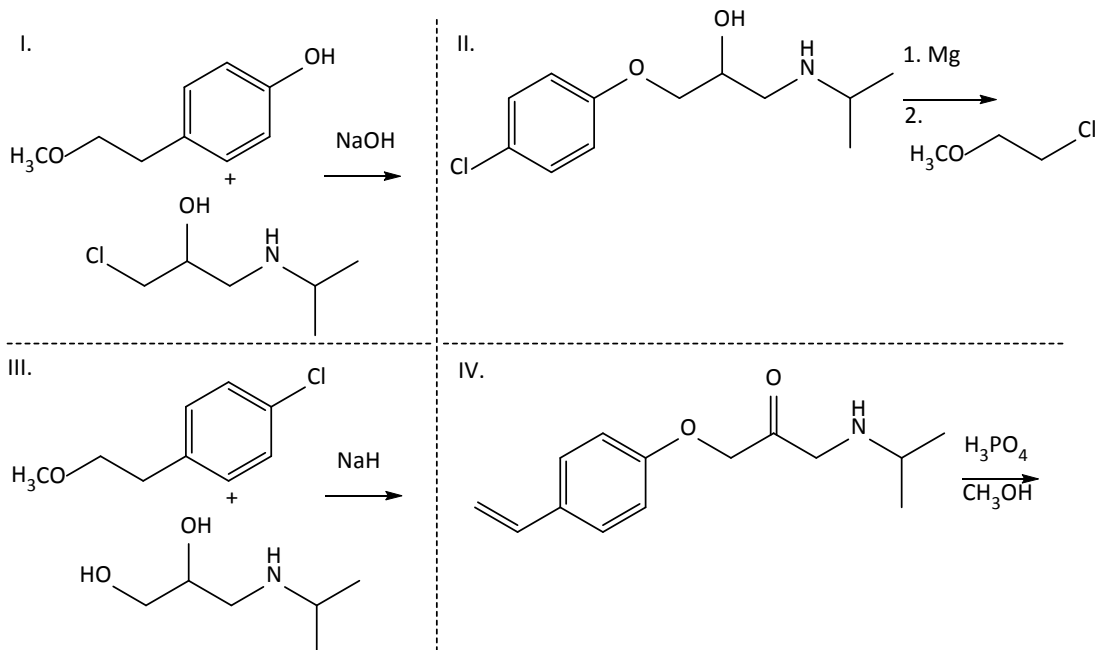
- a) I only  
b) I & II  
c) III only  
d) II & III  
e) III & IV

- I. 1. H<sub>3</sub>PO<sub>4</sub>, H<sub>2</sub>O 2. NaH  
II. 1. BH<sub>3</sub> 2. H<sub>2</sub>O<sub>2</sub>, NaOH 3. NaH  
III. 1. Cold, dilute KMnO<sub>4</sub> 2. 1 equiv NaH  
IV. 1. BH<sub>3</sub> 2. H<sub>2</sub>O<sub>2</sub>, NaOH 3. NaH 4. Mg 5. H<sub>2</sub>O

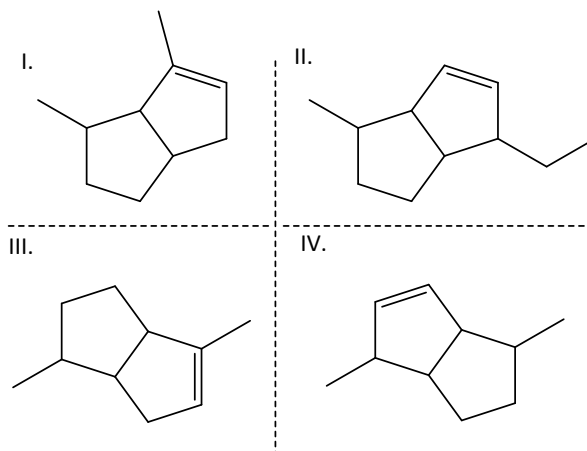
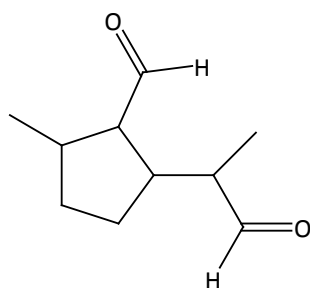
7. Which set of starting materials could be used to prepare an ether functional group in metoprolol through a Williamson ether synthesis? **D**



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

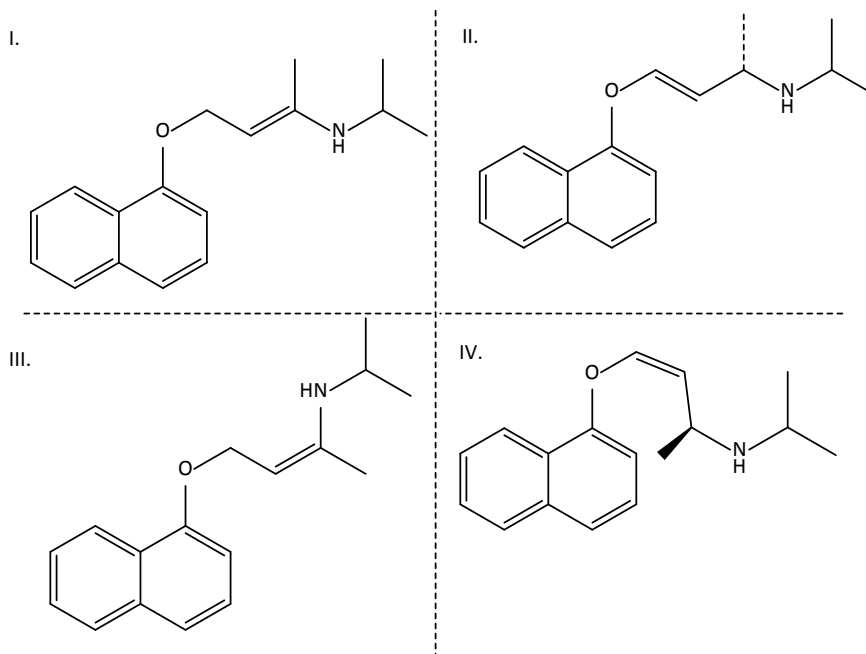
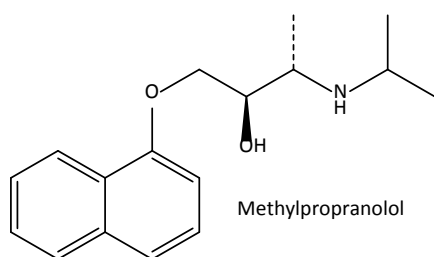


8. Which of the following starting materials, when reacted with ozone (1. O<sub>3</sub> 2. Zn, HCl), will provide the compound below? **A**



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

9. Treatment of methylpropranolol with TsCl, pyridine will provide which of the following alkenes as the major thermodynamic product(s) of the reaction? **C**



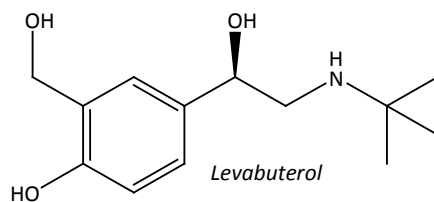
- a) I only
- b) II only
- c) III only
- d) I & III
- e) II & IV

10. Which of the following compounds will provide a product that contains two aldehydes upon reaction with 2 equivalents of PDC,  $\text{CH}_2\text{Cl}_2$ ? **D**

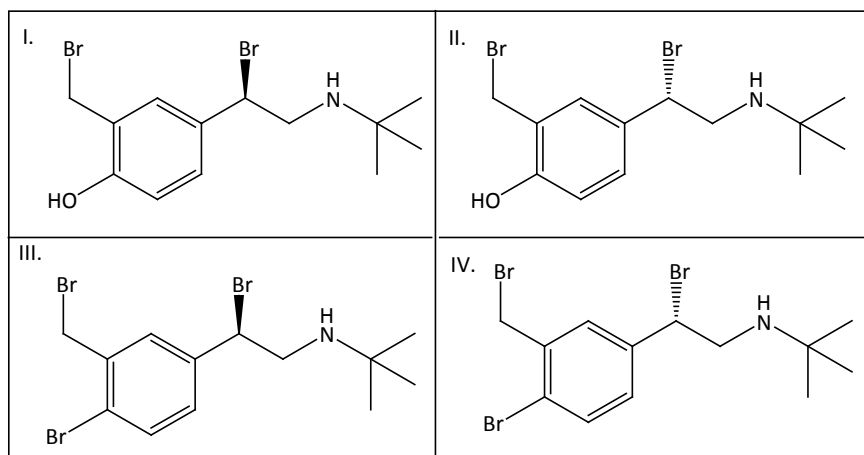
- |                     |
|---------------------|
| I. 1,2-butanediol   |
| II. 1,3-butanediol  |
| III. 1,4-butanediol |
| IV. 2,3-butanediol  |

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

11. Reaction of levabuterol with excess  $\text{PBr}_3$  will provide: **C**



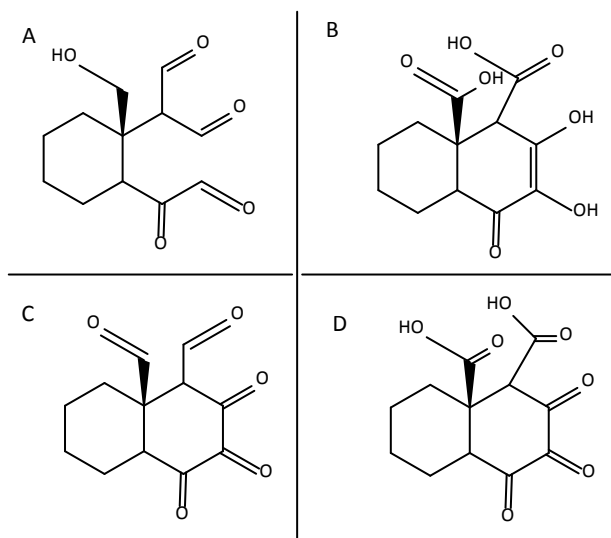
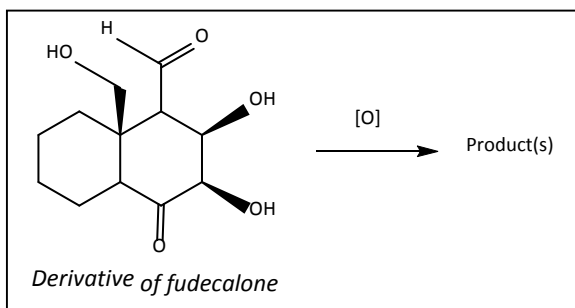
- |            |
|------------|
| a) I only  |
| b) I & II  |
| c) II only |
| d) IV only |
| e) II & IV |



12. The compound below is a derivative of fudecalone, an agent used to control parasitic infections in poultry. This compound can be reacted with a variety of oxidizing agents, listed below (I, II, III, IV). Match each reagent with the product that is generated (A, B, C, D) when the reagent is reacted with this derivative. **A**

- I.  $\text{Na}_2\text{Cr}_2\text{O}_7$   
 II.  $\text{HIO}_4$ ,  $\text{H}_2\text{O}$ , THF  
 III. PDC,  $\text{CH}_2\text{Cl}_2$   
 IV.  $\text{H}_2\text{SO}_4$ ,  $\text{CrO}_3$

- a) I = D ; II = A; III = C; IV = D  
 b) I = D; II = C; III = A; IV = D  
 c) I = B; II = A; III = C; IV = D  
 d) I = D; II = B; III = A; IV = D  
 e) I = B; II = A; III = C; IV = B

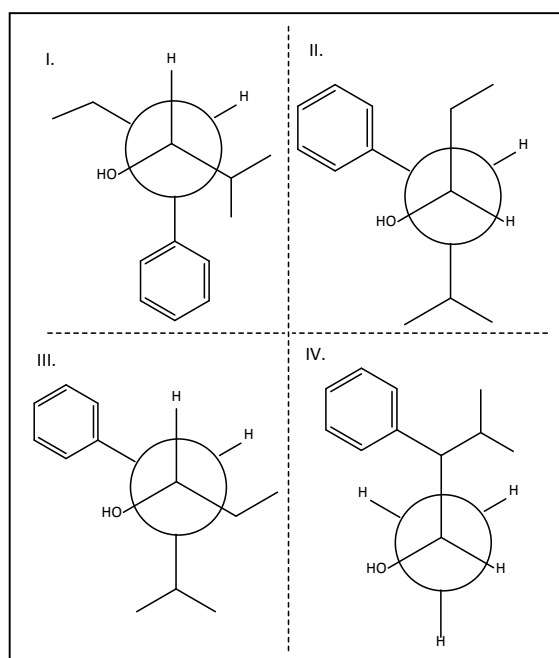


13. Reaction of 3R-methylcyclobutene with cold, dilute  $\text{KMnO}_4$  will provide: **B**

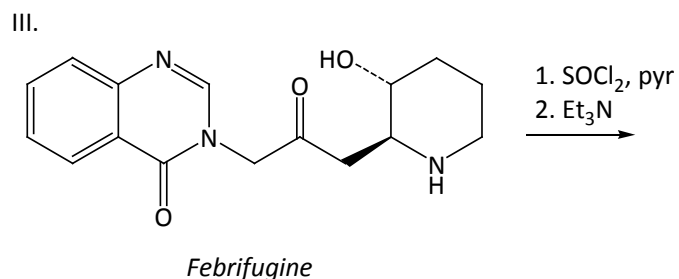
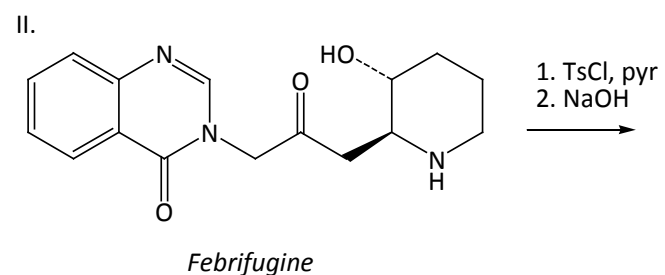
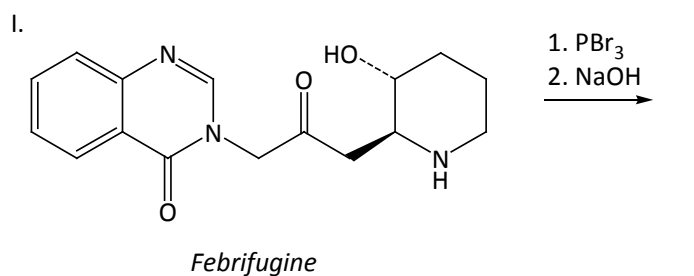
- I. 3R-methyl -1R, 2S-cyclobutanediol  
 II. 3R-methyl -1S, 2R-cyclobutanediol  
 III. 3R-methyl -1S, 2S-cyclobutanediol  
 IV. 3R-methyl -1R, 2R-cyclobutanediol
- a) I & III  
 b) I & II  
 c) II & IV  
 d) III & IV  
 e) I, II, III & IV

14. Which of the following Newman projections represent the conformer(s) that provide(s) the major product(s) of the reaction of 3S, 4S-5-methyl-4-phenyl-3-hexanol with  $\text{POCl}_3$ ,  $\text{Et}_3\text{N}$ ? **B**

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



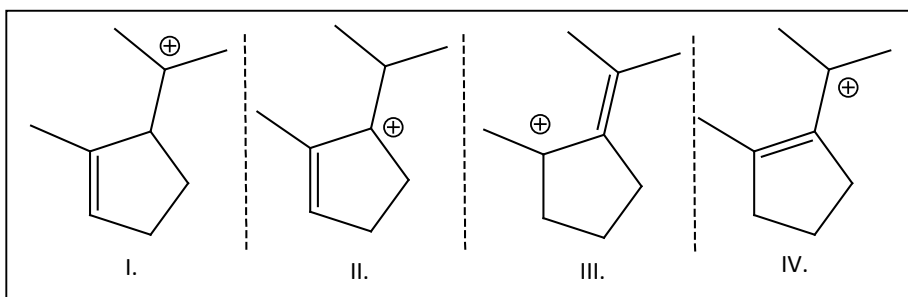
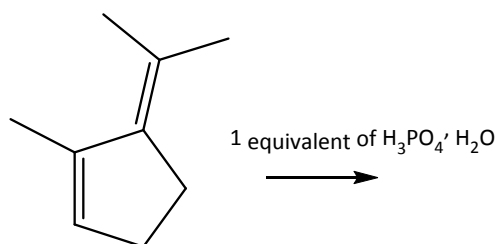
15. Which of the following statements is true regarding the reactions given below? **B**



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

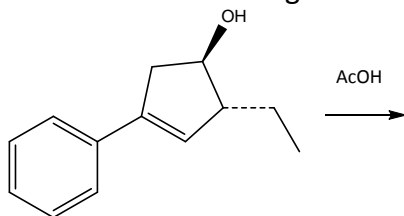
- a) I & IV  
 b) II & III  
 c) III & IV  
 d) II only  
 e) III only

16. Which of the following reaction intermediates will lead to the major *thermodynamic* product in the reaction outlined below? **D**

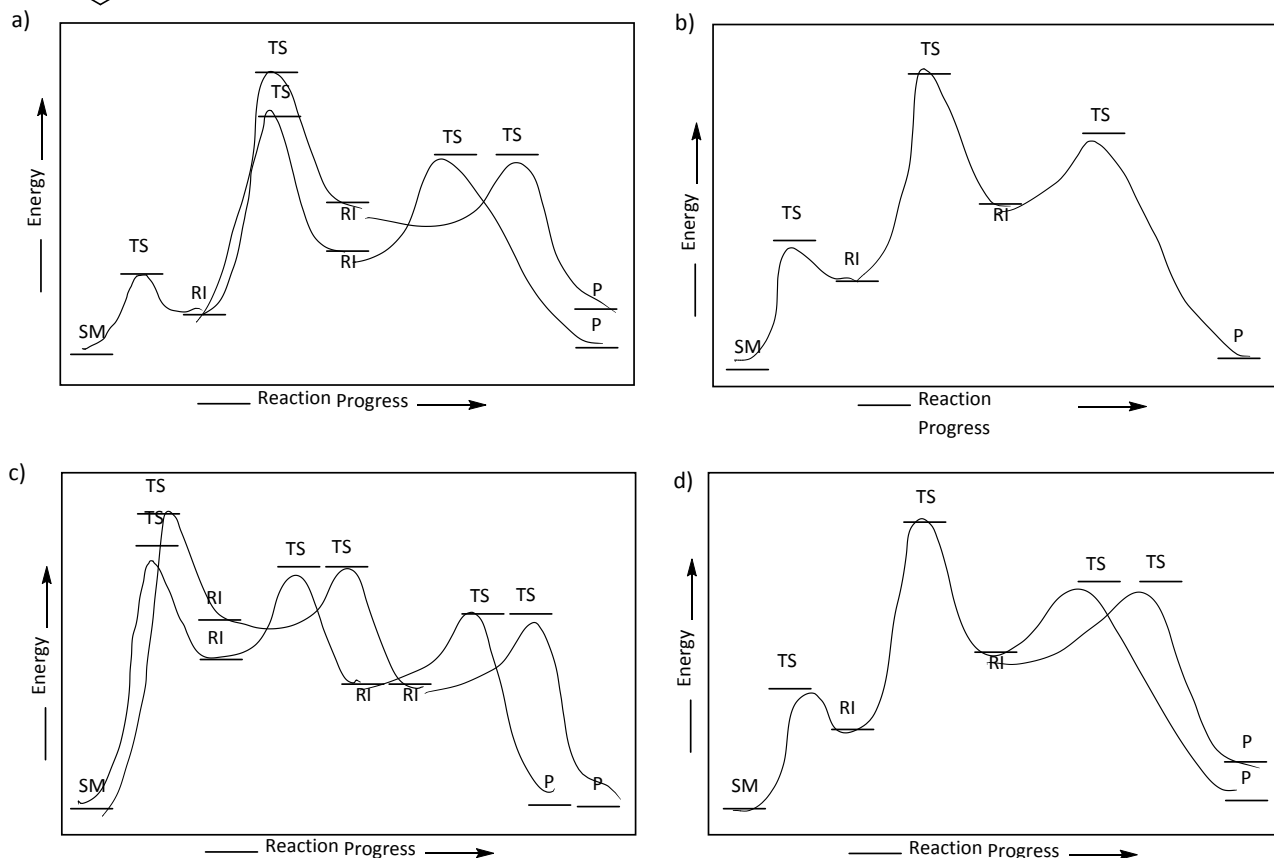


- a) II & III  
 b) I only  
 c) II, III & IV  
 d) III & IV  
 e) I, II, III & IV

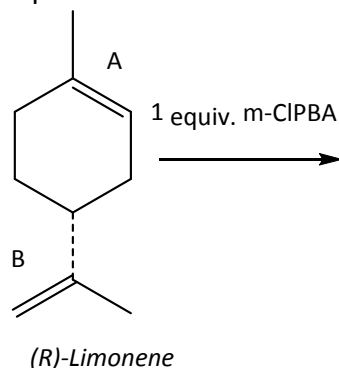
17. Which of the following reaction energy diagrams corresponds to the reaction given below? **D**



SM = starting material  
TS = transition state  
RI = reaction intermediate  
P = product



18. Which of the following statements is true as they relate to the reaction of (R)-limonene with one equivalent of m-CIPBA? **A**



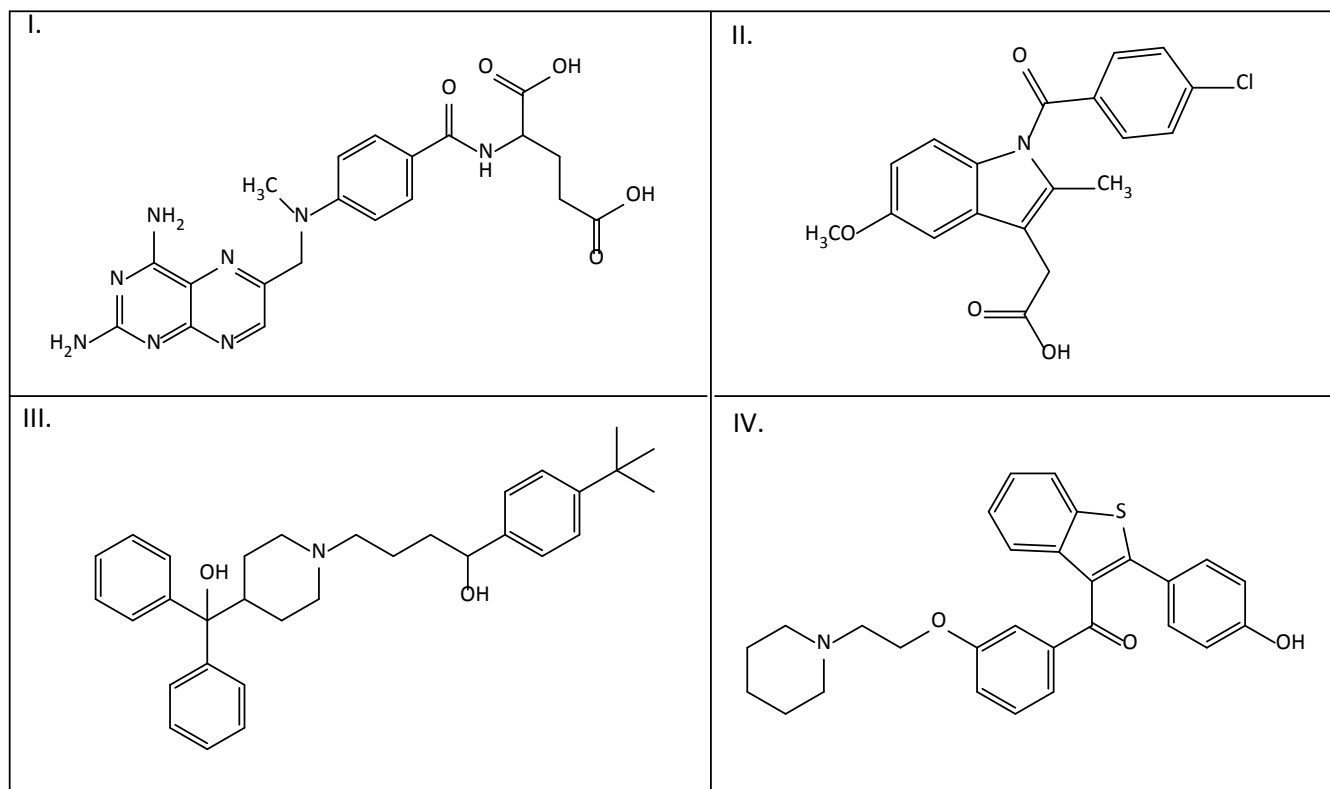
- I. Reaction on the A alkene will provide a mixture of diastereomers.
- II. Reaction on the B alkene will provide a mixture of diastereomers.
- III. Reaction on the A alkene will provide a mixture of enantiomers.
- IV. Reaction on the B alkene will provide a mixture of enantiomers.
- V. Reaction on A or B does not give a mixture of any stereoisomers.

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

19. At pH = 2, raloxifene, terfenadine and methotrexate have ion-dipole interactions, but indomethacin does not. At pH = 8, methotrexate has ion-dipole interactions and H-bonding interactions, indomethacin has only ion-dipole interactions, but no H-bonding and raloxifene and terfenadine have only H-bonding interactions, but no ion-dipole interactions at this pH. At pH 12, raloxifene and indomethacin have only ion-dipole interactions, but no H-bonding interactions. Terfenadine has only H-bonding interactions at pH =12 and methotrexate has both ion-dipole and H-bonding interactions at this pH. Identify the structures of raloxifene, terfenadine, methotrexate and indomethacin. **C**

- a) I = methotrexate II = indomethacin III = raloxifene IV = terfenadine  
 b) I = raloxifene II = terfenadine III = indomethacin IV = methotrexate  
 c) I = methotrexate II = indomethacin III = terfenadine IV = raloxifene  
 d) I = indomethacin II = methotrexate III = terfenadine IV = raloxifene  
 e) I = raloxifene II = methotrexate III = terfenadine IV = indomethacin

pKa Values	
Carboxylic acid	4-6
Phenol	8-10
Amine	6-8
Alcohol	15-20



20. Which of the following compounds contains a tri-substituted alkene and a primary alcohol? **A**

- I. 2-methylcyclopent-2-en-1-ol  
 II. 1-methylcyclopent-3-en-1-ol  
 III. 3-methylpent-3-en-2-ol  
 IV. 2-methylpent-2-en-1-ol  
 V. 4-methylcyclopent-2-en-1-ol

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



21. In the reaction of R-2,3-dimethyl-3-pentanol with  $\text{H}_2\text{SO}_4$ ,  $\text{CH}_3\text{OH}$  which of the following statements is true?

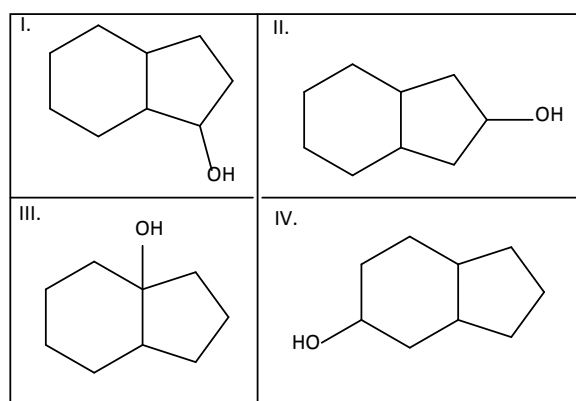
**B**

- I. A pi bond is broken and a sigma bond is formed in the rate-determining step.
- II. A reaction intermediate is generated that contains an  $\text{sp}^2$  carbon.
- III. The product is a mixture of enantiomers.
- IV. The product contains an ether functional group.

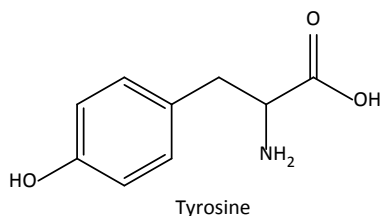
- |                                      |
|--------------------------------------|
| a) I only                            |
| b) II, III & IV                      |
| c) II & IV                           |
| d) II only                           |
| e) None of these statements are true |

22. Which of the following alcohols will form one di-substituted and one tri-substituted alkene as *major kinetic products* when reacted with  $\text{H}_2\text{SO}_4$ ? **A**

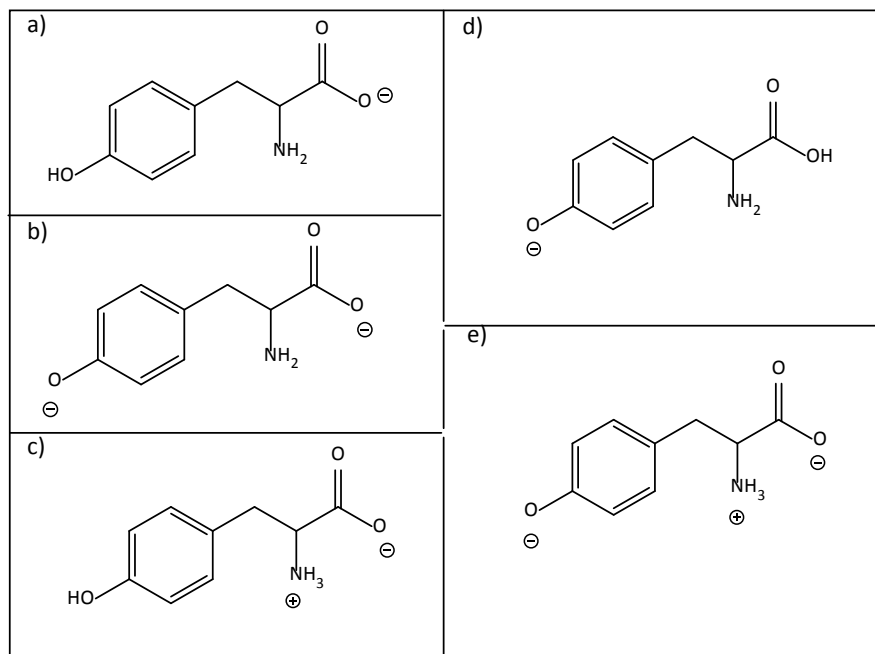
- |             |
|-------------|
| a) I only   |
| b) I & III  |
| c) III only |
| d) IV only  |
| e) II only  |



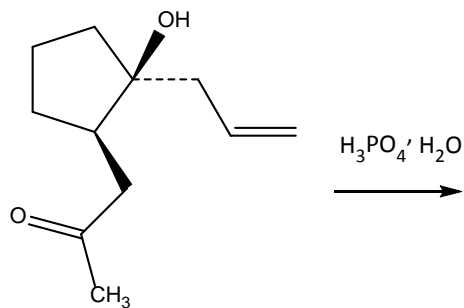
23. Which of the following structures best represents the major form of tyrosine at  $\text{pH} = 8.4$ ? **B**



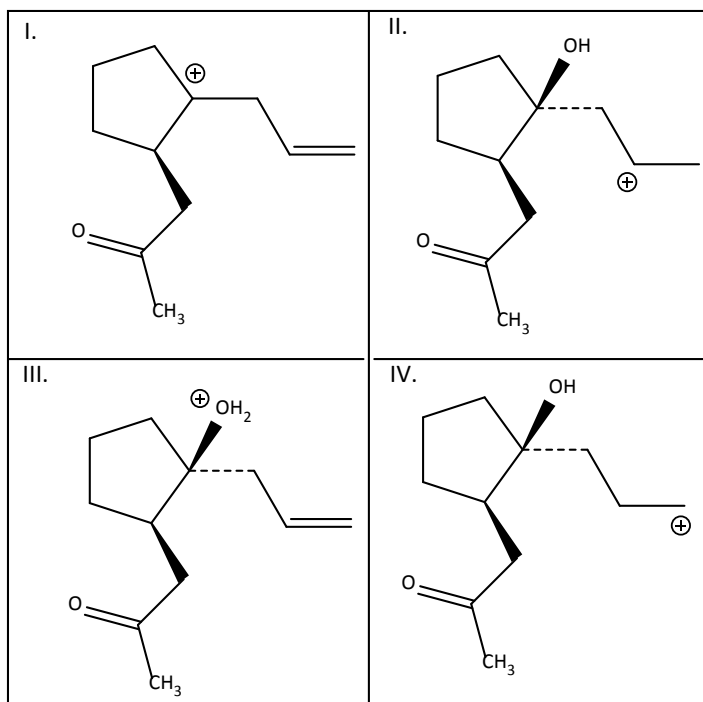
Carboxylic acid $\text{pK}_a = 2$
Phenol $\text{pK}_a = 6.8$
Amine: $\text{pK}_a = 7.9$



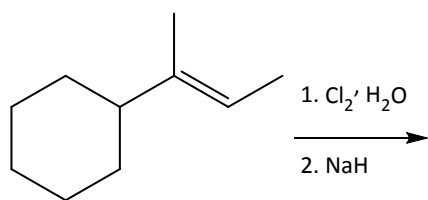
24. Formation of the major product(s) of the reaction below will involve formation of which of the following reaction intermediates? **D**



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



25. The major product(s) of the reaction below is(are): **E**



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

