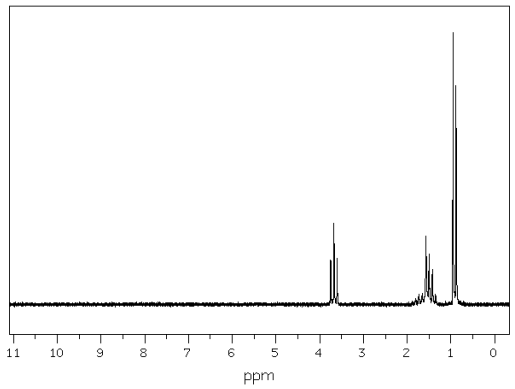
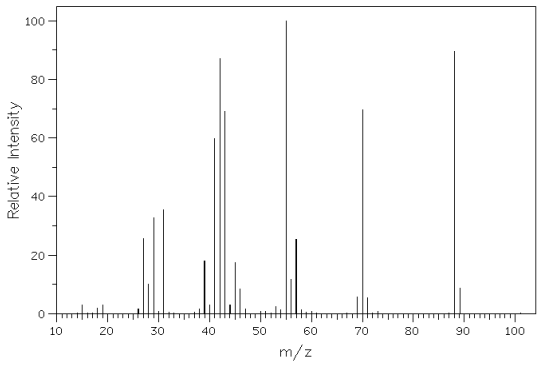
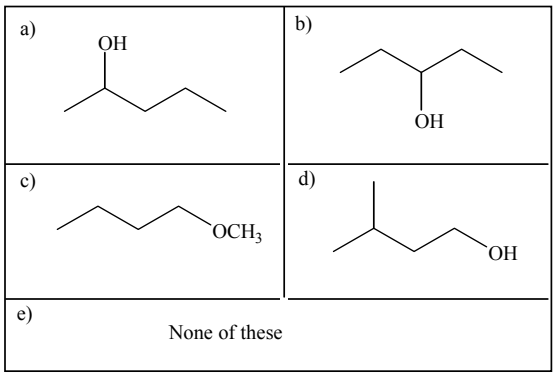
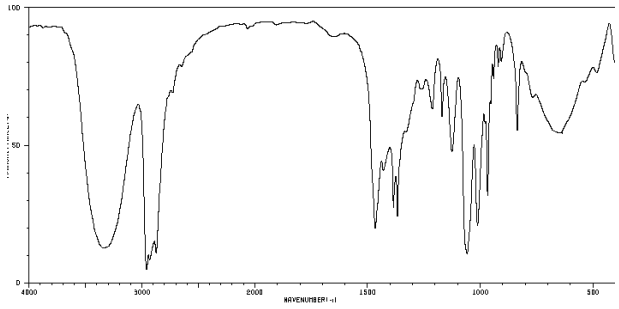
1. Which of the following compounds corresponds to the spectral data given below?



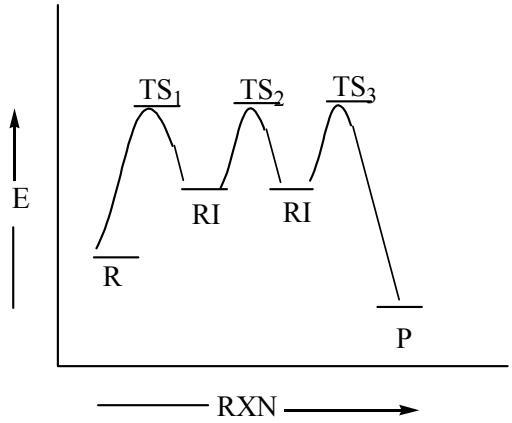


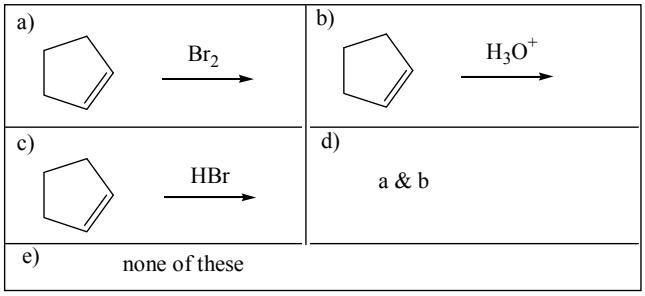
D





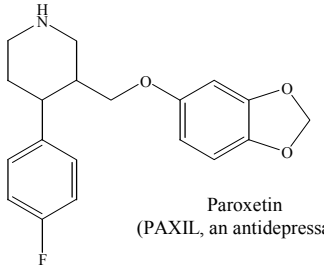
2. The reaction energy diagram given below corresponds to which of the following reactions?





D

3. How many chiral centers are present in the molecule given below?



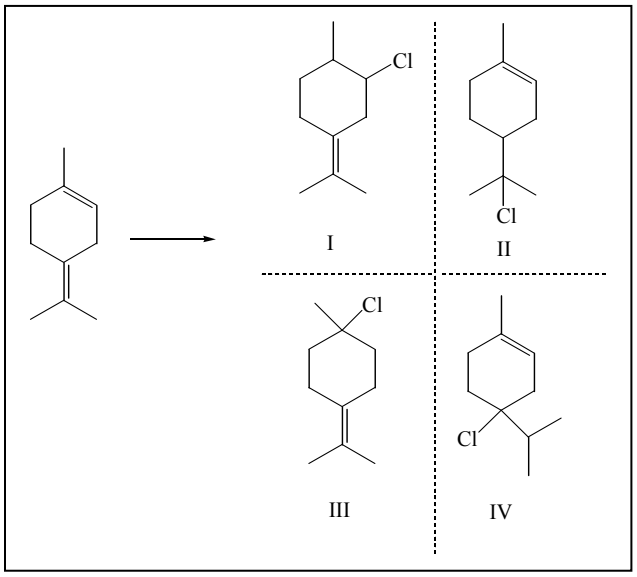
Paroxetin
(PAXIL, an antidepressant)

a) none
b) 1
c) 2
d) 3
e) 4

C

4. For the reaction given below, which of the following statement(s) is (are) true?

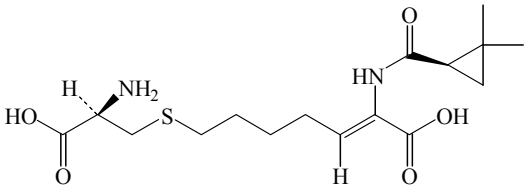
a) The electrophilic reagent is HCl
b) The kinetic product is a racemic mixture
c) Products I and III are thermodynamic products
d) a & c
e) a, b & c



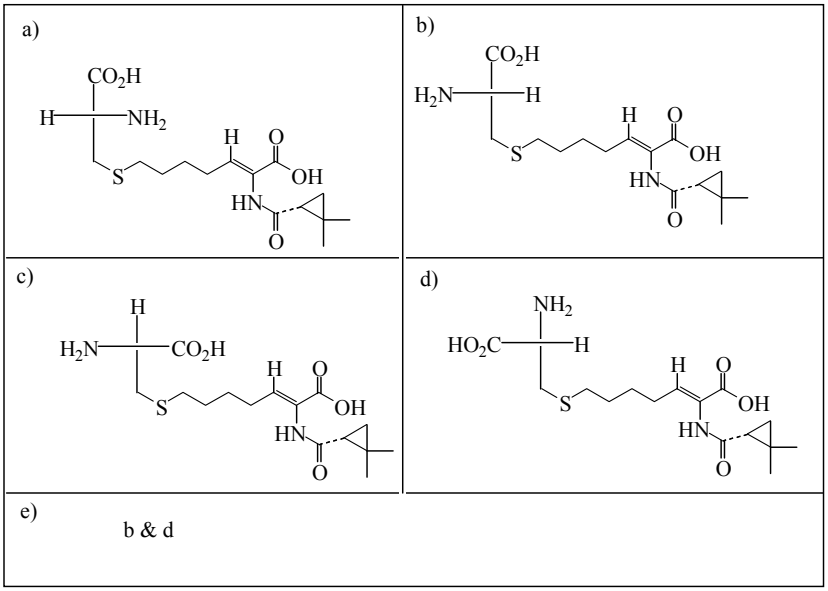
D

5. A Fisher projection for cilastatin, a dipeptidase inhibitor, is:

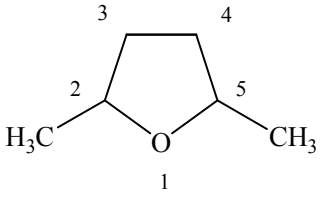
B



Cilastatin



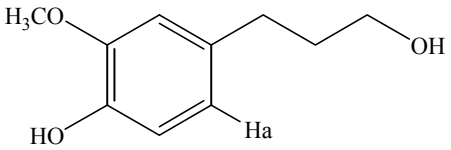
6. Which stereoisomer(s) of 2,5-dimethyltetrahydrofuran is (are) meso?



a) 2S, 5S
b) 2R, 5R and 2S, 5S
c) 2S, 5R
d) 2R, 5S and 2S, 5R
e) none of these

D

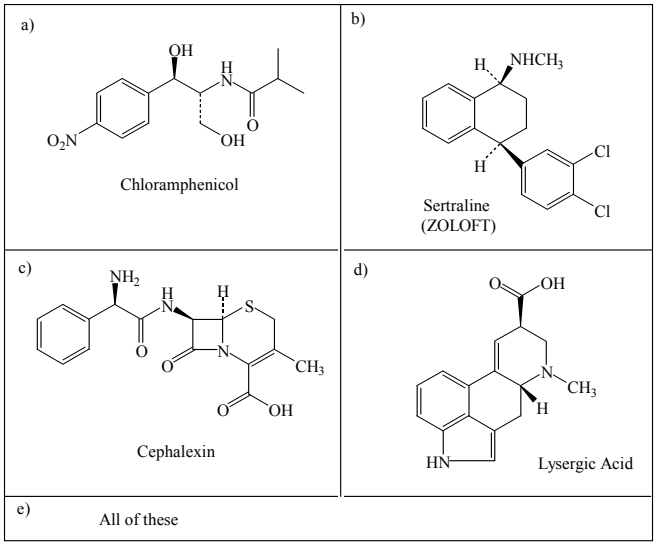
7. In the NMR spectrum of the alcohol given below, the Ha proton will appear:



a) as a singlet between 6.5-8.5 ppm
b) as a singlet between 2.5-4.5 ppm
c) as a doublet between 6.5-8.5 ppm
d) as a triplet between 6.5-8.5 ppm
e) anywhere

C

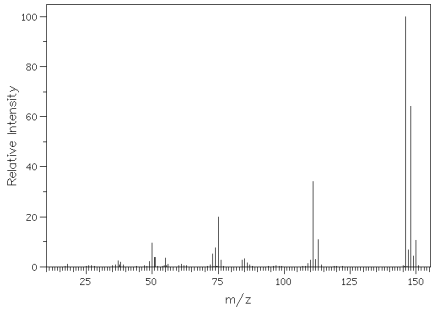
8. Which of the following compounds contains a chiral center with an R configuration?



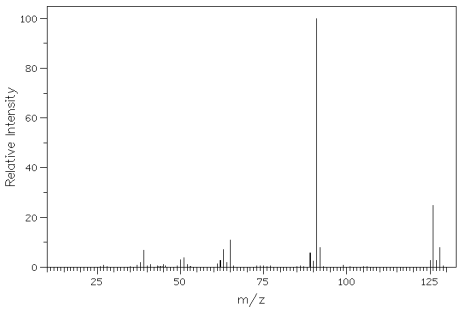
E

9. Which of the follow mass spectra corresponds to ortho-dichlorobenzene?

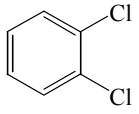
a)



b)

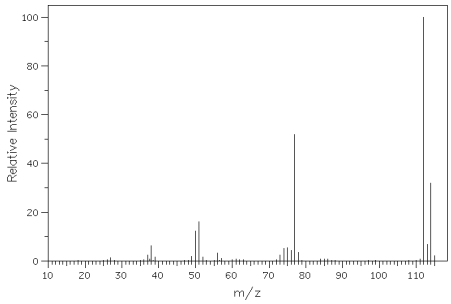


A

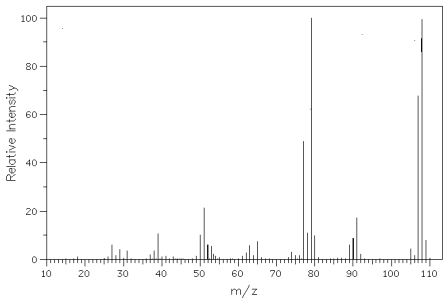


ortho-dichlorobenzene

c)

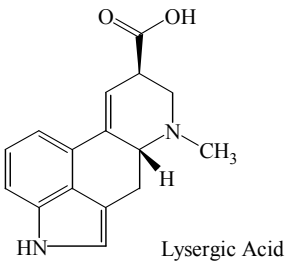


d)

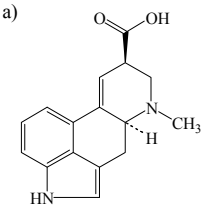


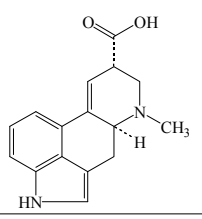
e) none of these

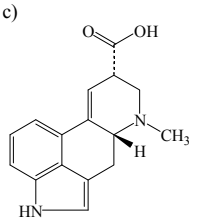
10. Lysergic acid has an optical rotation of +40°. Which of the following compounds has an optical rotation of –40°?

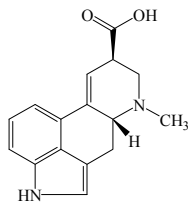


Lysergic Acid

a)


b)


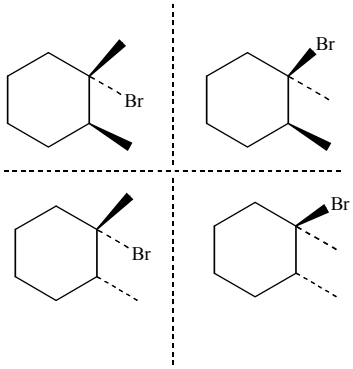
c)


d)


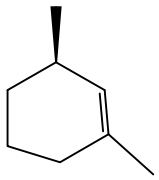
e) b & d

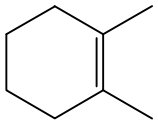
B

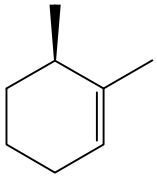
11. Which of the following alkene(s) will give rise to the product mixture given below when reacted with HBr under kinetic conditions?

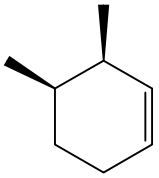


Product Mixture

a)


b)


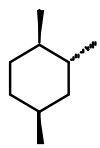
c)


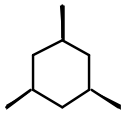
d)


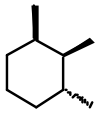
e) b & c

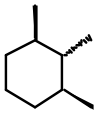
B

12. Which of the following statements is true regarding the stereochemical relationships of compounds A-D?


A


B


C

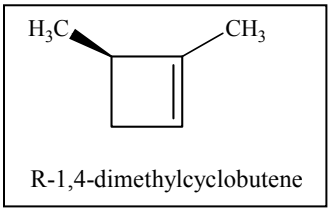

D

a) Structures C and D are meso compounds
b) Structure C and D are diastereomers
c) Structures A and C are diastereomers
d) Structures B & D are positional isomers
e) b & d

E

13. How many stereoisomers are formed upon reaction of H_3O^+ (kinetic conditions) with R-1,4-dimethylcyclobutene?

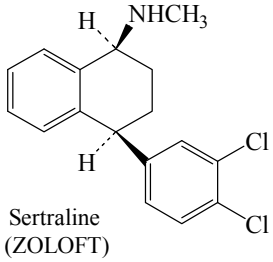
a) 2
b) 4
c) 8
d) 16
e) 32



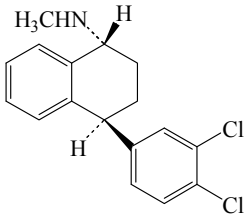
R-1,4-dimethylcyclobutene

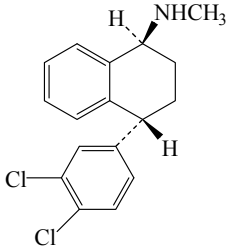
A

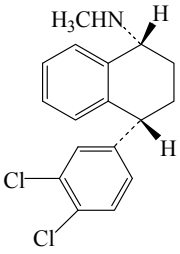
14. A diastereomer of setraline, an antidepressant is:

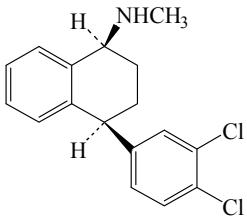


Sertraline
(ZOLOFT)

a)


b)


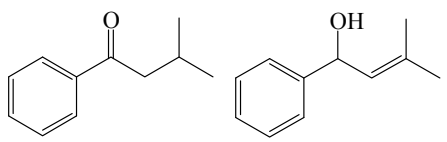
c)


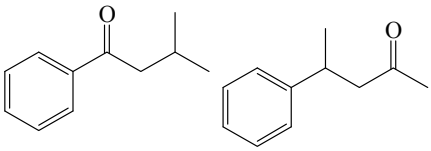
d)


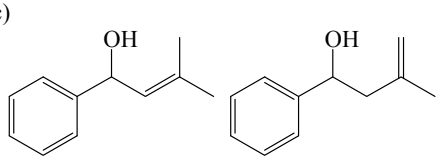
e) a & b

E

15. Which of the following pairs of compounds could be distinguished by IR spectroscopy?

a)


b)


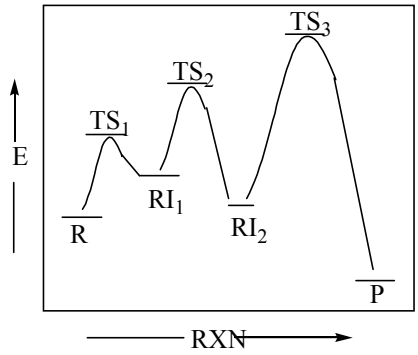
c)


d) a & c

e) none of these

A

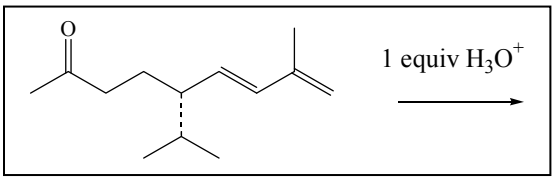
16. The rate-determining step of the reaction depicted in the reaction energy diagram given below involves which of the following transformation(s)?



a) R -->RI_1
b) RI_1 --> RI_2
c) RI_2 --> P
d) a & b
e) All steps of the reaction occur at the same rate

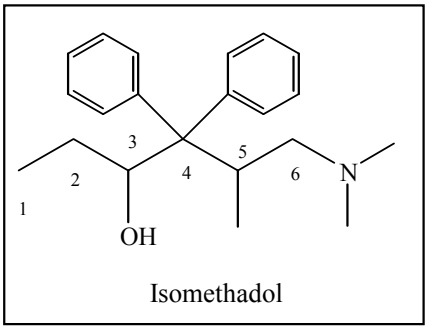
C

17. The thermodynamic product(s) of the reaction given below:
    a) is derived from a 2 ° alkyl carbocation
    b) is derived from a 3 ° allylic carbocation
    c) is derived from a 2 ° allylic carbocation
    d) is derived from a 1 ° allylic carbocation
    e) c & d

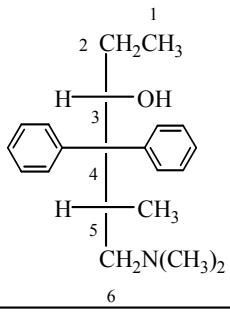


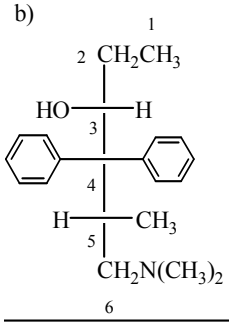
E

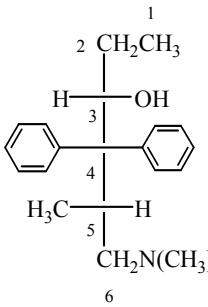
18. Isomethadol is an analgesic agent whose 3R, 5S stereoisomer has potent analgesic activity. None of the other stereoisomers of this compound have analgesic activity. Which of the following compounds corresponds to the active form of isomethadol?

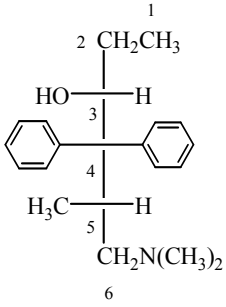


B

a)


b)


c)


d)


e) a & c

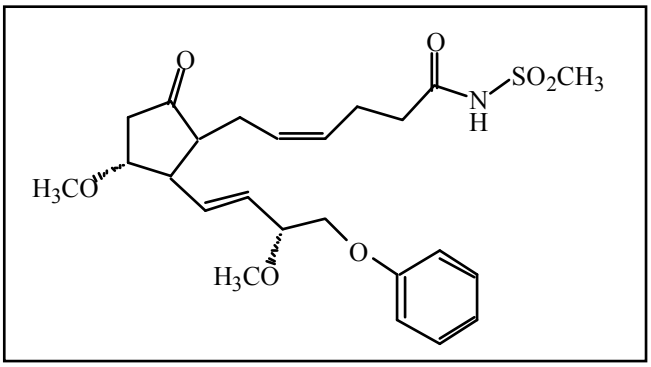
19. An absorbance value of 0.71 was obtained in the UV spectrum of ephedrine at λ_{max} = 254. The concentration of this solution is:
(Standard curve data is provided in the table below. Assume a pathlength = 1)

Standard Curve Data	
Concentration	***A***
2.5 X 10^{-4} M	0.625
3.5 X 10^{-4} M	0.875
4.5 X 10^{-4} M	1.125
5.5 X 10^{-4} M	1.375

a) 2.79 X 10^{-3} M
b) 1.775 X 10^{3} M
c) 2.84 X 10^{-4} M
d) 6.4 X 10^{-4} M
e) none of these

C

20. Reaction of the molecule below with 1 equivalent of HBr under kinetic conditions will provide (a) product(s) that contain(s):



a) a secondary alkyl bromide
b) a cis double bond
c) a trans double bond
d) a & c
e) all of these

D

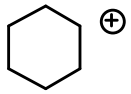
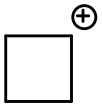
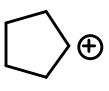
21. Reaction of 2-chloro-3-ethyl-5-methylhexane with acid gives 3-chloro-3-ethyl-5-methylhexane. This reaction type is:
a) an addition
b) a substitution
c) an elimination
d) a rearrangement
e) none of these

D

22. A transition state structure in a single-step, exothermic reaction:
a) is lower in energy than the products
b) is lower in energy than the reactants
c) leads to a reaction intermediate
d) is closer in energy to the reactants
e) is closer in energy to the products

D

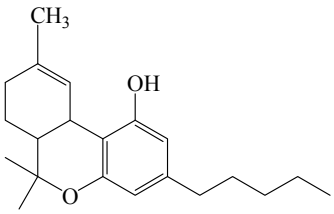
23. The most stable reaction intermediate given below is:

a) 
b) 
c) 
d) 
e) All of these are equally stable.

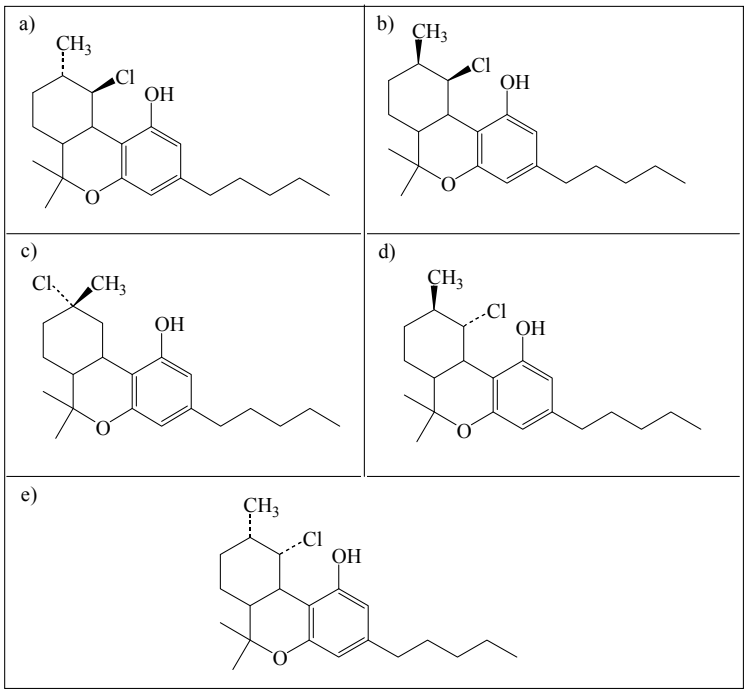
A

24. The major kinetic product of the reaction of Δ^1-THC with HCl is:

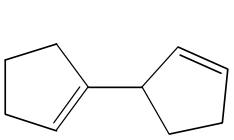
C



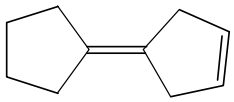
Δ^1-THC



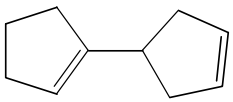
25. Which of the following compounds will react the fastest with HBr?



I



II



III

a) All react at the same rate
b) I &II
c) I & III
d) II & III
e) II

C

Chemical Shift Ranges for Protons in NMR Spectroscopy

Range	Type of Proton
0-1.5 ppm	H atoms bonded to sp3 carbons where the sp3 carbons are only bonded to other sp3 carbons and hydrogen (alkanes)
1.5 - 2.5 ppm	H atoms bonded to sp3 carbons where the sp3 carbon is bonded to at least one sp2 C and no heteroatoms (allylic, benzylic, α-H)
2.5 - 4.5 ppm	H atoms bonded to an sp3 C that is also bonded to at least one heteroatom
4.5 - 6.5 ppm	H atoms bonded to sp2 carbons of alkenes (not aromatic sp2 carbons)
6.5 - 8.5 ppm	H atoms bonded to sp2 carbons of an aromatic ring
10 - 12 ppm	H atom bonded to an sp2 carbon atom of the carbonyl group of an aldehyde or H atom bonded to the sp3 oxygen of a carboxylic acid.
Anywhere	H atom directly bonded to a heteroatom other than the oxygen atom of a carboxylic acid. Show up as a broad singlet

Absorbance Ranges for Bond Types in IR Spectroscopy

Absorbance Range	Functional Group Class
2850-2960 cm^{-1}	Alkanes, Alkyl Groups (C_{sp3}-H)
3020-3100 cm^{-1}	Alkenes, Aromatics (C_{sp2}-H)
1640-1680 cm^{-1}	Alkenes (C=C)
3300 cm^{-1}	Alkynes (C_{sp}-H)
2100-2260 cm^{-1}	Alkynes (C=C)
500-800 cm^{-1}	Alkyl Halide (C-X, X = halogen)
3200-3650 cm^{-1}	Alcohol, Carboxylic acid (O-H)
1600 cm^{-1}, 1500 cm^{-1}	Aromatic (C=C)
1680-1850 cm^{-1}	Carbonyl (C=O, ketone, aldehyde, ester, amide, carboxylic acid)
3300-3500 cm^{-1}	Amines (N-H)
1540 cm^{-1}	Nitro ($-NO_2$)

Natural Abundances of Atoms Common in Organic Molecules

Atom	Natural Abundance
^{12}C	98.895%
^{13}C	1.1%
^{14}C	0.005%
^{35}Cl	75%
^{37}Cl	25%
^{79}Br	51%
^{81}Br	49%