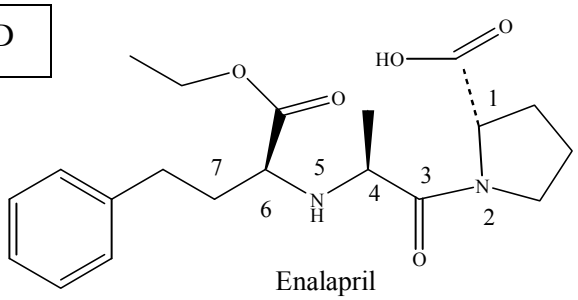
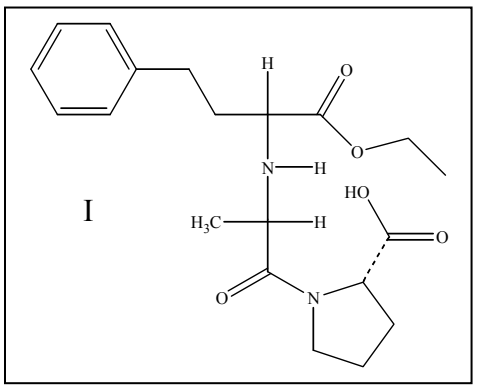
1. Which of the following statements is true as they relate to enalapril, an ACE inhibitor (antihypertensive agent)?

D

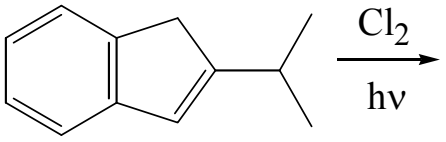


Enalapril
(antihypertensive)

a) The configuration of the chiral centers are 1R, 4S, 6S.
b) The Fisher projection labeled "I" is an enantiomer of enalapril
c) The Fisher projection labeled I is a diastereomer of enalapril.
d) The Fisher projection labeled I represents the exact structure of enalapril.
e) a & d

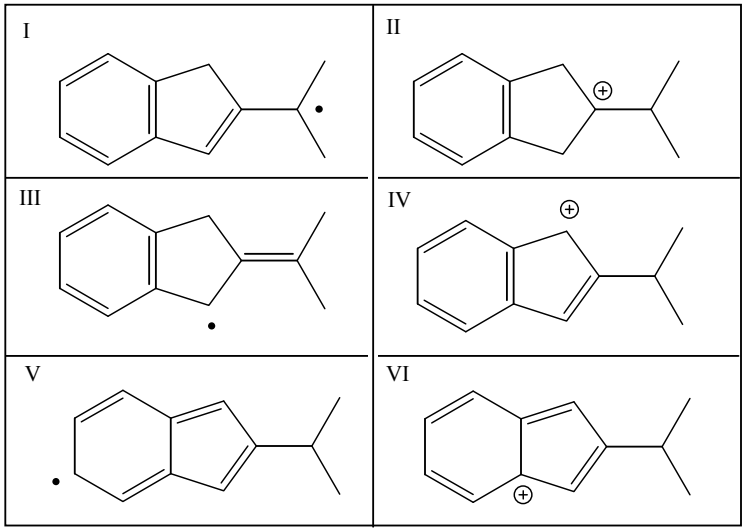


2. Which of the following reaction intermediate(s) would give rise to the major product in the reaction given below?



A

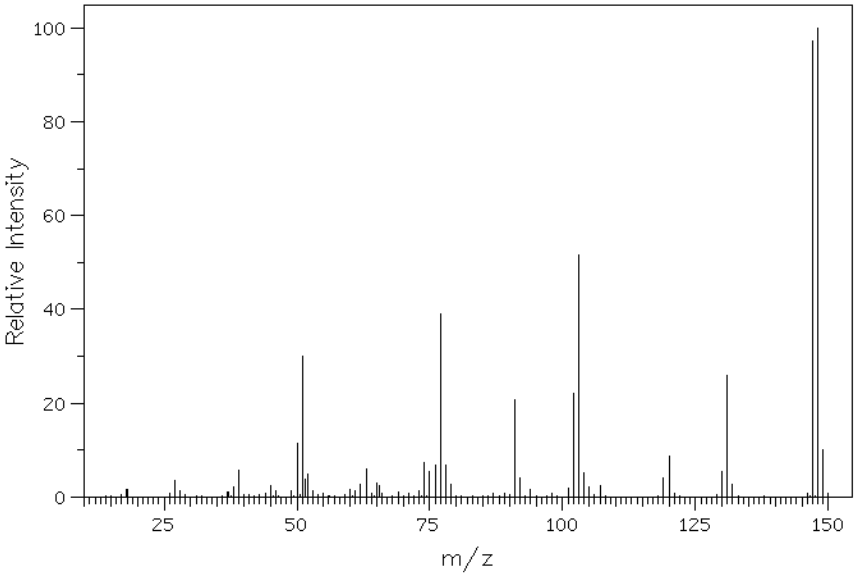
a) I
b) III & V
c) VI
d) I, III, V
e) VI

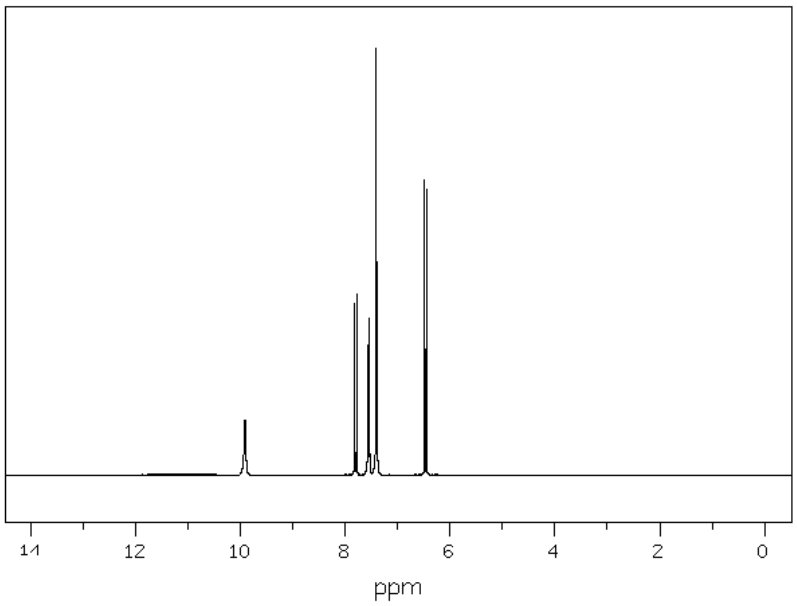


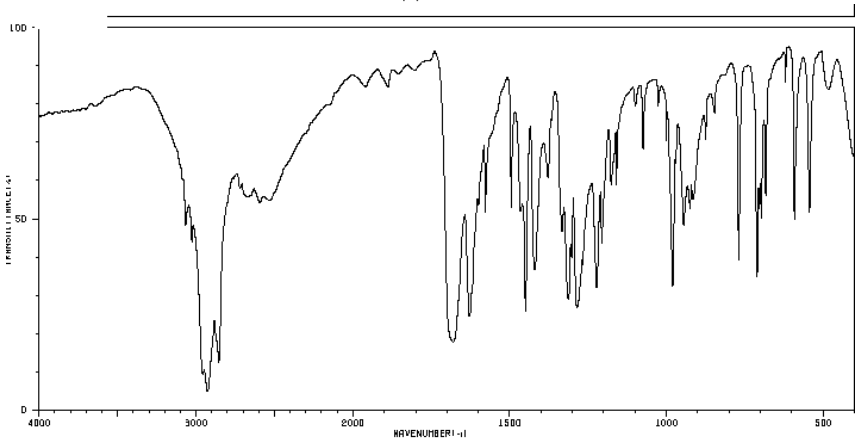
3. The most stable reaction intermediate in the reaction of 2,4-dimethyl-2-pentene with HCl is:
   a) a tertiary allylic carbocation
   b) a tertiary alkyl radical
   c) a tertiary alkyl carbocation
   d) a secondary allylic carbocation
   e) a secondary alkyl carbocation

C

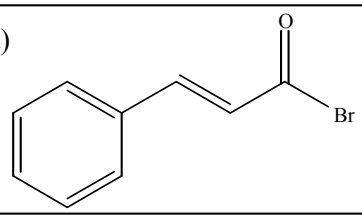
4. Which of the following compounds is most consistent with the spectra data given below?

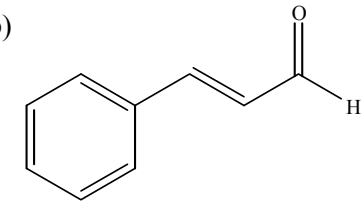


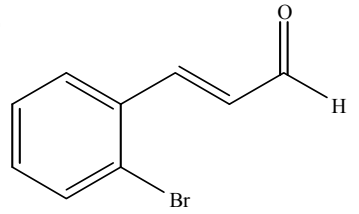


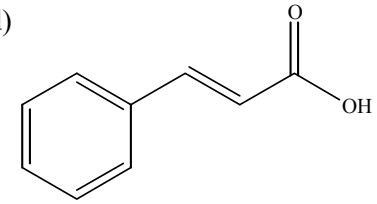


D

a) 

b) 

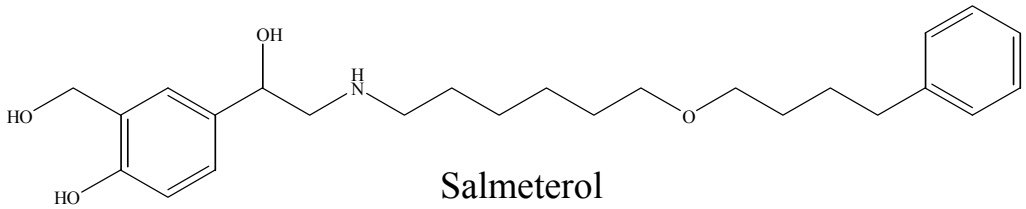
c) 

d) 

e) none of these

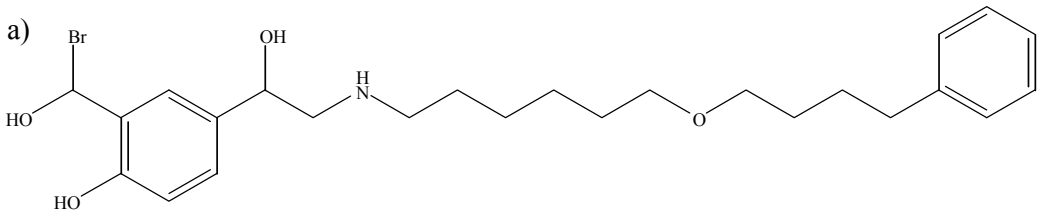
5. Which of the following would form as the *major product(s)* in the bromination of salmeterol (ADVAIR), a bronchodilator, with NBS/hν?

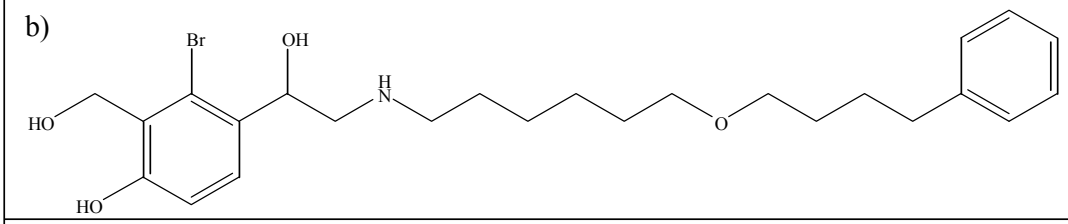
D

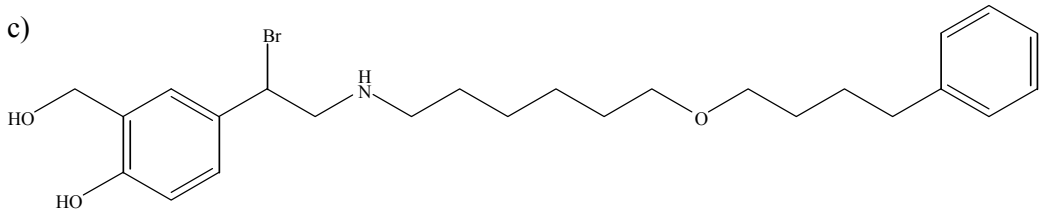


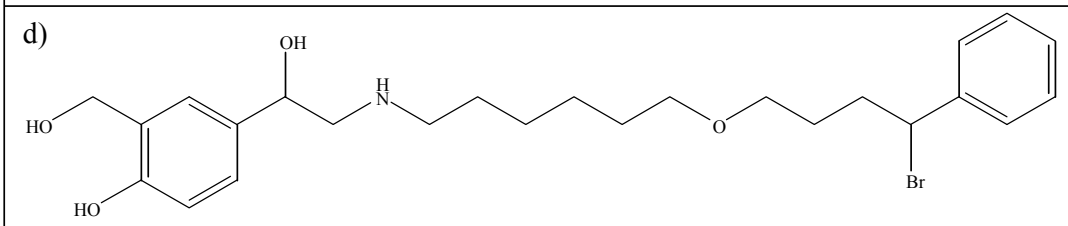
Salmeterol

(bronchodilator)

a)


b)


c)


d)


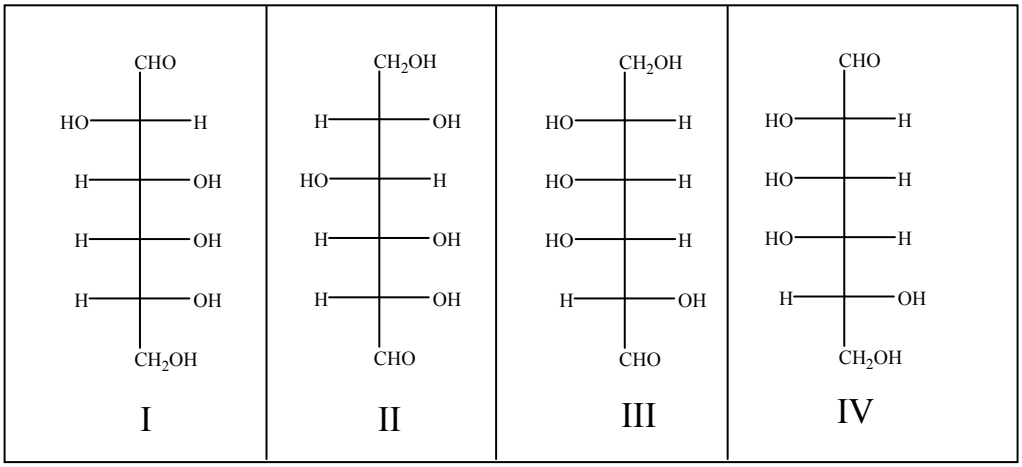
e) a & d

6. The most reactive carbon-hydrogen bond of 1,4-dimethyl-1-propylcyclohexane in a kinetically-controlled radical chlorination reaction is:
   a) C_1-H
   b) C_2-H
   c) C_3-H
   d) C_4-H
   e) a & d

D

7. Which of the statements is (are) true for the four sugars given below?

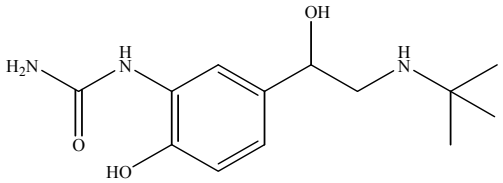
D



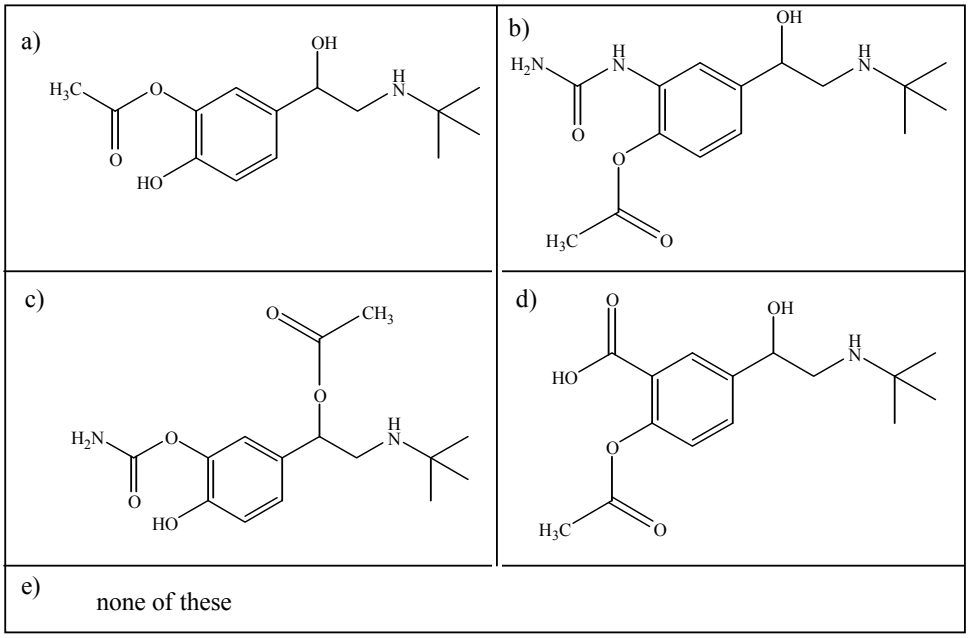
a) All of these sugars are pentoses
b) All of these sugars are ketoses
c) All of these sugars are D- sugars
d) II and IV are diastereomers
e) c & d

8. Carbuterol, a bronchodilator, can be acetylated in a manner similar to acetylation of hydroxybenzoic acids to give salicylate ester derivatives. Which of the following products would result upon acetylation of carbuterol with acetic anhydride?

B

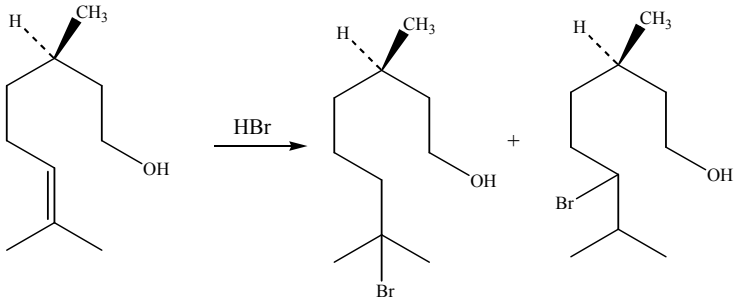


Carbuterol
(brochodilator)



9. Which of the following statements is true as it (they) relate to the reaction in the diagram given below?

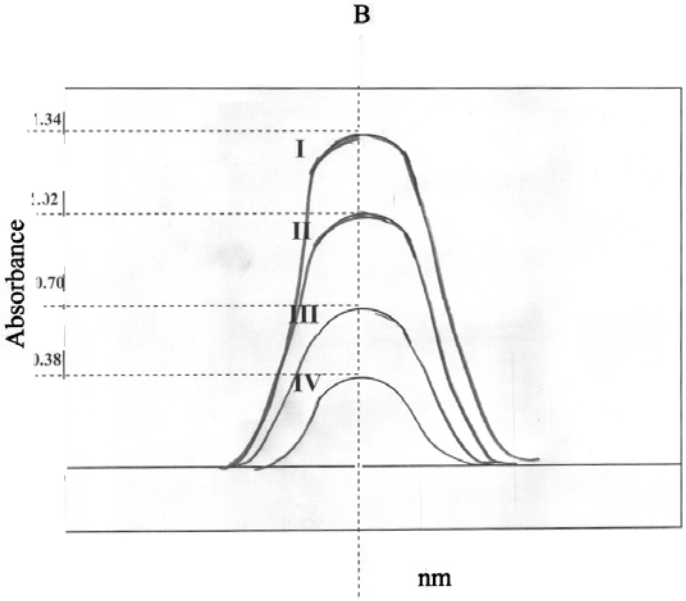
E



A B

a) The reaction mechanism is shown in the diagram.
b) A heterolytic bond cleavage occurs in the reaction shown in the diagram
c) The reaction represents a substitution reaction.
d) The major kinetic product of the reaction is A.
e) b & d

10. Four concentrations of the same compound are represented in the UV spectrum given below. Assume b = 1. The concentrations corresponding to each curve in the spectrum are as follows: I = 1.5 X 10^{-5}M; II = 1.15 X 10^{-5}M; III = 7.8 X 10^{-6}M; IV = 4.25 X 10^{-6}M. Which of the following statements is true for this UV spectrum?



A

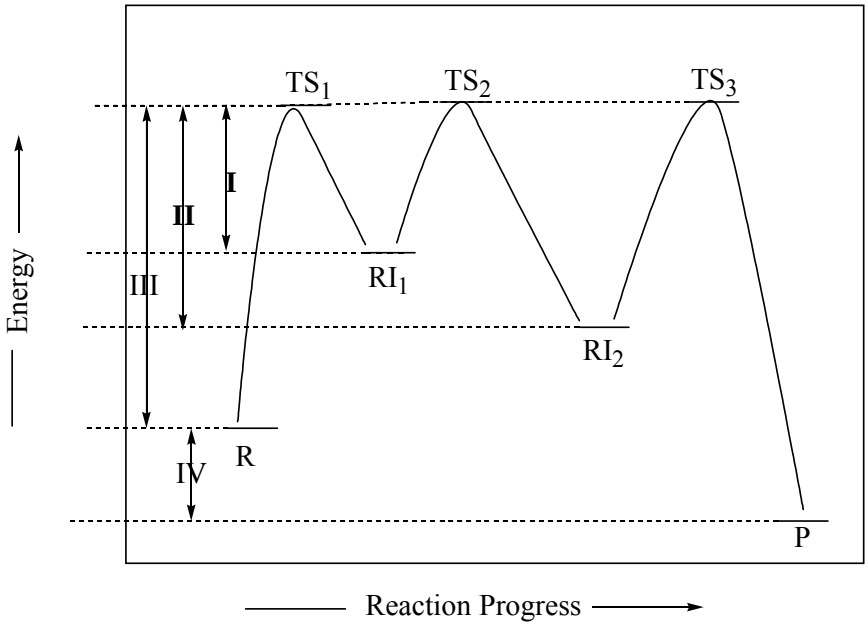
a) Line "B" represents the compound's λ_{max}
b) The extinction coefficient is 0.32
c) All four curves (I, II, III, IV) can be used to generate a standard curve.
d) a & b
e) b & c

11. Which of the following statements is true as they relate to the reaction energy diagram in question #12?
a) The K_{eq} for this reaction is greater than 1.
b) The free energy for the reaction is zero.
c) The rate-determining step of the reaction is step 2.
d) The reaction is endothermic.
e) a & c

A

12. Match the roman numerals (I-IV) labeled in the reaction energy diagram with their appropriate energies.

A



a) I = activation energy of step 2;
II = activation energy of step 3;
III = activation energy of step 1;
IV = free energy of the reaction

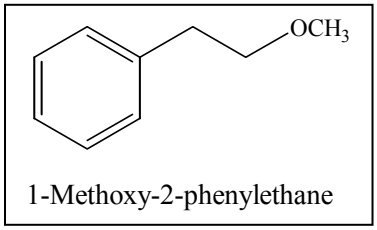
b) I = activation energy of step 1;
II = activation energy of step 2;
III = activation energy of step 3;
IV = free energy of the reaction

c) I = activation energy of step 3;
II = activation energy of step 2;
III = free energy of the reaction;
IV = activation energy of step 1

d) I = free energy of step 1;
II = free energy of step 2;
III = free energy of step 3;
IV = activation energy of the reaction

13. The benzylic protons of 1-methoxy-2-phenyl ethane will appear as _____ in its proton NMR spectrum.

a) a singlet
b) a doublet
c) a triplet
d) a quartet
e) a multiplet



1-Methoxy-2-phenylethane

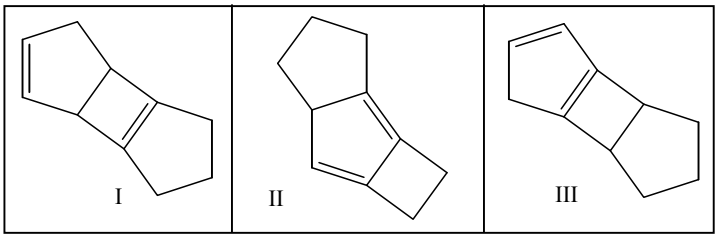
C

14. Conversion of methylcyclopentane and Cl_2 to 1-chloro-1-methylcyclopentane and HCl is;

a) an addition
b) a substitution
c) an elimination
d) a rearrangement
e) b & d

B

15. Rank the three compounds from most stable to least stable. (Most> >>Least)



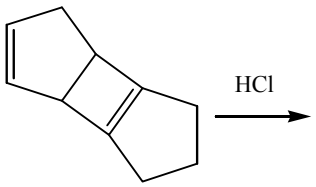
a) I > II > III
b) II > III > I
c) III = I > II
d) II > I = II
e) All are equally stable

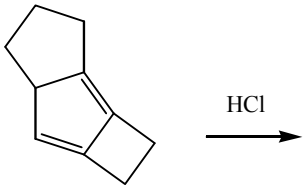
B

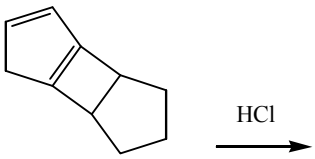
16. Which of the following statements is true as they relate to the electrophilic addition reaction of HCl with an alkene?
    a) The rate-determining step involves conversion of the alkene to a carbocation.
    b) A larger activation energy results if the transition state is higher in energy and the reactant energy remains constant.
    c) A larger activation energy results if the transition state energy remains constant and the reactant energy is lowered.
    d) a & b
    e) a, b & c

E

17. Which of the following reactions occurs the fastest?

a) 

b) 

c) 

d) a & c

e) They all react at the same rate

CREDIT GIVEN FOR ALL ANSWERS

18. Which of the following will increase the rate of the second order reaction of 2,3-dimethylhexane (0.1M) with Cl_2, (0.05M) in the presence of ultraviolet light?
    a) Changing the concentration of 2,3-dimethylhexane to 0.05M and Cl_2 to 0.025M
    b) Changing only the concentration of 2,3-dimethylhexane to 0.5M and leaving the Cl_2 concentration at 0.05M
    c) Diluting the entire reaction by one half.
    d) Doubling the concentration of Cl_2 and halving the concentration of 2,3-dimethylhexane.
    e) None of these

B

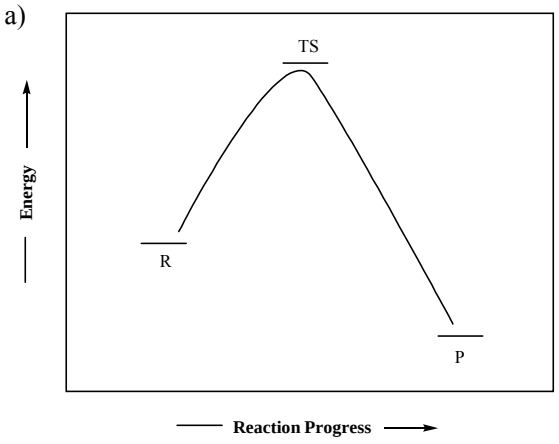
19. The major product in a kinetically-controlled reaction of 3,4-dimethyl-2-hexene with HCl is (are):
    a) 2-chloro-3,4-dimethylhexane
    b) 3-chloro-3,4-dimethylhexane
    c) 4-chloro-3,4-dimethylhexene
    d) 4-chloro-3,4-dimethylhexane
    e) a & b

B

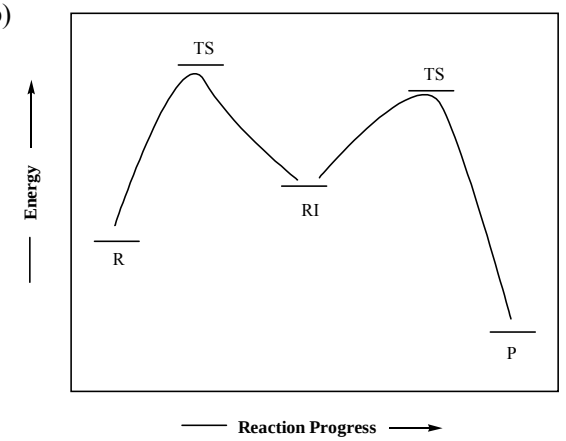
20. Which of the following reaction energy diagrams represents an endothermic, two step reaction with the rate-determining step as step 2?

E

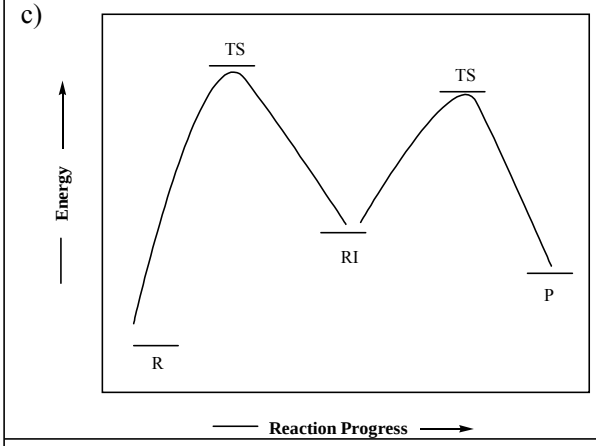
a)



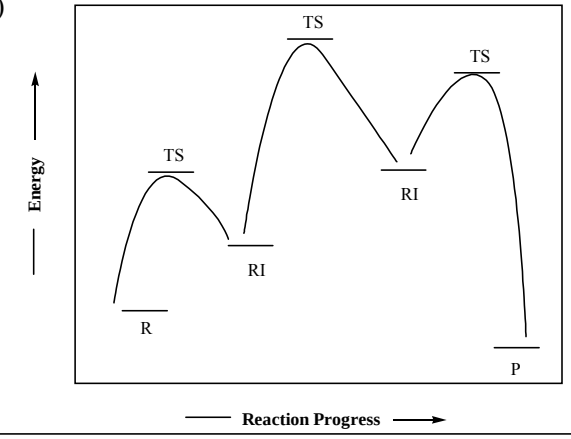
b)



c)



d)



e) none of these

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%