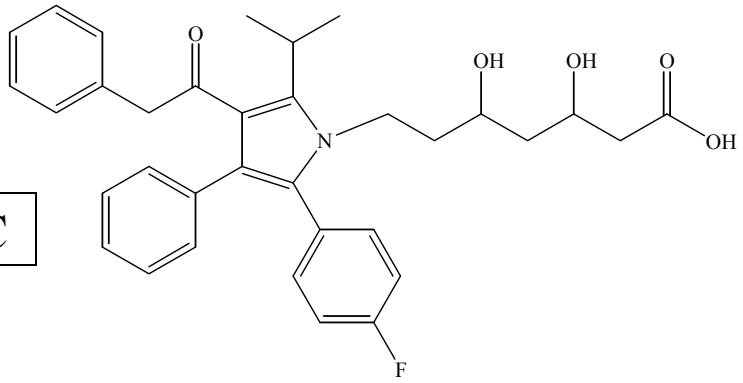
1. How many chiral centers are present in atorvastatin (LIPITOR), a drug used for lowering serum lipid levels?

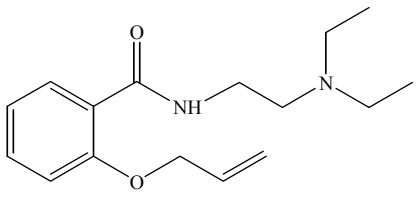



Atorvastatin
(LIPITOR)

C

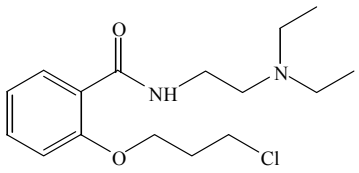
a) none
b) 1
c) 2
d) 3
e) 4

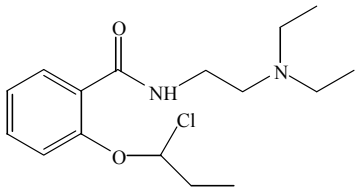
2. Reaction of alloclamide, a drug used as a cough suppressant, with HCl, under kinetic conditions, will provide which of the following as the major product(s) of the reaction?

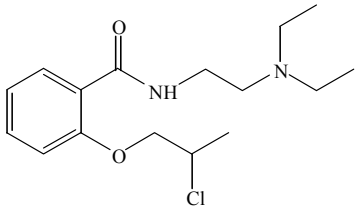


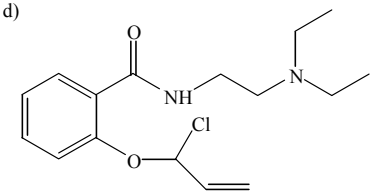

Alloclamide

C

a)


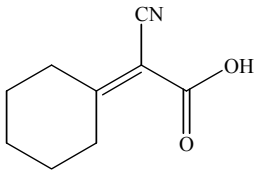

b)



c)



d)



e) b & c

3. An absorbance value of 0.645 was obtained in the UV spectrum at $\lambda_{max}$ = 235 for the compound given below. The concentration of this solution is 5 X $10^{-5}$ M. The molar absorbtivity of this compound is: (Assume a pathlength = 1)

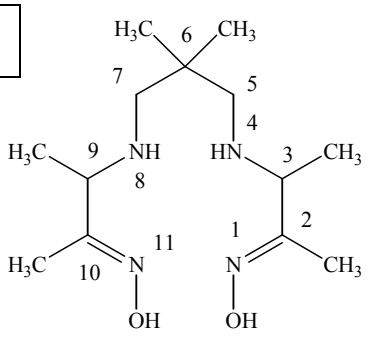



D

a) 470,000
b) 364
c) 73,437
d) 12,900
e) none of these

4. Which of the following stereoisomers of exametazime, a diagnostic agent used to monitor cerebral blood flow, is(are) a meso compound(s)?

A

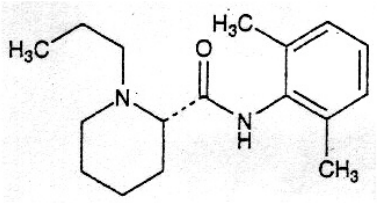


Exametazime

a) 3R, 9S and 3S, 9R
b) 3R, 9R and 3S, 9S
c) Exametazime has no chiral centers
d) None of these stereoisomers are meso
e) All of these stereoisomers are meso

5. The following information for ropivacaine is provided in the Merck Index (12th edition, p. 1421). Which of the following statements is true related to this drug?

**8417. Ropivacaine.** *(S)-N-(2,6-dimethylphenyl)-1-propyl-2-piperidinecarboxamide;* (*S*)-(−)-1-propyl-2′,6′-pipecoloxylidide; *l-N-n*-propylpipecolic acid-2,6-xylidide; LEA-103 $C_{17}H_{26}N_2O$; mol wt 274.41. C 74.41%, H 9.55%, N 10.21% O 5.83%. Prepn: A. F. Thuresson, C. Bovin, **PCT Int.** pat **Appl. 85 00,599** (1985 to Apothekernes); H.-J. Federsel *et al., Acta Chem. Scand.* **B41,** 757 (1987). Physicochemical properties: G. R. Strichartz *et al., Anesth. Analg.* **71,** 158 (1990). HPLC determn in human plasma: Z. Yu *et al., J. Chromatog. B* **654,** 221 (1994). *In vitro* metabolism: Y. Oda *et al., Anesthesiology* **82,** 214 (1995). Clinical pharmacokinetics: D. J. Kopacz *et al., ibid.* **81,** 1139 (1994). Toxicity study in sheep: A. C. Santos *et al., ibid.* **82,** 734 (1995) Clinical evaluation in relief of surgical pain: I. Cederholm *et al., Regional Anesth.* **19,** 18 (1994); B. Johansson *et al., Anesth. Analg.* **78,** 210 (1994); labor pain: R. Stienstra *et al., ibid.* **80,** 285 (1995).



Crystals from toluene, mp 144-146°. $[\alpha]_D^{25}$ −82.0° (c = 2 in methanol). pKa 8.16. Distribution coefficient (1-octanol/aq buffer, pH 7.4): 115.0.

Monohydrochloride, $C_{17}H_{26}N_2O.HCl$, crystals from isopropyl alcohol, mp 260-262°. $[\alpha]_D^{25}$ −6.6° (c = 2 in water).

Monohydrochloride monohydrate, crystals from acetone + water, mp 269.5-270.6°. $[\alpha]_D^{20}$ −7.28° (c = 2 in water).

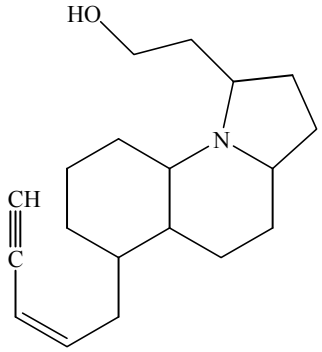
THERAP CAT: Anesthetic (local).

B

a) Ropivacaine is a *d*- enantiomer.
b) Ropivacaine's enantiomer has an optical rotation of +82.0 °
c) The parent peak in the mass spectrum of ropivacaine would appear at 74.
d) The IR spectrum of ropivacaine would not have a peak in the region 1500-1800$cm^{-1}$.
e) a & b

6. The molecule given below contains:

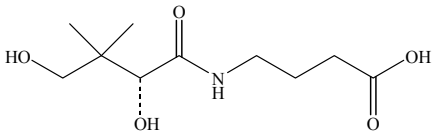
E



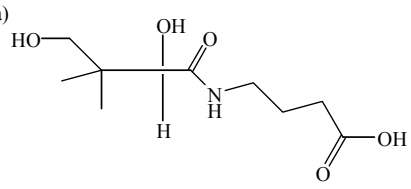
a) an internal alkyne and a trans, disubstituted alkene
b) an internal alkyne and a monosubstituted alkene
c) a terminal alkyne and a trisubstituted alkene
d) a terminal alkyne and a trans, disubstituted alkene
e) a terminal alkyne and a cis, disubstituted alkene

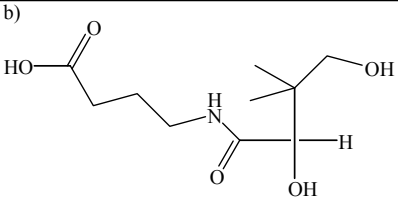
7. A Fisher projection for hopantenic acid, a cerebral activator is:

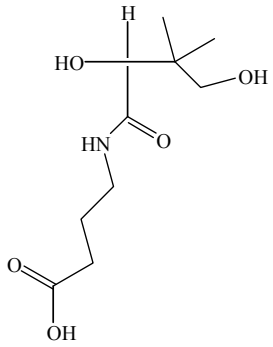
A

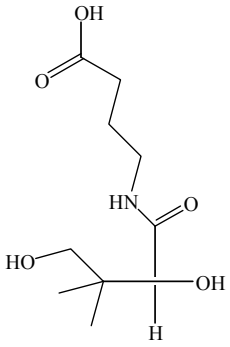


Hopatenic acid

a)


b)


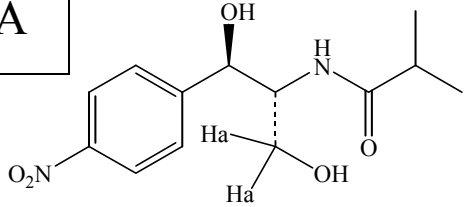
c)


d)


e) none of these

8. In the proton NMR spectrum of chloramphenicol, the Ha protons will appear:

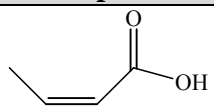
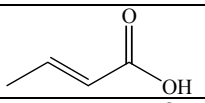
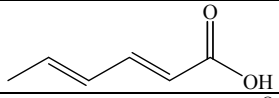
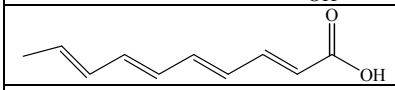
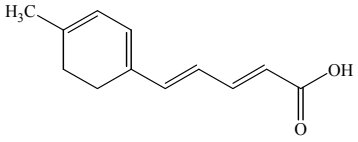
A

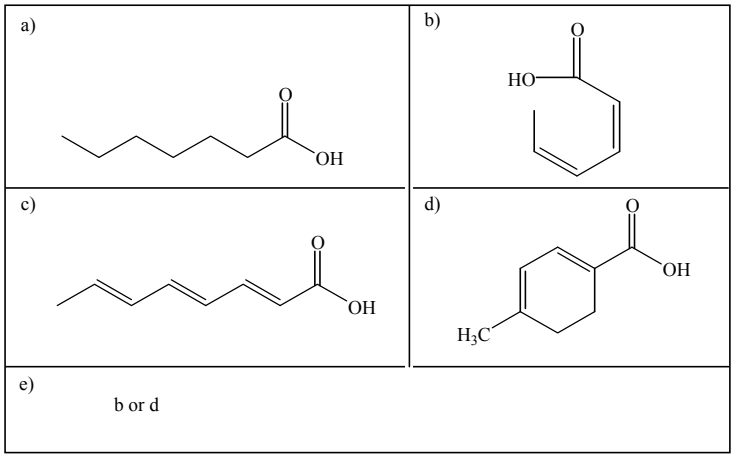


Chloramphenicol

a) as a doublet between 2.5-4.5ppm
b) as two singlets between 2.5-4.5ppm
c) as a triplet between 2.5-4.5ppm
d) as two doublets between 2.5-4.5ppm
e) as a singlet between 1.5-2.5ppm

9. The $\lambda_{max}$ values for a series of compounds are given below. Which of the following compounds would be expected to have a $\lambda_{max}$ value of ~295nm?

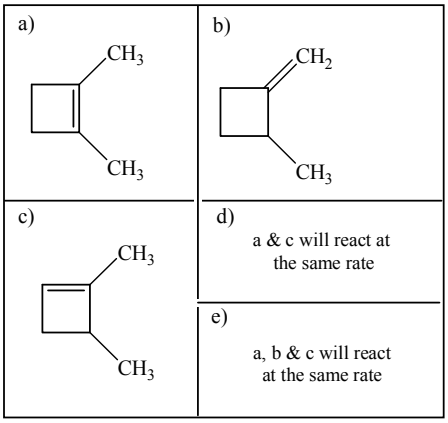
| Compound | $\lambda_{max}$ |
|---|---|
|  | 205nm |
|  | 205nm |
|  | 254nm |
|  | 332nm |
|  | 332nm |



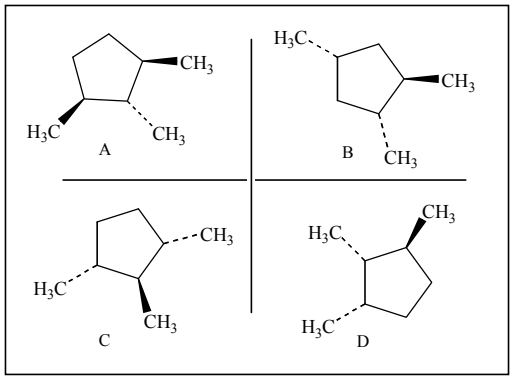

C

10. Which of the following compounds will react the fastest with HBr in an electrophilic addition reaction?

B



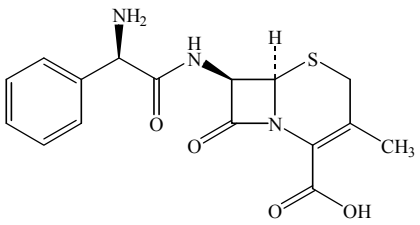

11. Which of the following statements is true regarding the isomeric relationships of compounds A-D?




C

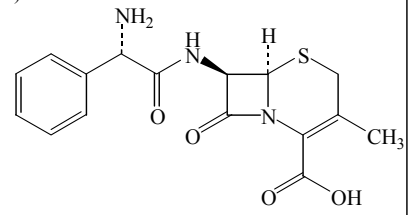
a) Structures A and B are enantiomers
b) Structure C and D are positional isomers
c) Structures A and C are identical and meso
d) Structures C and D are enantiomers
e) b & c

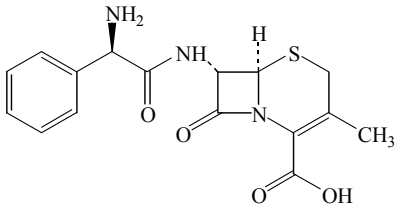
12. A diastereomer of cephalexin, an antibiotic is:

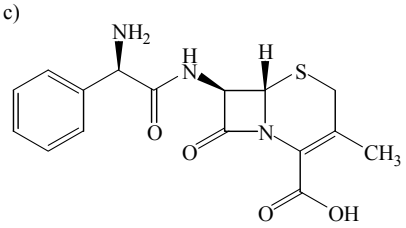


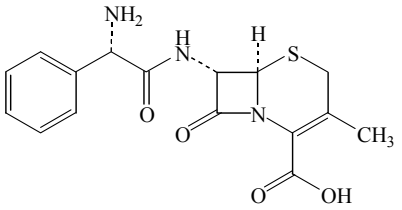
Cephalexin

E

a) 

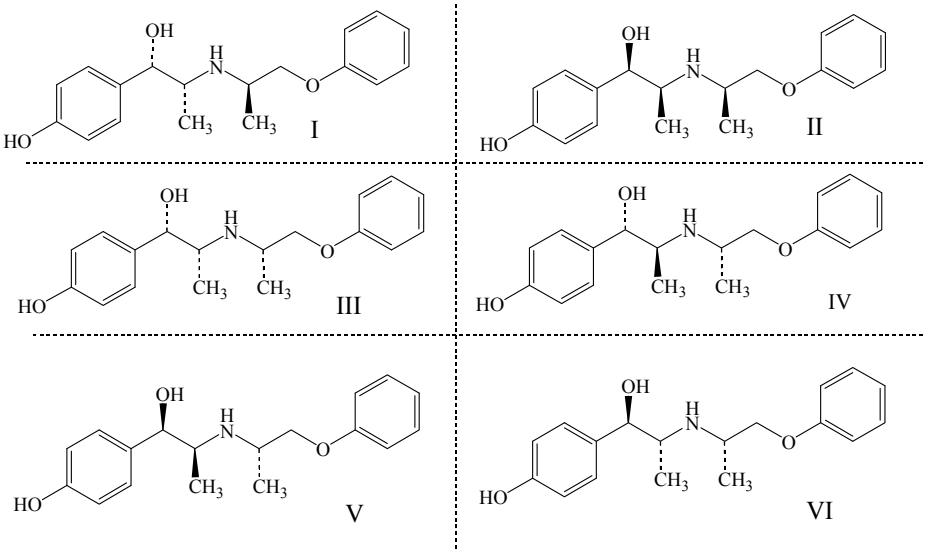
b) 

c) 

d) 

e) all of these

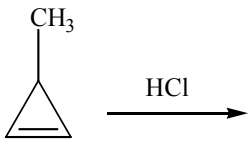
13. Which of the following compounds has the same melting point?




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

E

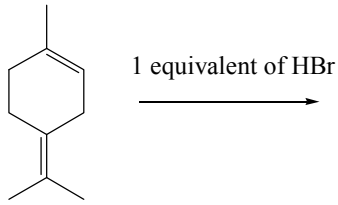
14. The electrophilic addition reaction, given below, will provide:

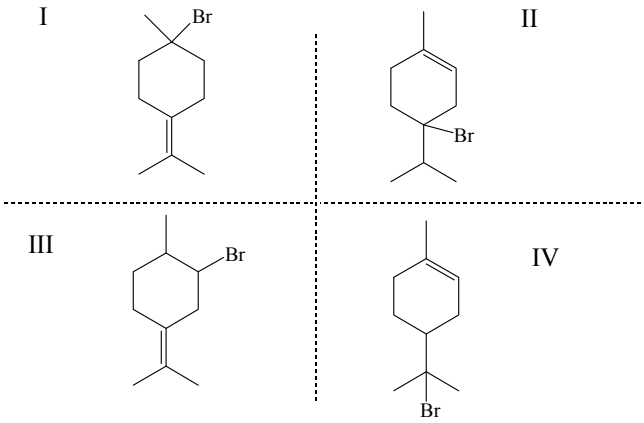



a) a meso compound and a pair of enantiomers
b) four stereoisomers
c) a product with no stereochemistry
d) a meso compound and a pair of diastereomers
e) a single enantiomer

B

15. Electrophilic addition reactions may occur in molecules with more than one alkene functional group. If only "one equivalent" of the electrophilic reagent (i.e. hydrohalic acid) is available, then only one of the alkene functional groups will react. Which of the following products will form under *thermodynamic* conditions in the electrophilic addition reaction outlined below?

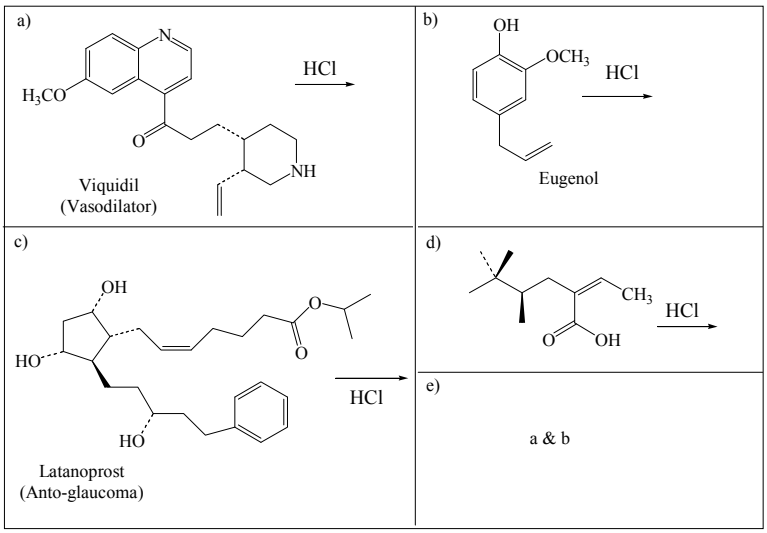


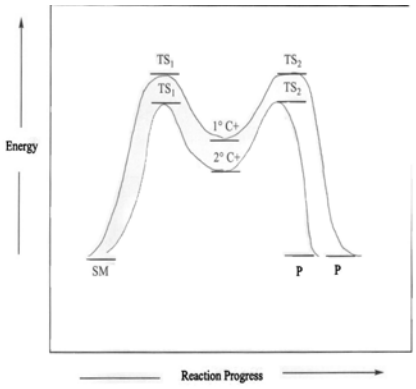

a) I
b) I & II
c) II & III
d) I & III
e) IV & IV

D

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



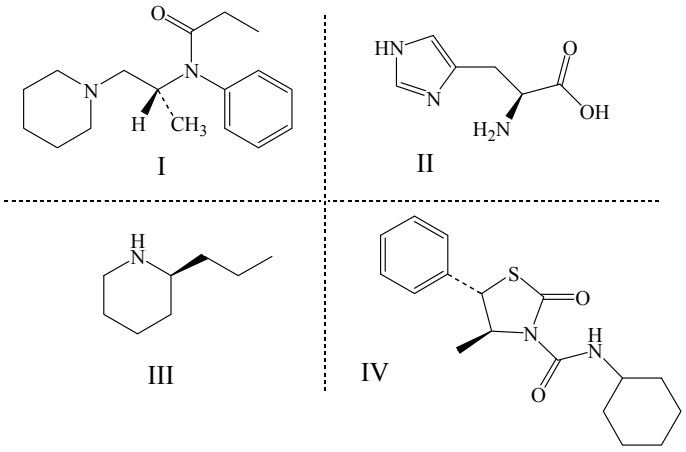

E




17. The major monochlorinated product that forms upon treatment of 1,1,2-trimethylcyclopentane with $Cl_2$, hν under kinetic conditions is:
    a) 2-chloro-1,1,2-trimethylcyclopentane
    b) 1-chloro-2,2,3-trimethylcyclpentane
    c) 1-chloro-2,3,3-trimethylcyclopentane
    d) 1-chloro-1,2,2-trimethylcyclopentane
    e) 1-chloro-1,1,2-trimethylcyclopentane

D

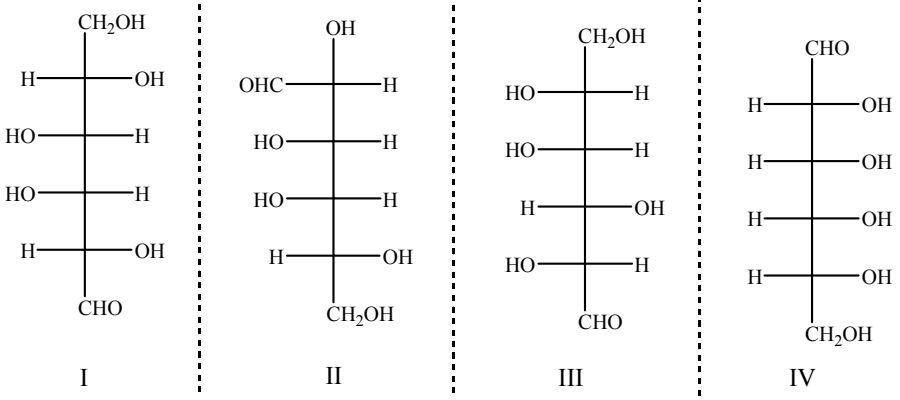
18. Which of the following compounds has an "R" configuration?




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

A

19. Which of the sugars given below represent a D- isomer?

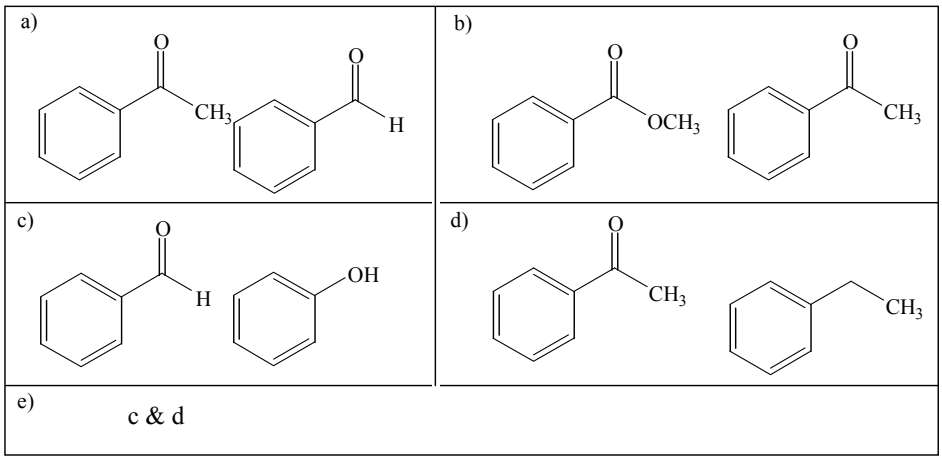



a) I & II only
b) II & III only
c) I, II & III only
d) II, III, & IV only
e) I, III & IV only

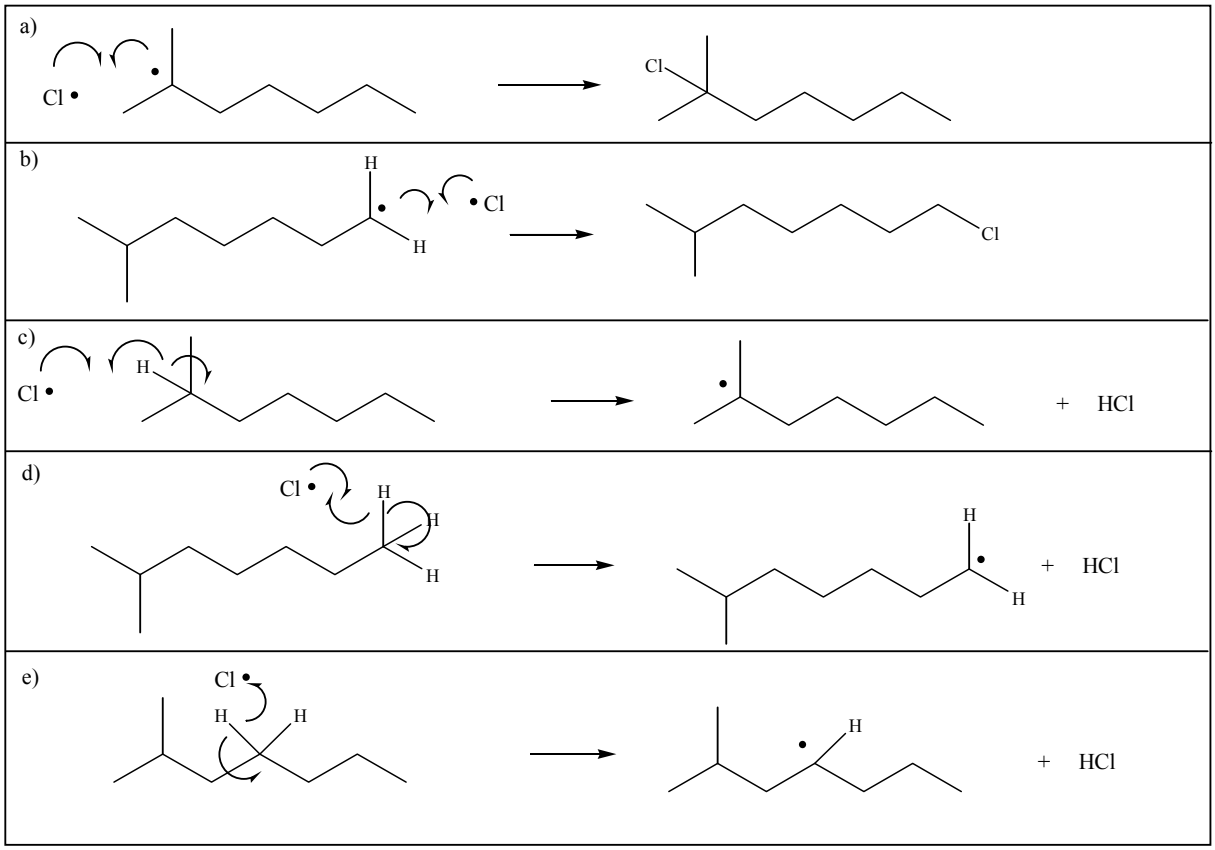
D

20. Which of the following pairs of compounds could be *most easily* distinguished by IR spectroscopy?

E

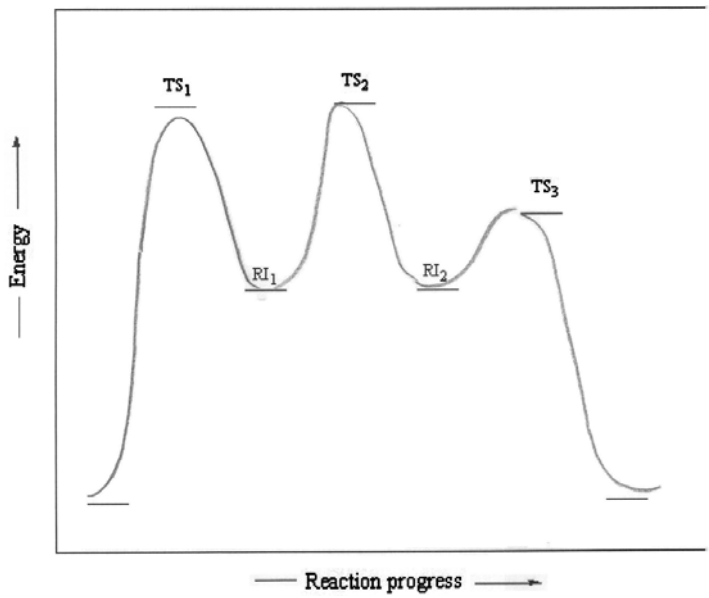


21. Which of the following mechanistic steps represents the propagation step in a *kinetically*-controlled radical chlorination reaction of 2-methylheptane?




C

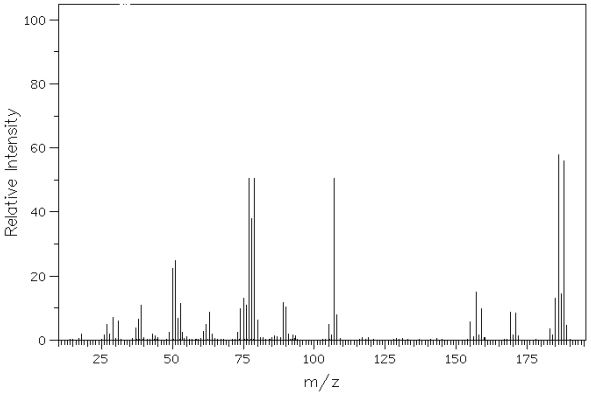
22. The rate-determining step of the reaction described by the reaction energy diagram given below is:

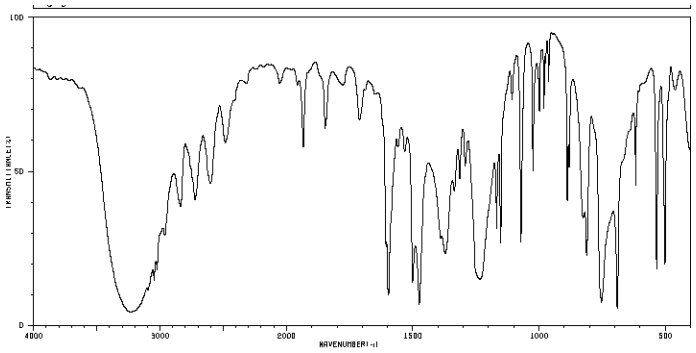


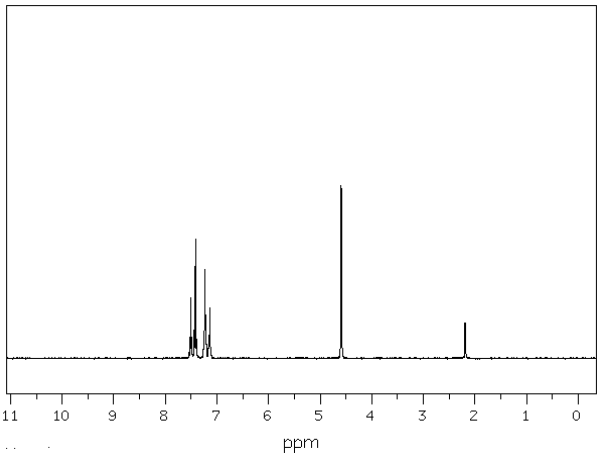

a) SM → $RI_1$
b) $RI_1$ → $RI_2$
c) $RI_2$ → P
d) $TS_1$ → $TS_2$
e) $TS_2$ → $TS_3$

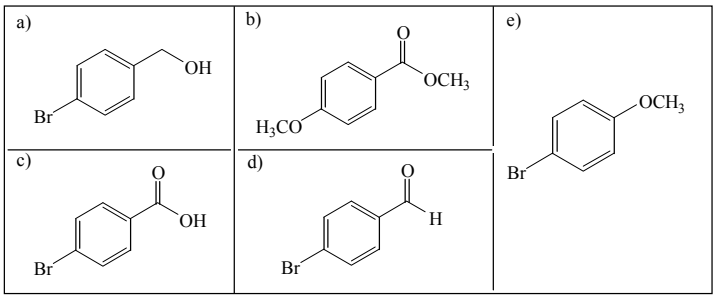
A

23. Which of the following compounds is most consistent with the spectral data given below?



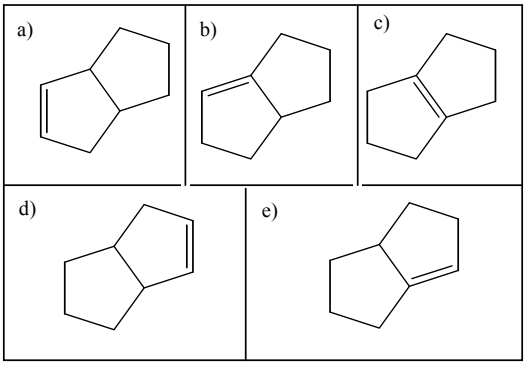





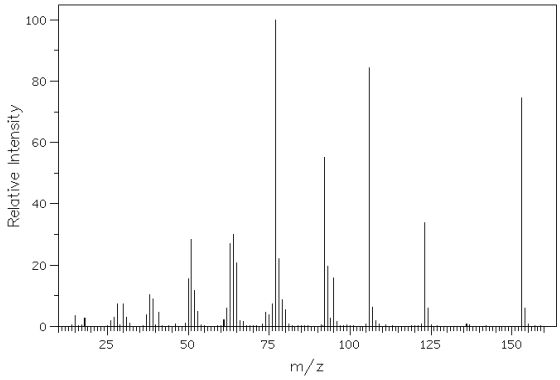

A

24. Which of the following compounds is the most stable?




C

25. The parent peak in the mass spectrum given below is:




a) A
b) B
c) C
d) D
e) E

E

**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, $\alpha$-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% |