

1. Circle the correct answer: (40 pts; 4 pts/each)

(1) 2-Butyne ($\text{CH}_3\text{C}\equiv\text{CH}_3$) does not show IR absorption in the region $2100\text{-}2200\text{ cm}^{-1}$ because:

- a. C-H stretches occur at lower frequencies.
- b. $\text{C}\equiv\text{C}$ stretches occur at about 1640 cm^{-1} .
- c. there is no change in the dipole moment when the $\text{C}\equiv\text{C}$ bond stretches.
- d. there is a change in the dipole moment when the $\text{C}\equiv\text{C}$ bond stretches.

(2) When a high-energy electron impacts molecules in the ionization chamber, what type of species is initially produced?

- a. cation;
- b. anion ;
- c. radical;
- d. radical cation;
- e. radical anion

(3) How many nuclear spin states are allowed for the ^{13}C nucleus?

- a. 1;
- b. 2;
- c. 3;
- d. 4;
- e. 10

(4) ^1H nuclei attached to or near electronegative atoms tend to be _____ relative to ^1H nuclei that are not.

- a. shielded;
- b. deshielded;
- c. conjugated;
- d. split

(5) The Williamson ether synthesis proceeds via an _____ mechanism.

- a. $\text{S}_{\text{N}}1$;
- b. $\text{S}_{\text{N}}2$;
- c. $\text{E}1$;
- d. $\text{E}2$

(6) Which compound would show a larger than usual $\text{M}+2$ peak?

- a. $\text{CH}_3\text{CH}_2\text{OH}$;
- b. $\text{CH}_3\text{CH}_2\text{Cl}$;
- c. $\text{CH}_3\text{CH}_2\text{I}$
- d. $\text{CH}_3\text{CH}_2\text{F}$

(7) Which will occur at the lowest frequency:

- a. a C-O stretch;
- b. a C=O stretch;
- c. a C-H stretch;
- d. an O-H stretch

(8) If two signals differ by 1.0 ppm in a 300 MHz spectrometer, how do they differ in ppm in a 100 MHz spectrometer?

- a. 0.33 ppm;
- b. There's no difference;
- c. 1.0 ppm;
- d. Cannot determine

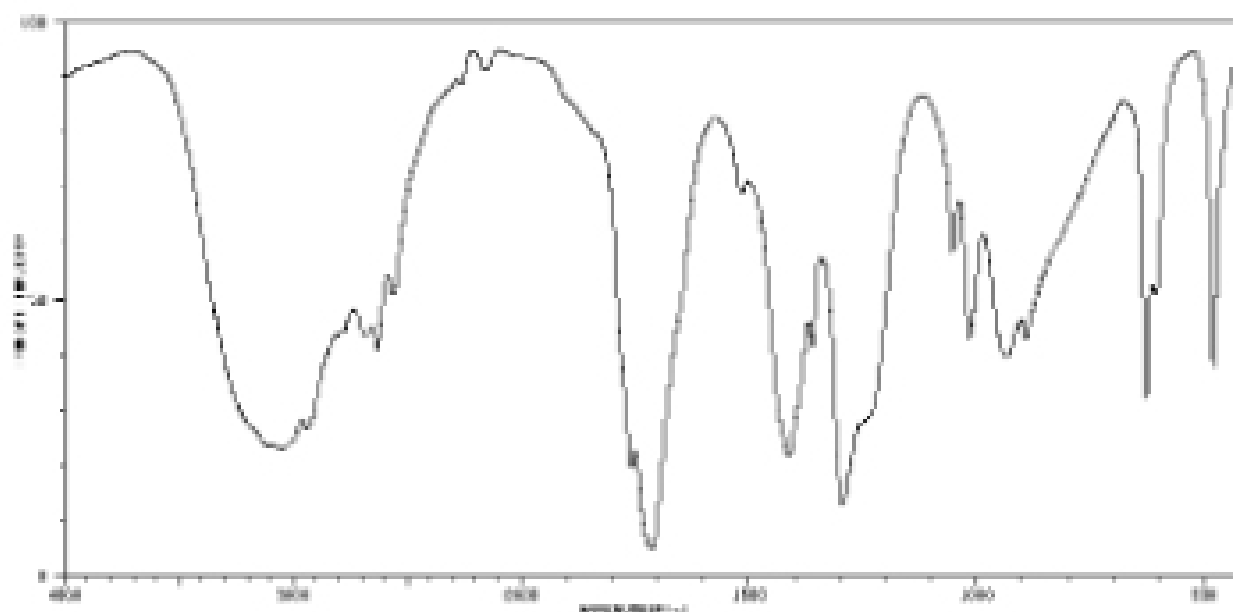
(9) Ethers have significantly lower boiling points than their corresponding alcohol isomers because of their:

- a. lack of polarity; **b. lack of H-bonding;** c. volatility; d. effective packing

(10) Epoxide's high ring strain makes it susceptible to

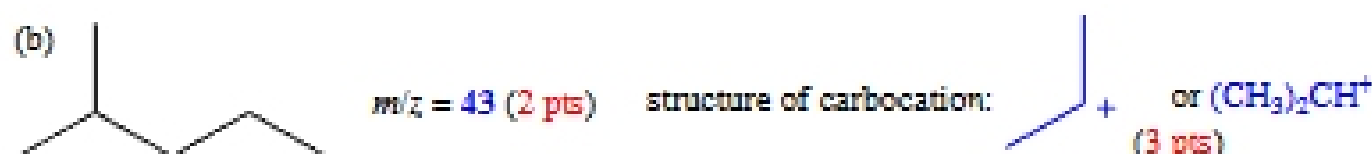
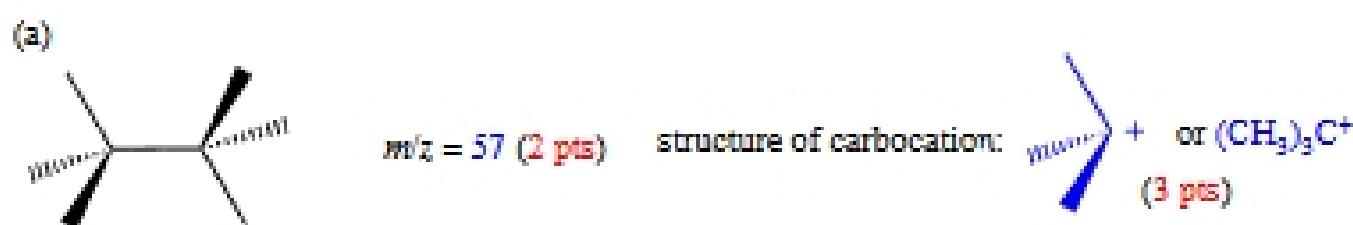
- a. hydrolysis; b. electrophilic attack; c. ring-opening; **d. nucleophilic attack**

2. Which of the following two compounds gives the IR spectrum shown? What kind of absorption gives the broad band at $\sim 3300\text{ cm}^{-1}$? (10 pts)



Answer: A (5 pts); O-H stretching (5 pts)

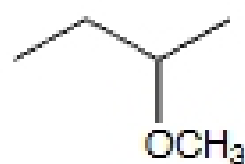
3. What m/z value would you predict for the base peak in the mass spectrum of each of the following compounds? Draw the structure of the carbocation corresponding to each base peak. (10 pts)



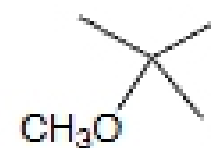
4. The mass spectra of three isomeric ethers, A, B, and C, are shown below. Match the compound with the spectra. (15 pts, 5 pts/each)



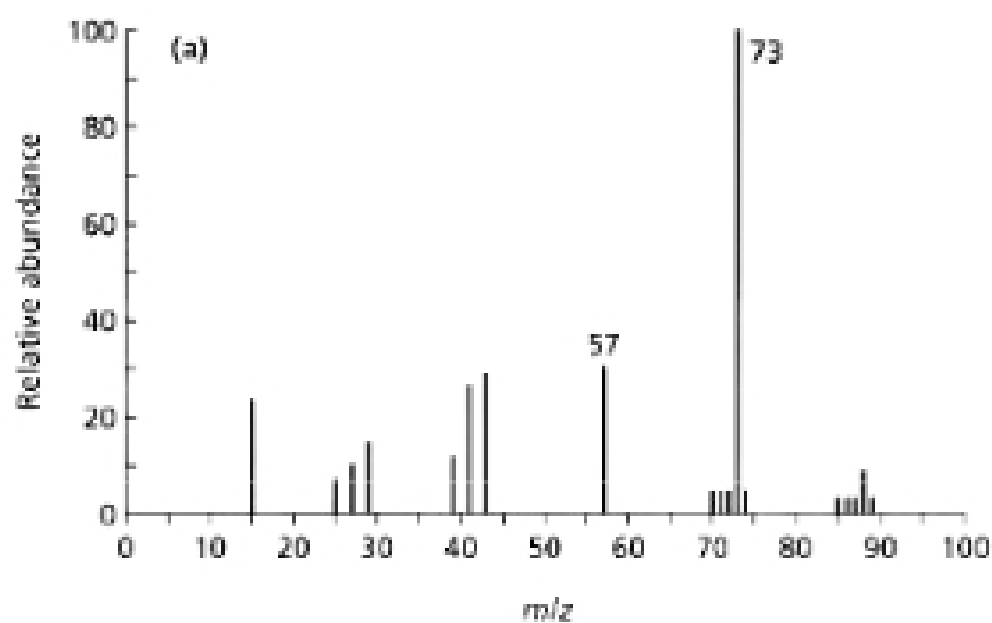
A



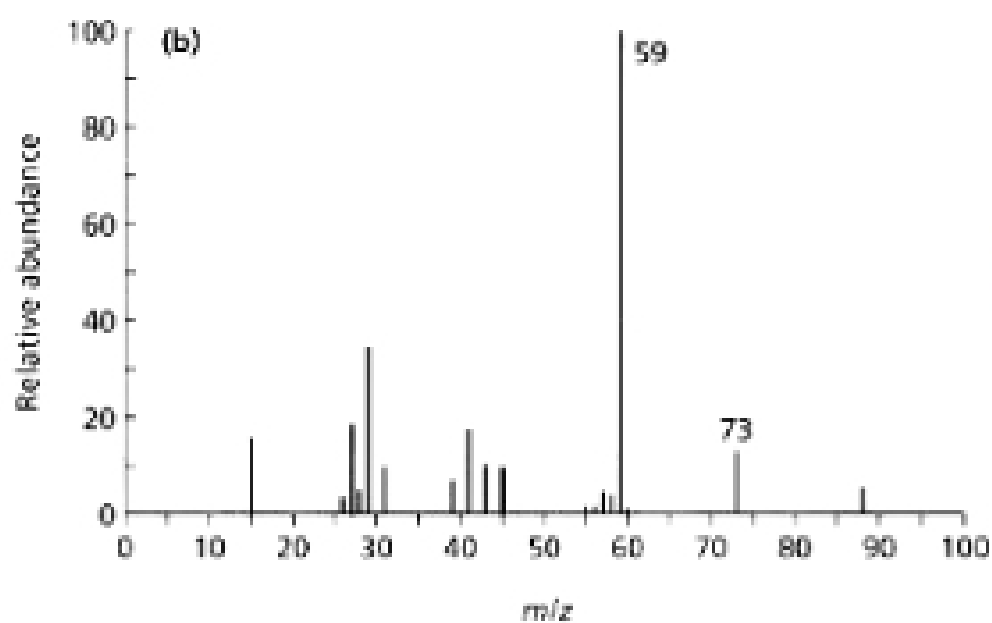
B



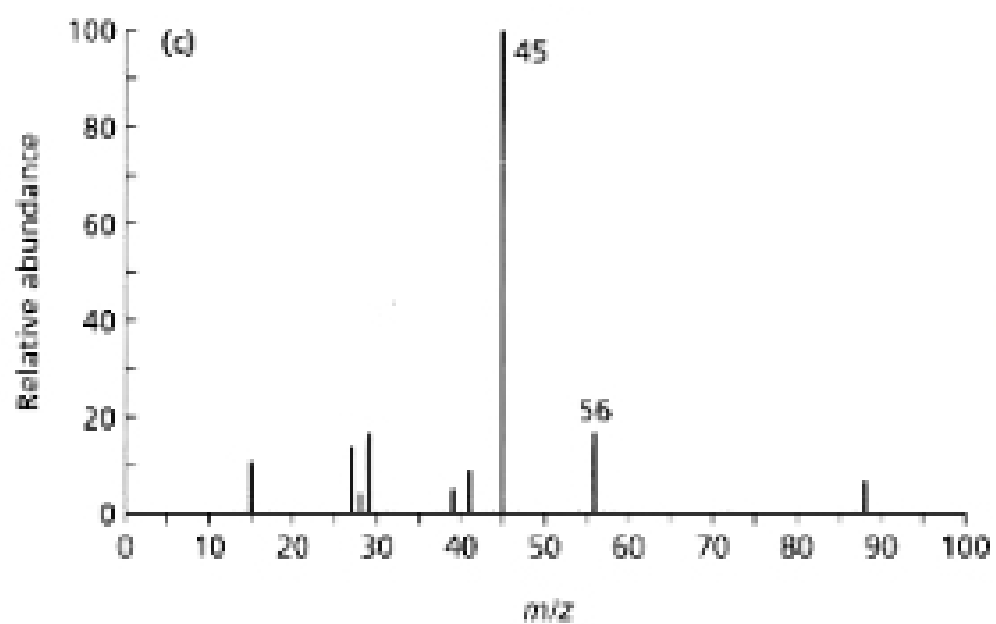
C



C (5 pts)



B (5 pts)



A (5 pts)