

PROTON NMR SPECTROSCOPY – CONCEPT TEST

QUESTION 1

Signals in a proton NMR spectrum do not provide information about...

- A the relative number of hydrogen atoms in a particular environment
- B the number of chemically different hydrogen atoms on adjacent atoms
- C the environment of different hydrogen atoms in a molecule
- D the molecular mass of an organic molecule

QUESTION 2

The splitting pattern for a signal is found by...

- A counting the number of chemically equivalent hydrogen atoms on adjacent atoms
- B counting the number of chemically different hydrogen atoms on adjacent atoms
- C counting the number of chemically different hydrogen atoms on adjacent atoms and adding 1
- D counting the number of chemically different hydrogen atoms on adjacent atoms and subtracting 1

QUESTION 3

Which one of the following statements about protons on O-H groups is incorrect?

- A They always produce a doublet
- B They always produce a singlet
- C They are not taken into account when working out splitting patterns of adjacent protons
- D Their signal can be removed from its normal location by shaking with deuterium oxide

QUESTION 4

The isomer of C_4H_8 which produces an NMR spectrum with four different signals is...

- A $CH_2=CHCH_2CH_3$
- B $CH_3CH=CHCH_3$
- C $(CH_3)_2C=CH_2$
- D cyclobutane

QUESTION 5

The proton NMR of 1-bromopropane will consist of...

- A two doublets and a sextet
- B a doublet and a septet
- C a singlet, a doublet and a triplet
- D two triplets and a sextet

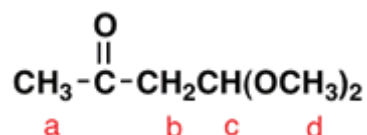
QUESTION 6

The molecule HOCH₂CH₂OH will have an NMR spectrum consisting of...

- A two singlets
- B a triplet and a doublet
- C two doublets
- D a singlet and a doublet

QUESTION 7

Which of hydrogens a – d in the following molecule gives a triplet signal in a normal ¹H NMR spectrum?



- A Hydrogen a
- B Hydrogen b
- C Hydrogen c
- D Hydrogen d

QUESTION 8

How many signals does the aldehyde (CH₃)₃CCH₂CHO have in ¹H NMR and ¹³C NMR spectra?

- A Five ¹H signals and six ¹³C signals
- B Three ¹H signals and four ¹³C signals
- C Five ¹H signals and four ¹³C signals
- D Three ¹H signals and six ¹³C signals

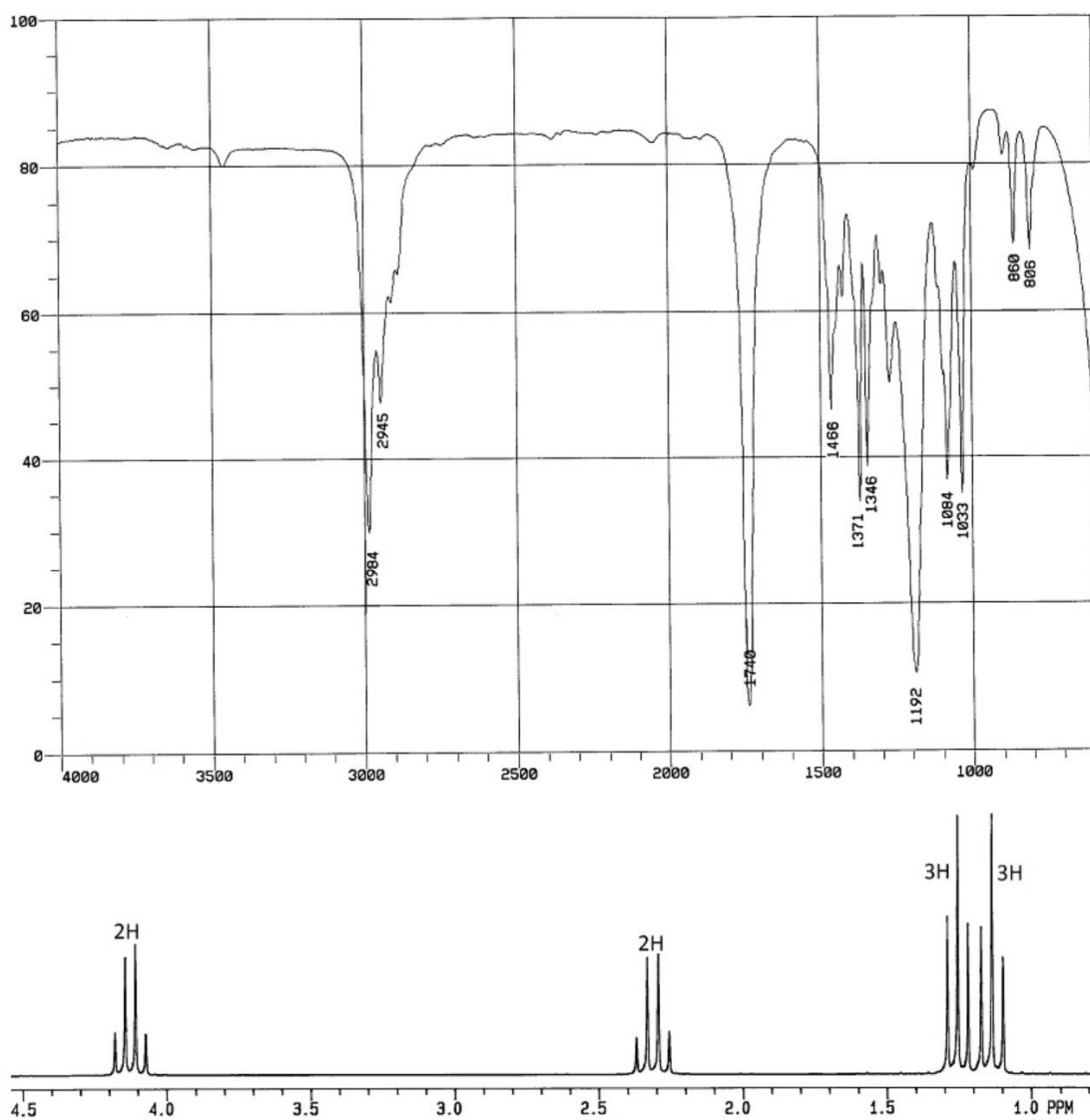
QUESTION 9

Which hydrogen of 1-chloropent-2-ene shows the largest chemical shift in its NMR spectrum?

- A The H on C1
- B The H on either C2 or C3
- C The H on C4
- D The H on C5

QUESTION 10

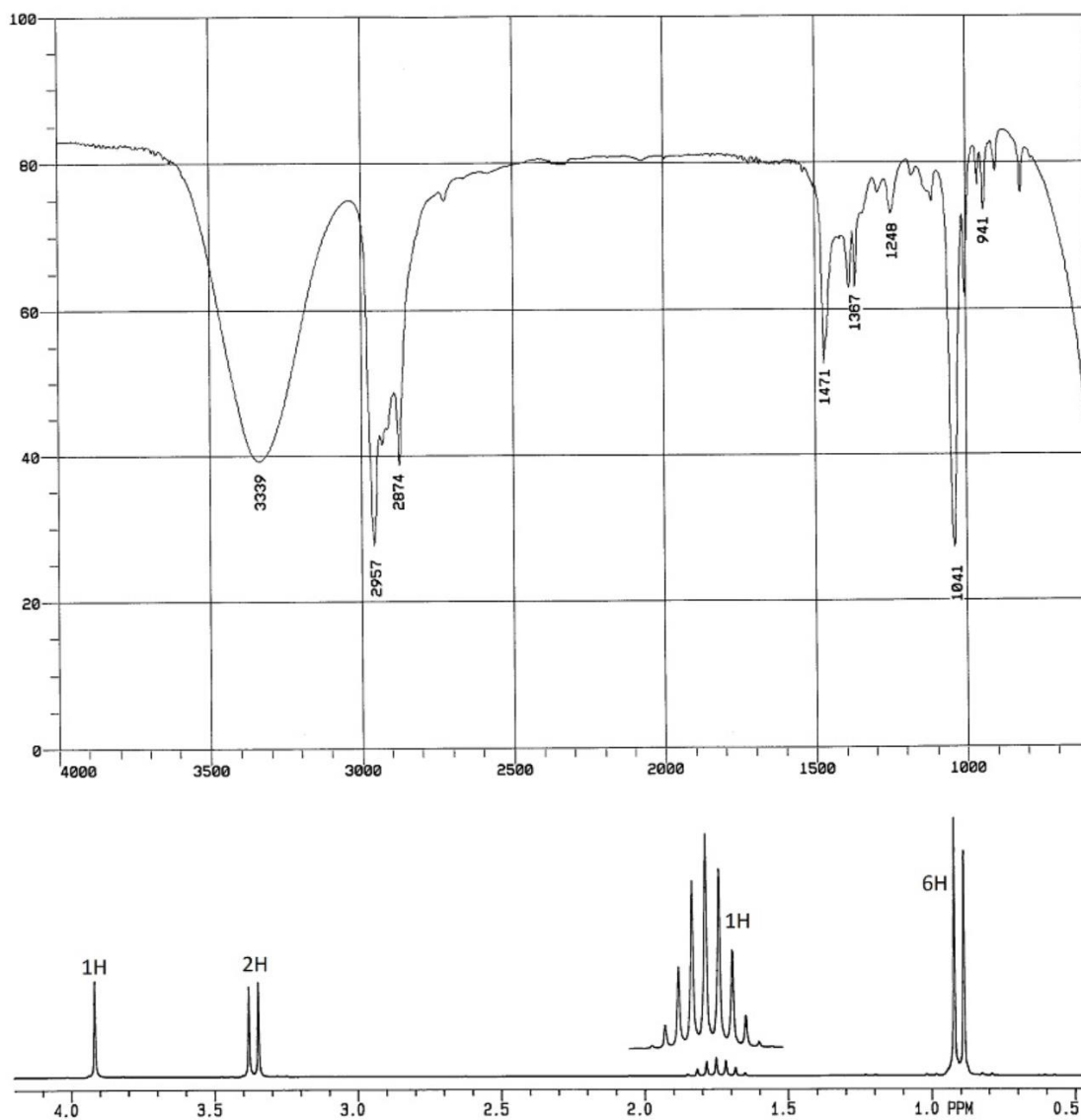
The molecular formula of an unknown compound is $C_5H_{10}O_2$. Use the spectra below to draw a possible structure for the unknown compound.



Solution

QUESTION 11

The molecular formula of an unknown compound is $C_4H_{10}O$. Use the spectra below to draw a possible structure for the unknown compound.



Solution

QUESTION 12

Which compound has a molecular ion at $m/z = 58$, an infrared absorption at 1650cm^{-1} and just one singlet in its NMR spectrum?

- A butane
- B CH_3COCH_3
- C $\text{CH}_3\text{CH}_2\text{CHO}$
- D 2-methylpropane

QUESTION 13

A compound of formula C_5H_{12} gives 1 signal in the ^1H NMR and 2 signals in the ^{13}C NMR. The compound is

- A pentane.
- B 2-methylbutane.
- C 2,2-dimethylpropane.
- D Cannot determine without more information.

SOLUTIONS

QUESTION 1 Answer is D

QUESTION 2 Answer is C

QUESTION 3 Answer is B

QUESTION 4 Answer is A

QUESTION 5 Answer is D

QUESTION 6 Answer is A

QUESTION 7 Answer is C

A triplet signal results from the spin-spin coupling with two equivalent adjacent hydrogen atoms.

QUESTION 8 Answer is B

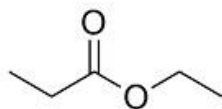
We need to find non-equivalent hydrogen and carbon atoms. This aldehyde has three kinds of hydrogen and four kinds of carbon atoms.

QUESTION 9 Answer is B

Hydrogens on unsaturated carbons generally have larger chemical shifts than those on saturated carbons

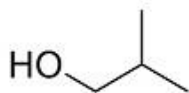
QUESTION 10

Ethyl propanoate



QUESTION 11

2-methyl-1-propanol



QUESTION 12 Answer is B

QUESTION 13 Answer is C