Self-test Questions

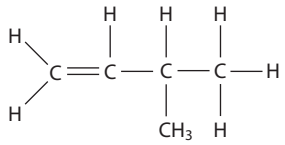
Topic 11 (HL)

1 The high resolution ^{1}H NMR spectrum of a hydrocarbon contains a quartet. What does this indicate?

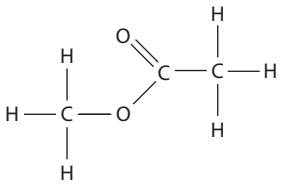
A That there are four hydrogen atoms (protons) in a particular chemical environment.
B That there are four hydrogen atoms (protons) on the adjacent carbon atom.
C That there are three hydrogen atoms (protons) on the adjacent carbon atom.
D That there are four hydrogen atoms (protons) in the molecule.

2 Which of the following has a high resolution ^{1}H NMR spectrum that consists of just two singlets?

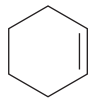
A



B



C



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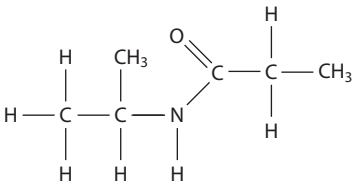
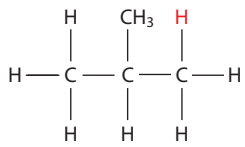


3 In the high resolution ^{1}H NMR spectrum, which of the following will the signal due to the hydrogen atom highlighted in red be a triplet?

A



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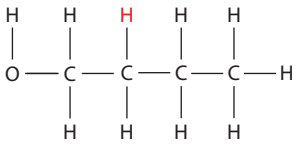

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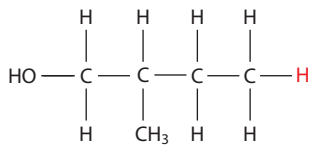

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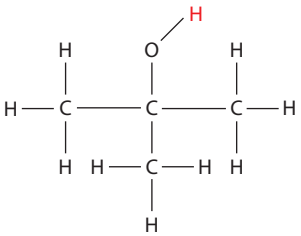
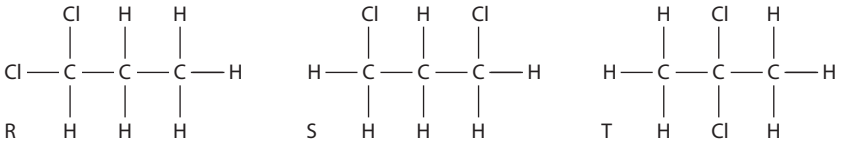


4 The high resolution ^{1}H NMR spectrum of an organic compound that contains only carbon and hydrogen is made up of one triple and one quartet. What is the structural formula of the compound?

A $CH_3CH_2CH_2CH_3$
B $C(CH_3)_4$
C $CH_3CH_2CH_2CH_2CH_3$
D $(CH_3)_3CCH_2CH_3$

5 R, S and T are isomers that contain carbon, hydrogen and chlorine.



Which of the following is correct?

A The molecular ion peak in the mass spectrum for all three compounds occurs at $m/z = 112.99$.

B The high resolution ^{1}H NMR spectrum of S contains a quartet.

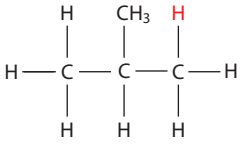
C The three compounds cannot be distinguished from each other by mass spectrometry because they are isomers.

D Only the high resolution ^{1}H NMR spectrum of T contains a singlet.

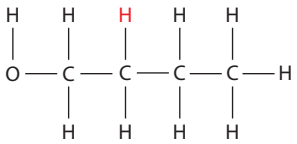
6 Compound X contains carbon, hydrogen and oxygen and has an IHD of 1. The IR spectrum of X has a band at 1716 cm^{-1}. The high resolution ^{1}H NMR spectrum of X contains two peaks: a triplet and a quartet.

What is the structure of X?

A



B



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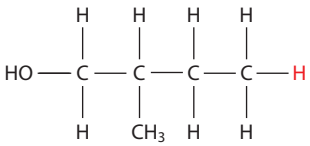

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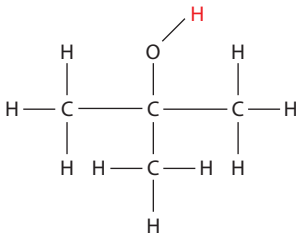
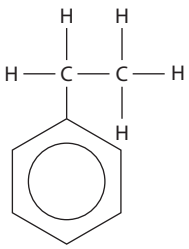


7 Compound Y is a hydrocarbon. It has a peak in the mass spectrum at $m/z = 77$. The high resolution ^{1}H NMR spectrum contains a triplet and a quartet. X-ray crystallographic data indicate C–C bond lengths of 0.140 nm and 0.154 nm only. Elemental analysis of the compound shows that it contains 90.5% C.

What is the structure of Y?

A



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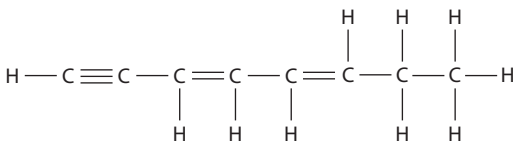

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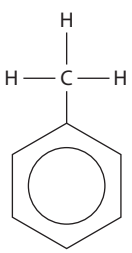

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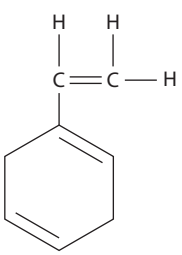
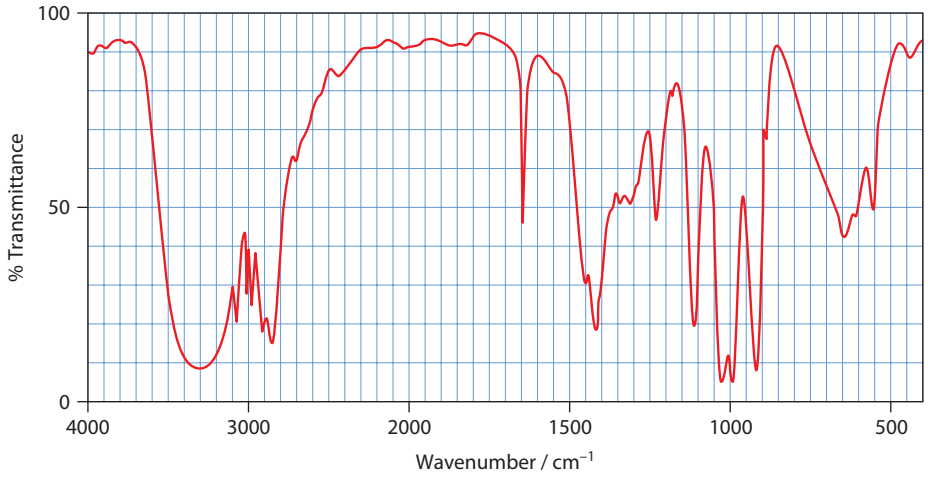
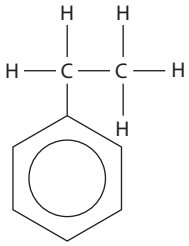


8 The infrared spectrum of an organic compound Z is shown below. The molecular ion peak for Z occurs at $m/z = 58$.
What is the structure of Z?



A



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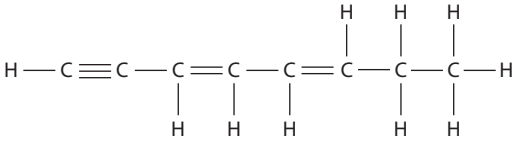

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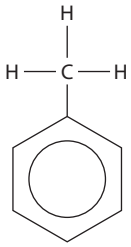
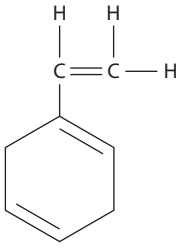
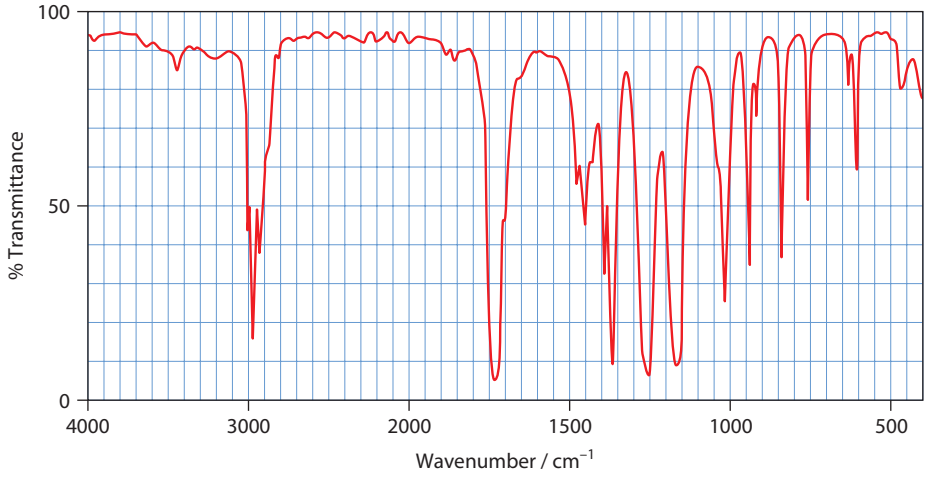


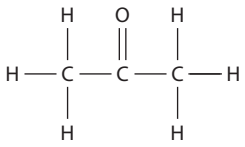
D



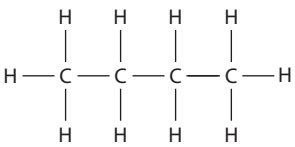
9 The infrared spectrum of a compound F, which contains carbon, hydrogen and oxygen, is shown below. The molecular ion peak for Z occurs at $m/z = 116$. The high resolution ^{1}H NMR spectrum contains only singlets.
What is the structure of F?



A

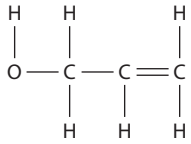


B

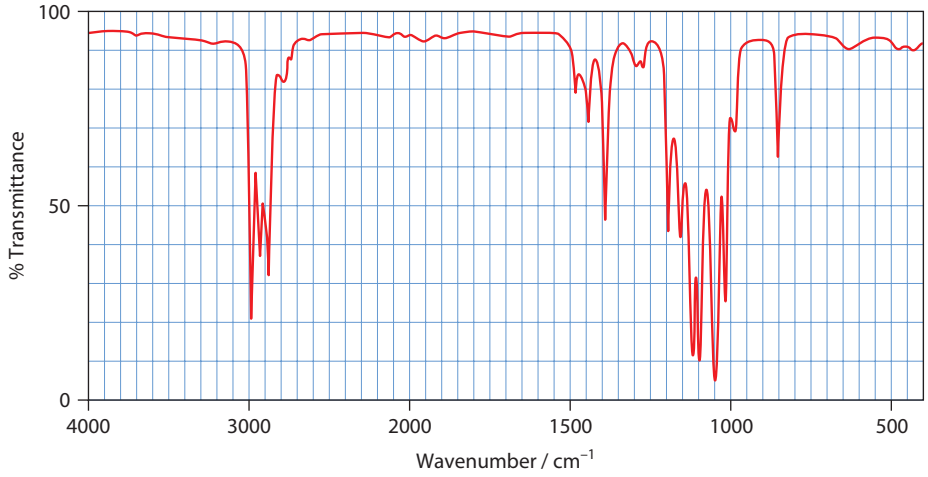


C

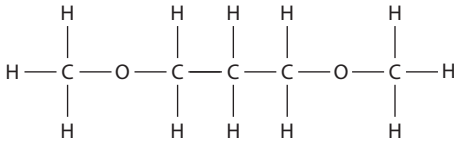
D



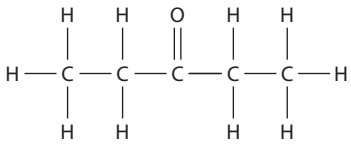
10 The infrared spectrum of a compound P is shown below. The high resolution ^{1}H NMR spectrum shows a singlet at 4.7 ppm, a quartet at 3.6 ppm and a triplet at 1.2 ppm.
What is the structure of P?



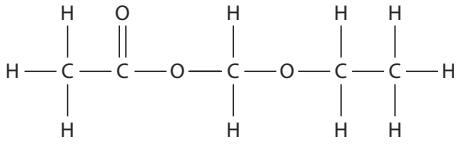
A



B



C



D