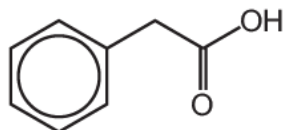


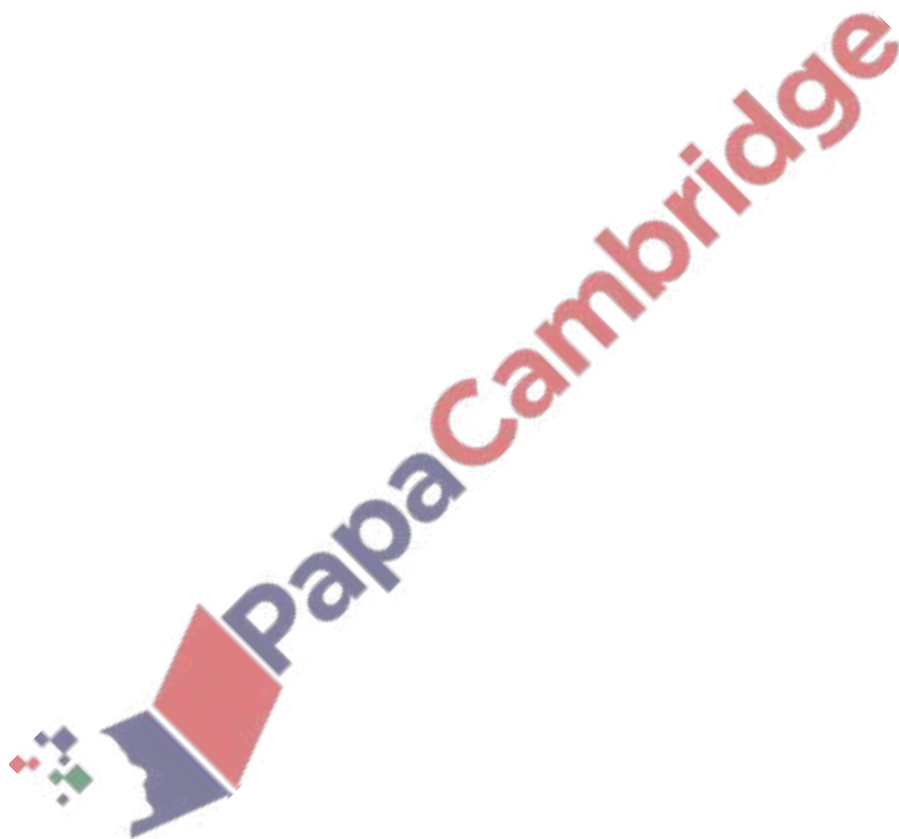
1. Nov/2021/Paper_41/No.7a

The structure of phenylethanoic acid is shown.



- (a) Give the number of different peaks in the carbon-13 (^{13}C) NMR spectrum of phenylethanoic acid.

number of peaks = [1]



(d) The relative abundance of the molecular ion peak in the mass spectrum of ethylamine is 62.

(i) Calculate the relative abundance of the M+1 peak in the mass spectrum of ethylamine.

relative abundance = [1]

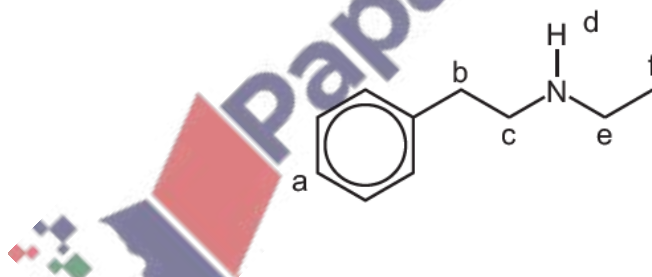
(ii) The mass spectrum of compound T contains several fragments. The m/e values of two of these fragments are 29 and 91.

Draw the structures of the ions responsible for these peaks.

m/e	structure of ion
29	
91	

[2]

(e) The proton (^1H) NMR spectrum of compound T shows hydrogen atoms in different environments. Six of these environments are shown on the structure using letters a, b, c, d, e and f.

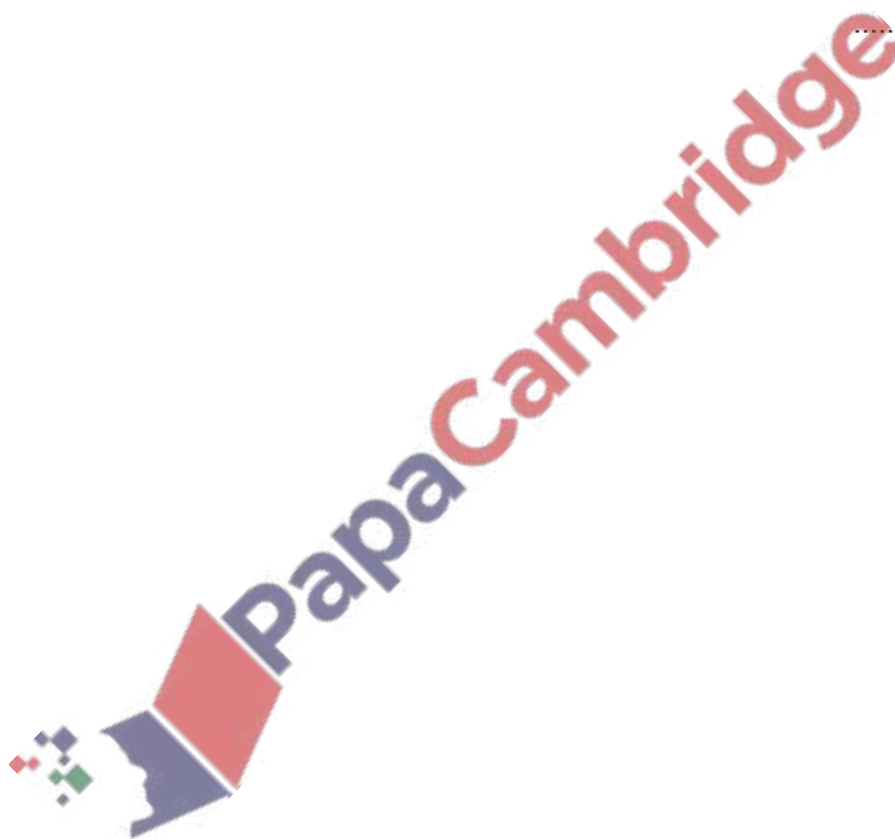


Use the letters a, b, c, d, e and f to answer the questions that follow. The questions relate to the proton (^1H) NMR spectrum of T.

Proton d does not cause splitting of the peaks for protons c or e under the conditions used.

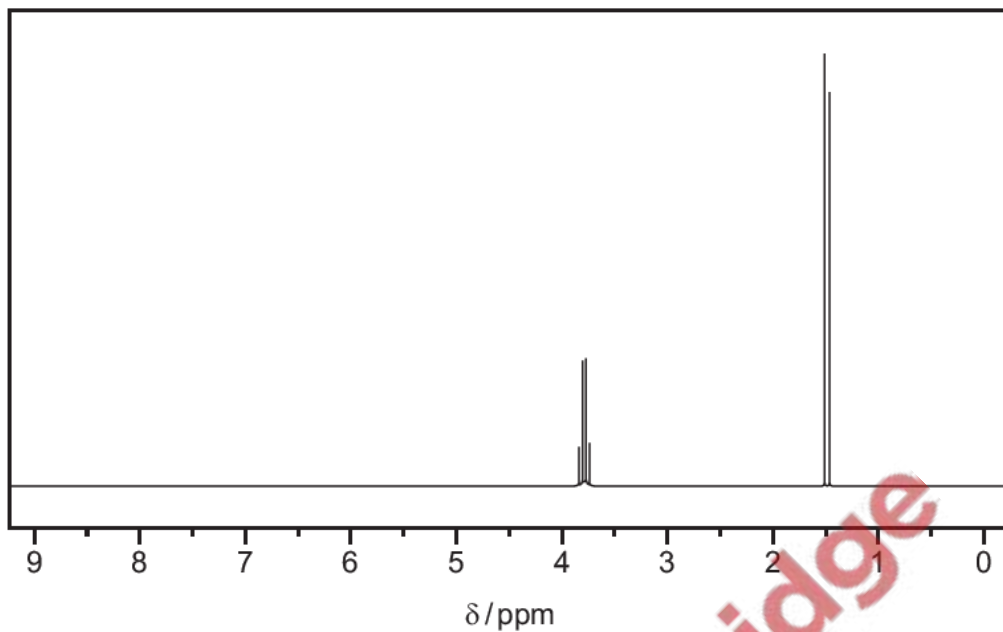
Each answer may be one, or more than one, of the letters a, b, c, d, e and f.

- (i) Identify the proton or protons with a chemical shift (δ) in the range 6.0 to 9.0.
..... [1]
- (ii) Identify the proton or protons whose peak will disappear if D_2O is added.
..... [1]
- (iii) Identify the proton or protons whose peak is a triplet.
..... [1]
- (iv) Identify the proton or protons with the lowest chemical shift (δ).
..... [1]



3. Nov/2021/Paper_42/No.8b,8c

(b) The proton (^1H) NMR spectrum of either alanine in D_2O or glutamic acid in D_2O is shown.



State whether this is the spectrum of alanine in D_2O or the spectrum of glutamic acid in D_2O . Explain your answer by reference to the number of peaks and splitting patterns.

.....

.....

.....

..... [3]



(c) The mass spectrum of glutamic acid, $\text{H}_2\text{NCH}(\text{CH}_2\text{CH}_2\text{CO}_2\text{H})\text{CO}_2\text{H}$, is obtained.

(i) State the m/e value of the molecular ion peak in this spectrum.

..... [1]

(ii) The spectrum has peaks with m/e values of 88 and 131.

Draw the structures of the ions responsible for these peaks.

m/e	structure of ion
88	
131	

[2]

