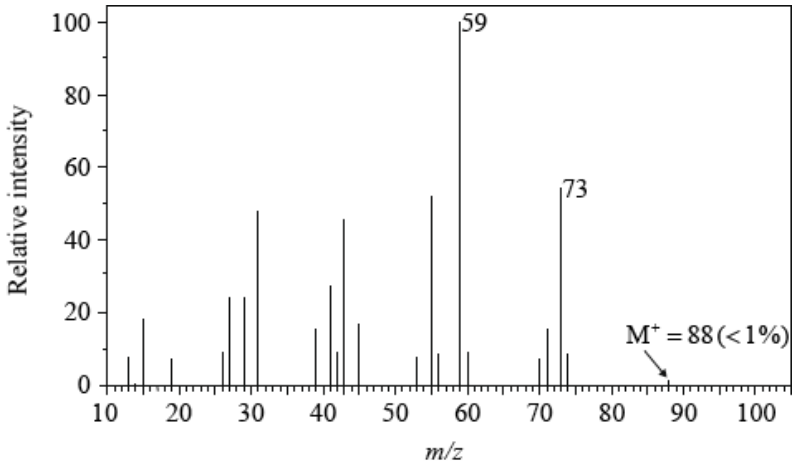
HL Paper 3

Organic compound X is 68.11% carbon, 13.74% hydrogen and 18.15 % oxygen by mass.

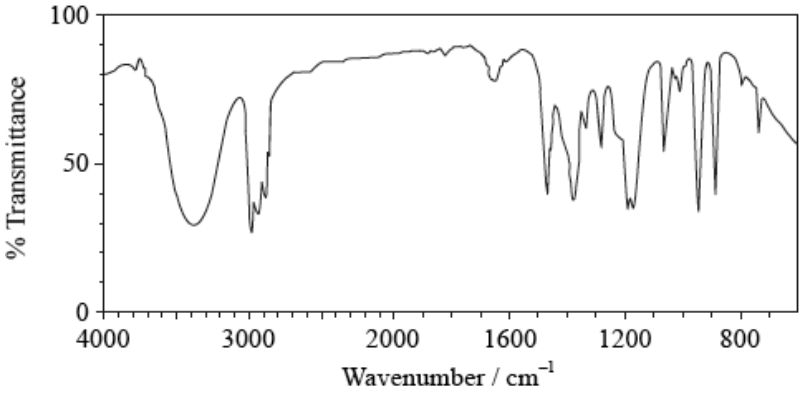
a. Show that the empirical formula of compound **X** is $C_5H_{12}O$. [1]

b. The mass spectrum, infrared spectrum and details of the $^1H\,NMR$ spectrum of compound **X** are given below. [11]

Mass spectrum:



Infrared spectrum:



$^1H\,NMR$ spectrum:

Peak with splitting	Integration trace (area under peak)
Singlet	1
Singlet	6
Triplet	3
Quartet	2

Analyse these three spectra and, using relevant information, deduce the identity of the compound.

Mass spectrum:

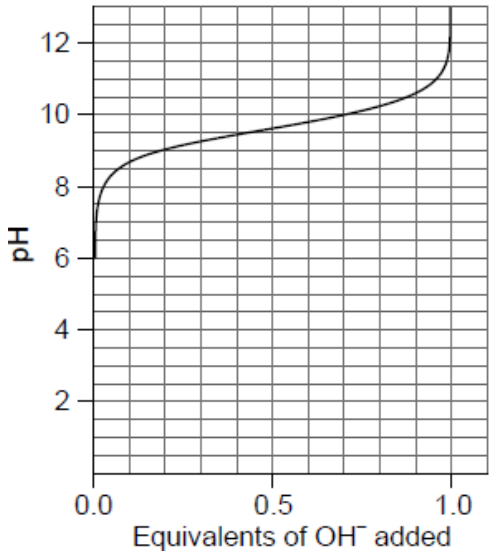
Infrared spectrum:

$^{1}\mathrm{H}$ NMR spectrum:

Identity of X:

Analysis of amino acid and protein concentration is a key area of biological research.

The titration curve of aqueous glycine zwitterions with aqueous sodium hydroxide is shown from pH 6.0 to 13.0. Refer to section 33 of the data booklet.



a. Deduce the pH range in which glycine is an effective buffer in basic solution. [1]

b. Enzymes are biological catalysts. [1]

The data shows the effect of substrate concentration, [S], on the rate, v, of an enzyme-catalysed reaction.

[S] / mmol dm^{-3}	v / mmol dm^{-3} min^{-1}
0.0	0.00
0.67	0.40
1.5	0.60
2.0	0.68
4.0	0.78
6.0	0.80
8.0	0.80
10.0	0.80

Determine the value of the Michaelis constant (K_m) from the data. A graph is not required.

c. Outline the action of a non-competitive inhibitor on the enzyme-catalysed reaction. [2]

d. The sequence of nitrogenous bases in DNA determines hereditary characteristics. [2]

Calculate the mole percentages of cytosine, guanine and thymine in a double helical DNA structure if it contains 17% adenine by mole.

Cytosine:

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Guanine:

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Thymine:

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