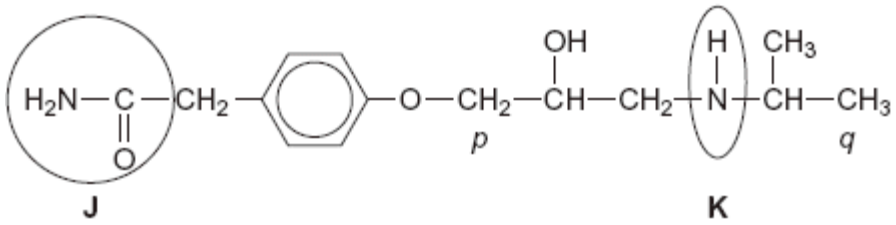
Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Amines

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Name of the Student:_____
Max. Marks : 16 Marks **Time : 16 Minutes**

Q1.

Atenolol is an example of the type of medicine called a beta blocker. These medicines are used to lower blood pressure by slowing the heart rate. The structure of atenolol is shown below.



(a) Give the name of each of the circled functional groups labelled **J** and **K** on the structure of atenolol shown above.

Functional group labelled **J** _____

Functional group labelled **K** _____

(2)

(b) The ^{1}H n.m.r. spectrum of atenolol was recorded.

One of the peaks in the ^{1}H n.m.r. spectrum is produced by the CH_2 group labelled *p* in the structure of atenolol.
Use **Table 2** on the Data Sheet to suggest a range of δ values for this peak.
Name the splitting pattern of this peak.

Range of δ values _____

Name of splitting pattern _____

(2)

(c) N.m.r. spectra are recorded using samples in solution.
The ^{1}H n.m.r. spectrum was recorded using a solution of atenolol in $CDCl_3$

(i) Suggest why $CDCl_3$ and **not** $CHCl_3$ was used as the solvent.

_____

_____

(1)

(ii) Suggest why $CDCl_3$ is a more effective solvent than CCl_4 for polar molecules such as atenolol.

_____

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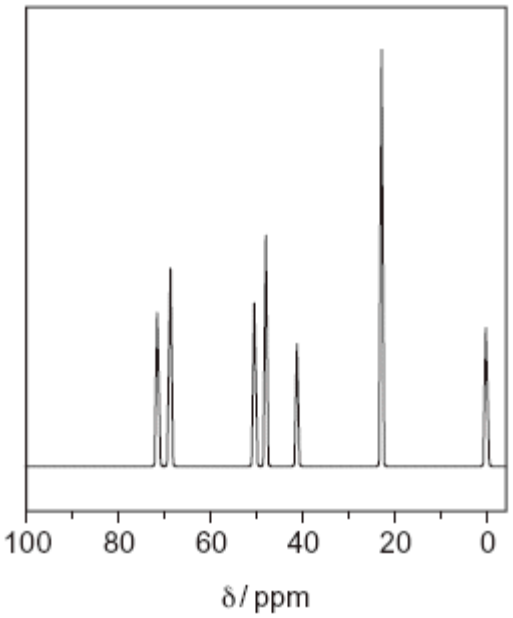
(1)

(d) The ^{13}C n.m.r. spectrum of atenolol was also recorded.

Use the structure of atenolol given to deduce the total number of peaks in the ^{13}C n.m.r. spectrum of atenolol.

(1)

(e) Part of the ^{13}C n.m.r. spectrum of atenolol is shown below. Use this spectrum and **Table 3** on the Data Sheet, where appropriate, to answer the questions which follow.



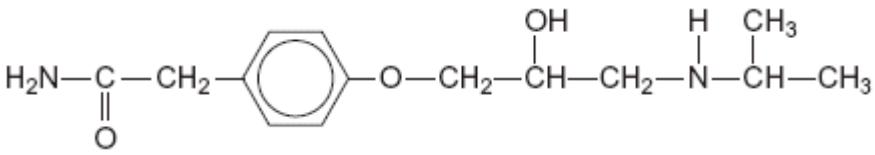
(i) Give the formula of the compound that is used as a standard and produces the peak at δ = 0 ppm in the spectrum.

(1)

(ii) One of the peaks in the ^{13}C n.m.r. spectrum above is produced by the CH_3 group labelled *q* in the structure of atenolol.
Identify this peak in the spectrum by stating its δ value.

(1)

(iii) There are three CH_2 groups in the structure of atenolol. One of these CH_2 groups produces the peak at δ = 71 in the ^{13}C n.m.r. spectrum above.
Draw a circle around this CH_2 group in the structure of atenolol shown below.



(1)

(f) Atenolol is produced industrially as a racemate (an equimolar mixture of two enantiomers) by reduction of a ketone. Both enantiomers are able to lower blood pressure. However, recent

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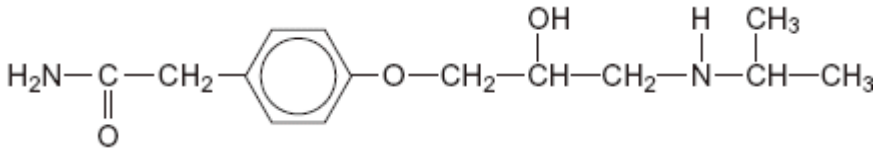
research has shown that one enantiomer is preferred in medicines.

(i) Suggest a reducing agent that could reduce a ketone to form atenolol.

_____

(1)

(ii) Draw a circle around the asymmetric carbon atom in the structure of atenolol shown below.



(1)

(iii) Suggest how you could show that the atenolol produced by reduction of a ketone was a racemate and **not** a single enantiomer.

_____

_____

_____

_____

(2)

(iv) Suggest **one** advantage and **one** disadvantage of using a racemate rather than a single enantiomer in medicines.

Advantage _____

_____

Disadvantage _____

_____

(2)

(Total 16 marks)

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