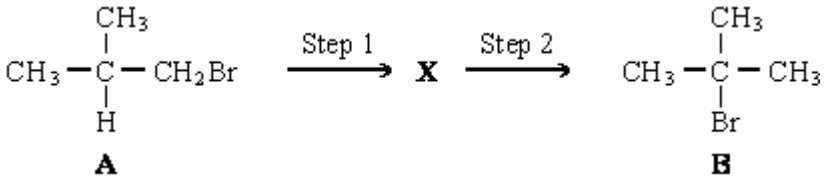
Q1. The conversion of compound **A** into compound **B** can be achieved in two steps as shown below.



A **B**

The intermediate compound, **X,** has an absorption at 1650 cm^{-1} in its infra-red spectrum.

(a) Identify compound **X**. Explain your answer.

(2)

(b) For each step in this conversion, give the reagents and essential conditions required and outline a mechanism.

(11)

(c) Show how the number of peaks in their proton n.m.r. spectra would enable you to distinguish between compounds **A** and **B**.

(2)

(Total 15 marks)

Q2. Which one of the following statements about but-2-enal, $CH_3CH=CHCHO$, is **not** true?

A It has stereoisomers.

B It shows a strong absorption in the infra-red at about 1700 cm^{-1}.

C It will turn an acidified solution of potassium dichromate(VI) green.

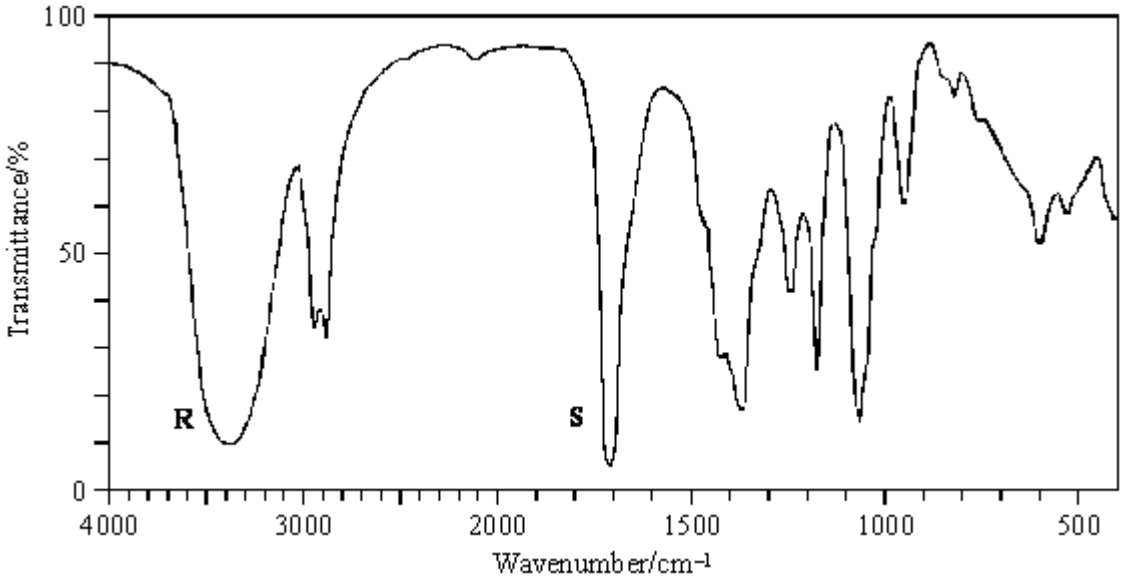
D It can be dehydrated by concentrated sulphuric acid.

(Total 1 mark)

Q3. Spectral data for use in this question are provided below the Periodic Table (first item on the database).

Compound **Q** has the molecular formula $C_4H_8O_2$

(a) The infra-red spectrum of **Q** is shown below.



Identify the type of bond causing the absorption labelled **R** and that causing the absorption labelled **S**.

R .....

S .....

(2)

(b) **Q** does not react with Tollens' reagent or Fehling's solution. Identify a functional group which would react with these reagents and therefore cannot be present in **Q**.

.....

(1)

(c) Proton n.m.r. spectra are recorded using a solution of a substance to which tetramethylsilane (TMS) has been added.

(i) Give two reasons why TMS is a suitable standard.

Reason 1 .....

Reason 2 .....

(ii) Give an example of a solvent which is suitable for use in recording an n.m.r. spectrum. Give a reason for your choice.

Solvent .....

Reason .....

(4)

(d) The proton n.m.r. spectrum of **Q** shows 4 peaks.

The table below gives δ values for each of these peaks together with their splitting patterns and integration values.

δ/ppm	2.20	2.69	3.40	3.84
Splitting pattern	singlet	triplet	singlet	triplet
Integration value	3	2	1	2

What can be deduced about the structure of **Q** from the presence of the following in its n.m.r. spectrum?

(i) The singlet peak at δ = 2.20

.....

(ii) The singlet peak at δ = 3.40

.....

(iii) Two triplet peaks

.....

(3)

(e) Using your answers to parts (a), (b) and (d), deduce the structure of compound **Q**.

(1)
(Total 11 marks)