



Name _____ Class: _____

Start Time _____ End Time _____ Time Taken _____

Time allowed: 31 minutes

INSTRUCTIONS TO CANDIDATES

- This document is designed to be used as a practice test.
- Complete the test under exam conditions in one sitting.
- Optional: Before marking it, go through the paper with a set of notes and improve your answers.
- Mark the test using the mark scheme make corrections on the paper.
- Complete the table on the front page.
- Improve your notes so that they better reflect your weaknesses.
- Make a note of your strengths and weaknesses for future revision.

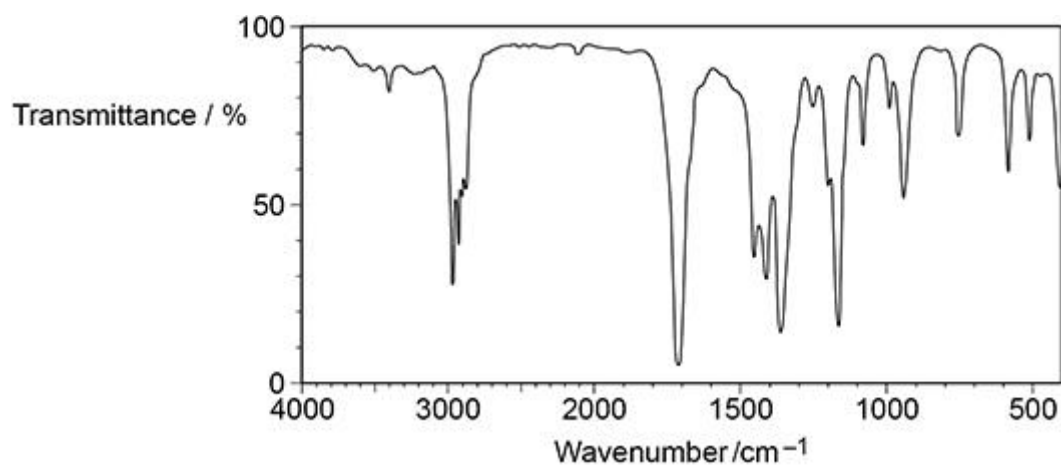
Success Criteria	Questions in Paper	Mark	Out of	%	Rank Order
IR Spec	1a, 1b		1, 3		
Proton NMR – determining structure	1c, 2b, 2c, 2d		5, 3, 1, 2		
Proton NMR – how it works	2a		6		
Multispectral Analysis	3		6		
Total			27		

**Q1.**

This question is about spectroscopy.

- (a) Compound **K** has molecular formula C_4H_8O
Figure 1 shows the infrared spectrum of **K**.

Figure 1



Which functional group does **K** contain?

Tick (✓) **one** box.

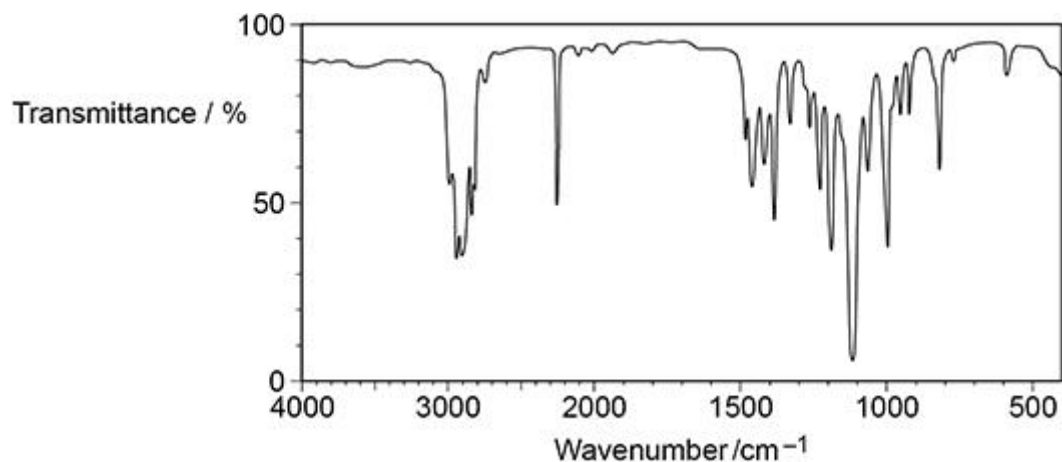
Functional Group				
alcohol	alkene	amine	carbonyl	nitrile
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(1)



- (b) Compound **L** has molecular formula C_4H_7NO
Figure 2 shows the infrared spectrum of **L**.

Figure 2



L reacts with H_2 in the presence of a nickel catalyst to give compound **M**.

Suggest **three** ways in which the infrared spectrum of **M** is different from the infrared spectrum of **L**.

1 _____

2 _____

3 _____

(3)

**Q2.**

This question is about NMR spectroscopy.

- (a) A compound is usually mixed with $\text{Si}(\text{CH}_3)_4$ and either CCl_4 or CDCl_3 before recording the compound's ^1H NMR spectrum.

State why $\text{Si}(\text{CH}_3)_4$, CCl_4 and CDCl_3 are used in ^1H NMR spectroscopy.

Explain how their properties make them suitable for use in ^1H NMR spectroscopy.

(6)

- (b) Deduce the splitting pattern for each of the peaks given by the H atoms labelled **x**, **y** and **z** in the ^1H NMR spectrum of the compound shown.



x _____

y _____

z _____

(3)

- (c) Suggest why it is difficult to use **Table B** in the Data Booklet to predict the chemical shift (δ value) for the peak given by the H atom labelled **y**.

(1)



- (d) Two isomers of $\text{CH}_3\text{CHClCOCH}(\text{CH}_3)_2$ each have two singlet peaks only in their ^1H NMR spectra.
In both spectra the integration ratio for the two peaks is 2:9

Deduce the structures of these two isomers.

Isomer 1

Isomer 2

(2)

(Total 12 marks)

Q3.

This question is about compound **X** with the empirical formula $\text{C}_2\text{H}_4\text{O}$

Figure 1 shows the infrared spectrum of **X**.

Figure 2 shows the ^{13}C NMR spectrum of **X**.

The ^1H NMR spectrum of **X** shows four peaks with different chemical shift values.
The table below gives data for these peaks.

Figure 1

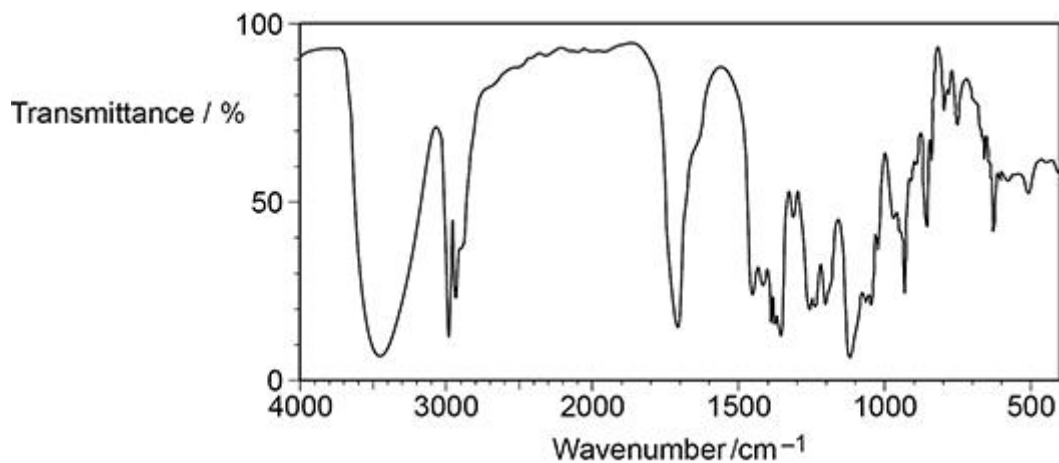


Figure 2

