

Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

How many peaks are there in the ^{13}C NMR spectrum of 1,4-dimethylbenzene?

A 8

☐

B 4

☐

C 3

☐

D 2

☐

(Total 1 mark)

Q2.

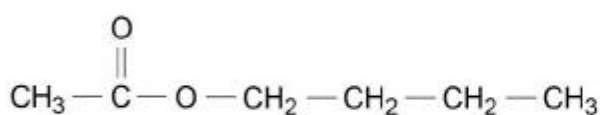
^1H NMR, ^{13}C NMR and infrared spectroscopy are used in organic chemistry to distinguish between compounds and to identify them.

- (a) Give the skeletal formula of the compound that is used as the standard when recording a ^{13}C NMR spectrum.

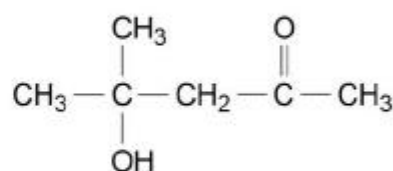
(1)

- (b) Four isomers of $\text{C}_6\text{H}_{12}\text{O}_2$, **P**, **Q**, **R** and **S**, shown in **Figure 1**, were analysed by ^{13}C NMR spectrometry.

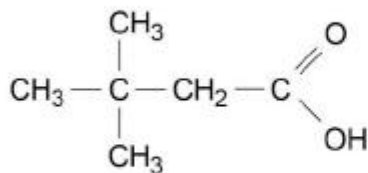
Figure 1



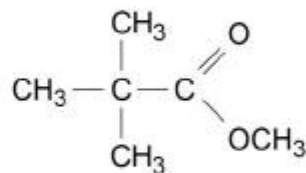
P



Q



R



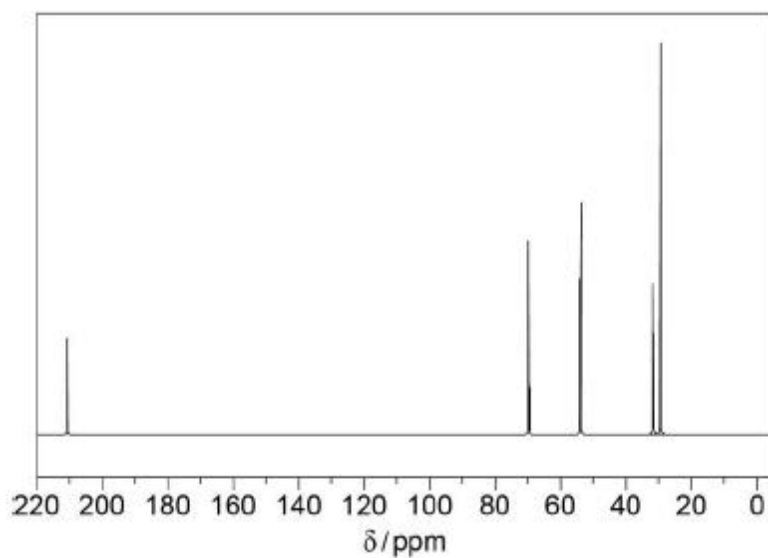
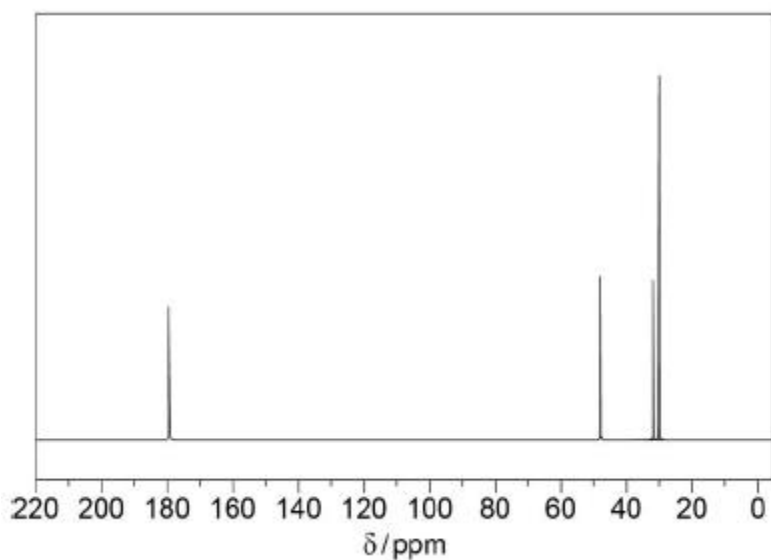
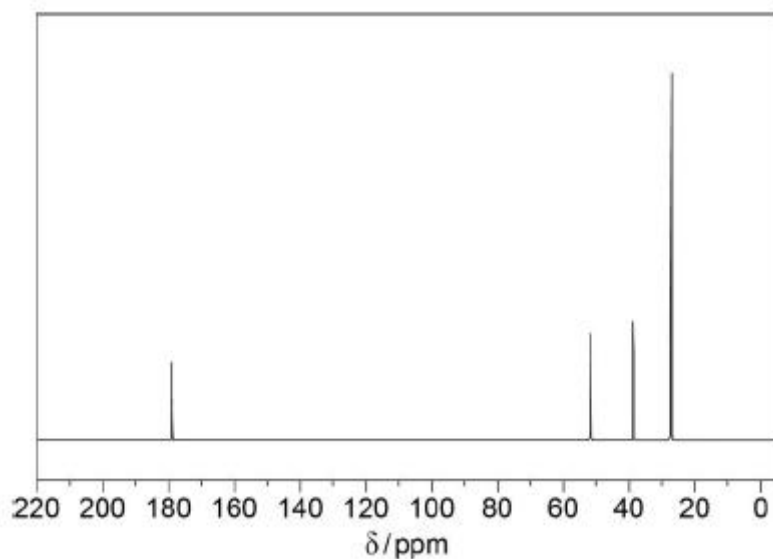
S

The ^{13}C NMR spectra of three of these isomers are shown in **Figure 2**.

Use **Table C** in the Data Booklet to help you to identify which isomer produces each spectrum.

Write the letter of each isomer opposite its spectrum in **Figure 2**.

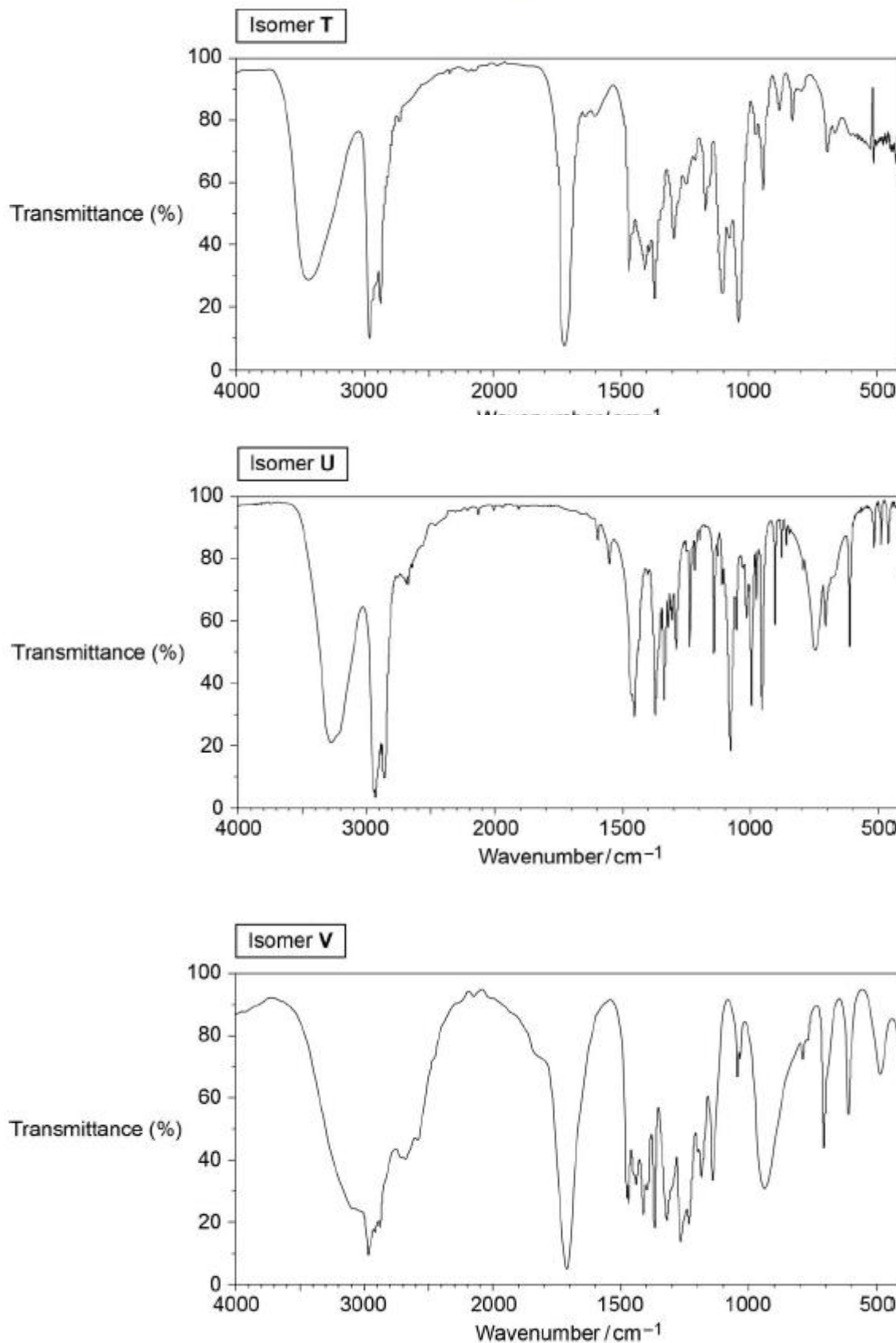
Figure 2



(3)

- (c) The infrared spectra shown in **Figure 3** are those of three different isomers of $C_6H_{12}O_2$, isomers **T**, **U** and **V**.

Figure 3



Identify the functional group(s) present in each isomer **T**, **U** and **V** of $C_6H_{12}O_2$ using **Table A** in the Data Booklet.

Explain your answer.

(6)

- | | | | | | |
|--|---------|---------|---------|---------|---------|
| Chemical shift, δ/ppm | 3.7 | 3.5 | 2.6 | 2.2 | 1.1 |
| Integration value | 0.6 | 0.6 | 0.6 | 0.9 | 0.9 |
| Splitting pattern | triplet | quartet | triplet | singlet | triplet |

- (1)

- Signal at $\delta = 3.5$ _____
- _____
- _____

Signal at $\delta = 2.2$ _____

(4)

- (f) Deduce the structure of compound **X**, $C_6H_{12}O_2$

Use your answer from part (e) to help you.

You are **not** required to explain how you deduced the structure.

(2)

(Total 17 marks)