



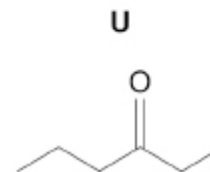
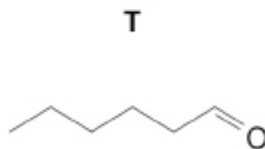
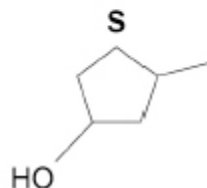
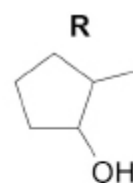
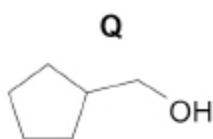
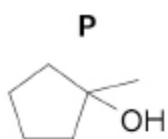
A-Level Chemistry
Identification of Functional
Groups
Question Paper

Time available: 64 minutes
Marks available: 57 marks

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1.

This question is about the structural isomers shown.



- (a) Identify the isomer(s) that would react when warmed with acidified potassium dichromate(VI).

State the expected observation when acidified potassium dichromate(VI) reacts.

Isomer(s) _____

Expected observation _____

(2)

- (b) Identify the isomer(s) that would react with Tollens' reagent.

State the expected observation when Tollens' reagent reacts.

Isomer(s) _____

Expected observation _____

(2)

- (c) Separate samples of each isomer are warmed with ethanoic acid and a few drops of concentrated sulfuric acid. In each case the mixture is then poured into a solution of sodium hydrogencarbonate.

Identify the isomer(s) that would react with ethanoic acid.

Suggest a simple way to detect if the ethanoic acid reacts with each isomer.

Give a reason why the mixture is poured into sodium hydrogencarbonate solution.

Isomer(s) _____

Suggestion _____

Reason _____

(3)

- (d) State the type of structural isomerism shown by isomers **P**, **Q**, **R** and **S**.

(1)

- (e) Describe fully how infrared spectra can be used to distinguish between isomers **R**, **S** and **T**. Use data from **Table A** in the Data Booklet in your answer.

(4)

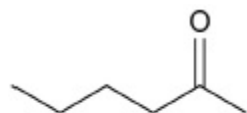
- (f) State why mass spectrometry using electrospray ionisation is **not** a suitable method to distinguish between the isomers.

(1)

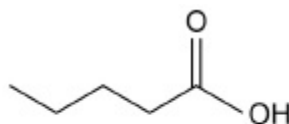
(Total 13 marks)

2.

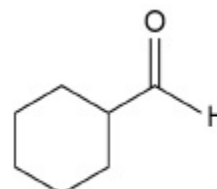
The structures of three organic compounds A, B and C are shown.



Compound A



Compound B



Compound C

These compounds can be distinguished by simple test-tube reactions.

For each pair of compounds in questions (a) and (b), give a reagent (or combination of reagents) that could be added separately to each compound to distinguish between them.

State what is observed in each case.

- (a) Compounds A and B

Reagent _____

Observation with A _____

Observation with B _____

(3)

- (b) Compounds A and C

Reagent _____

Observation with A _____

Observation with C _____

(3)

(Total 6 marks)

3.

Four compounds, all colourless liquids, are

- butan-2-ol
- butanal
- butanone
- 2-methylpropan-2-ol

Two of these compounds can be identified using different test-tube reactions.

Describe these **two** test-tube reactions by giving reagents and observations in each case. Suggest how the results of a spectroscopic technique could be used to distinguish between the **other** two compounds.

(Total 6 marks)

4.

The oxidation of propan-1-ol can form propanal and propanoic acid. The boiling points of these compounds are shown in the table.

Compound	Boiling point / °C
propan-1-ol	97
propanal	49
propanoic acid	141

In a preparation of propanal, propan-1-ol is added dropwise to the oxidising agent and the aldehyde is separated from the reaction mixture by distillation.

- (a) Explain, with reference to intermolecular forces, why distillation allows propanal to be separated from the other organic compounds in this reaction mixture.

(3)

(b) Give **two** ways of maximising the yield of propanal obtained by distillation of the reaction mixture.

1. _____

2. _____

(2)

(c) Describe how you would carry out a simple test-tube reaction to confirm that the sample of propanal obtained by distillation does **not** contain any propanoic acid.

(2)

- (d) A student carried out an experiment to determine the enthalpy of combustion of ethanol. Combustion of 457 mg of ethanol increased the temperature of 150 g of water from 25.1 °C to 40.2 °C

Calculate a value, in kJ mol^{-1} , for the enthalpy of combustion of ethanol in this experiment. Give your answer to the appropriate number of significant figures.

(The specific heat capacity of water is $4.18 \text{ J K}^{-1} \text{ g}^{-1}$)

Enthalpy of combustion _____ kJ mol^{-1}

(3)

- (e) A mixture of isomeric alkenes is produced when pentan-2-ol is dehydrated in the presence of hot concentrated sulfuric acid. Pent-1-ene is one of the isomers produced.

Name and outline a mechanism for the reaction producing pent-1-ene.

Name of mechanism _____

Mechanism

(4)

(f) A pair of stereoisomers is also formed in the reaction in **part (e)**.

Name the less polar stereoisomer formed.

Explain how this type of stereoisomerism arises.

Name _____

Explanation _____

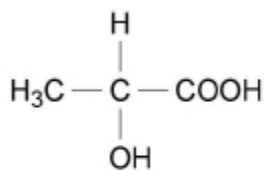
(2)

(Total 16 marks)

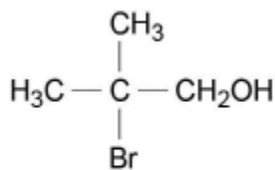
5.

Test-tube reactions can be used to identify the functional groups in organic molecules.

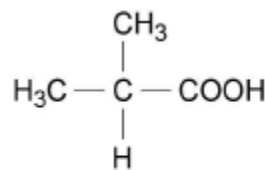
You are provided with samples of each of the four compounds.



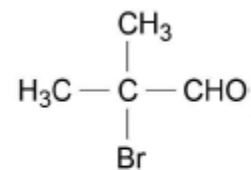
K



L



M



N

Describe how you could distinguish between all four compounds using the minimum number of tests on each compound.

You should describe what would be observed in each test.

(Total 6 marks)

6.

A student was given unlabelled samples of pentan-1-ol, pent-1-ene, pentanoic acid and pentanal.

- (a) Name the reagent(s) that the student could use to identify the sample that was pent-1-ene. Describe the observation(s) that the student would make to confirm this.

Reagent(s) _____

Observation(s) _____

(2)

- (b) Name the reagent(s) that the student could use to identify the sample that was pentanoic acid.

Describe the observation(s) that the student would make to confirm this.

Reagent(s) _____

Observation(s) _____

(2)

- (c) Name the reagent(s) that the student could use to identify the sample that was pentanal.

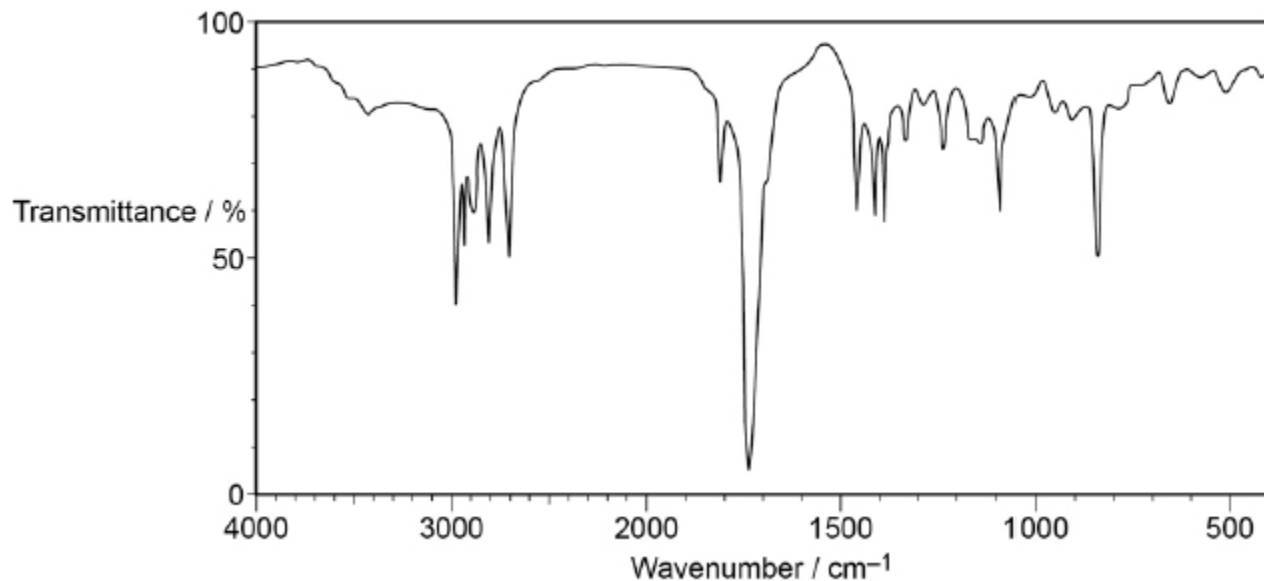
Describe the observation(s) that the student would make to confirm this.

Reagent(s) _____

Observation(s) _____

(2)

(d) The student deduced that the spectrum in the image below was that of pentanal.



Justify this deduction and suggest why this spectrum **cannot** be that of pentan-1-ol, pentanoic acid or pent-1-ene.

(4)
(Total 10 marks)