

Name of the Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

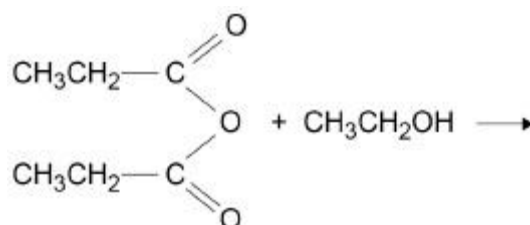
Q1.

This question is about esters including biodiesel.

- (a) An ester is formed by the reaction of an acid anhydride with
- $\text{CH}_3\text{CH}_2\text{OH}$

Complete the equation. In your answer show clearly the structure of the ester.
 Give the IUPAC name of the ester.

Equation



Name of ester _____

(3)

- (b) In a reaction to form biodiesel, one mole of a vegetable oil reacts with an excess of methanol to form two moles of an ester with molecular formula $\text{C}_{19}\text{H}_{34}\text{O}_2$ and one mole of an ester with molecular formula $\text{C}_{19}\text{H}_{36}\text{O}_2$

Draw the structure of the vegetable oil showing clearly the ester links.

You should represent the hydrocarbon chains in the form C_xH_y where x and y are the actual numbers of carbon and hydrogen atoms.

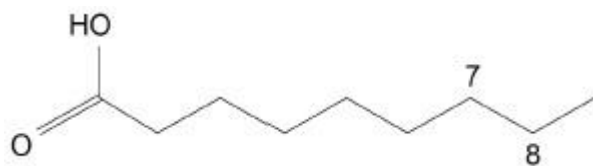
(2)

- (c) The compound
- $\text{C}_{19}\text{H}_{34}\text{O}_2$
- is the methyl ester of Z,Z-octadeca-9,12-dienoic acid.

Part of the structure of the acid is shown.

Complete the skeletal formula to show the next part of the hydrocarbon chain to carbon atom number 14.

In your answer, show the Z stereochemistry around both C=C double bonds.

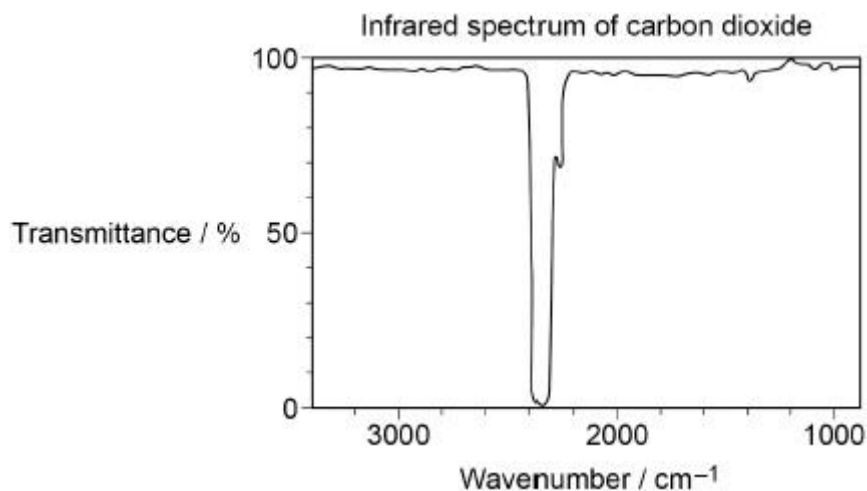


(2)

- (d) Give an equation for the complete combustion of the ester $C_{19}H_{34}O_2$

(1)

- (e) Combustion of biodiesel produces greenhouse gases such as carbon dioxide that cause global warming.
Part of the infrared spectrum of carbon dioxide is shown in the diagram.



State how the infrared spectrum of carbon dioxide in the diagram above is **not** what you might predict from the data provided in **Table A** in the Data Booklet.

(1)

- (f) Explain how carbon dioxide causes global warming.

(2)
(Total 11 marks)

Q2.

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.

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(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 _____

(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)