Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Alkanes

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Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Q1.

This question is about fossil fuels.

(a) The petrol fraction from crude oil contains octane (C_8H_{18}).

Give an equation for the complete combustion of octane.

_____

(1)

(b) The combustion of petrol in car engines produces the pollutant nitrogen monoxide.

Give an equation for a reaction that removes nitrogen monoxide in a catalytic converter.

_____

(1)

(c) Sulfur dioxide is produced in the combustion of fossil fuels. The total emissions of sulfur dioxide in the UK have fallen dramatically since 1970.

Sulfur dioxide is now removed from the flue gases in power stations by reaction with calcium oxide.

$$CaO + SO_2 \rightarrow CaSO_3$$

In 1970, the total UK emissions of sulfur dioxide were 6.49 million tonnes (1 tonne = 1000 kg).

Calculate the mass, in kilograms, of calcium oxide needed to react with this mass of sulfur dioxide.

Give your answer in standard form.

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Mass of calcium oxide _____ kg

(2)

(Total 4 marks)

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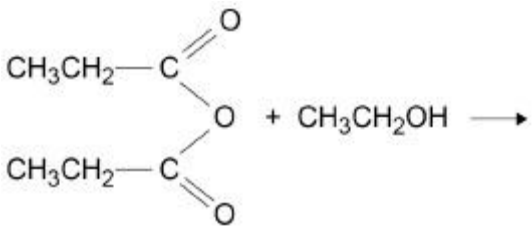
Q2.

This question is about esters including biodiesel.

(a) An ester is formed by the reaction of an acid anhydride with CH_3CH_2OH

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 $C_{19}H_{34}O_2$ and one mole of an ester with molecular formula $C_{19}H_{36}O_2$

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

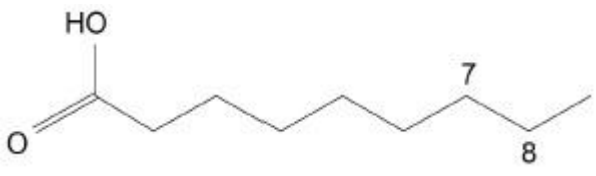
You should represent the hydrocarbon chains in the form C_xH_y where *x* and *y* are the actual numbers of carbon and hydrogen atoms.

(2)

(c) The compound $C_{19}H_{34}O_2$ 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.



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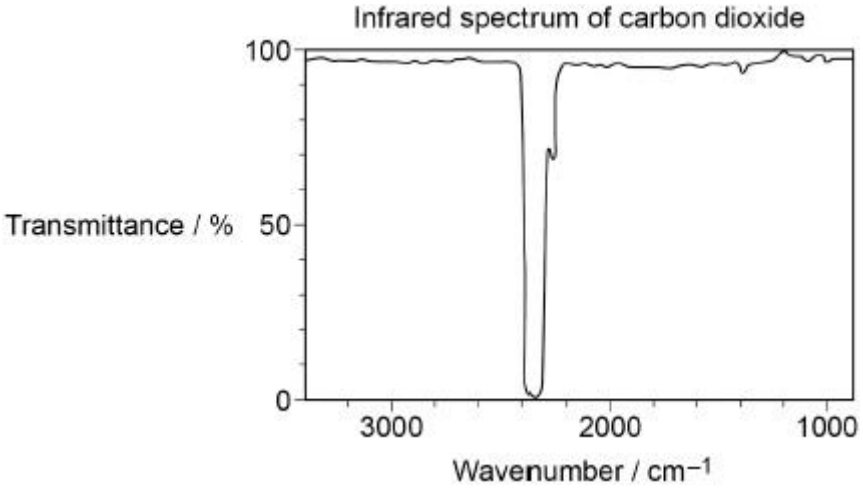
(2)

(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)

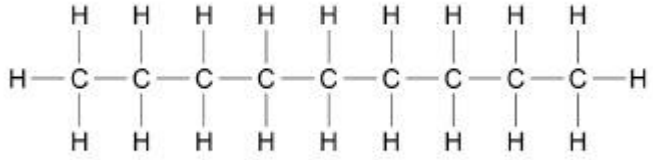
(Total 11 marks)

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Q3.

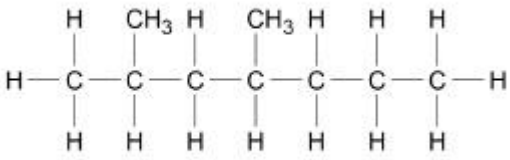
The alkanes nonane and 2,4-dimethylheptane are structural isomers with the molecular formula C_9H_{20}
They are found in crude oil and can be separated by fractional distillation.
Both can be used in fuels or cracked to form other products.

nonane



boiling point 151 °C

2,4-dimethylheptane



boiling point 134 °C

(a) State the general formula of an alkane containing n carbon atoms.
Deduce an expression for the relative molecular mass (M_r) of an alkane in terms of n.

General formula _____

Expression _____

(2)

(b) Explain why nonane has a higher boiling point than 2,4-dimethylheptane.

_____

_____

_____

_____

_____

_____

(2)

(c) Give an equation for the complete combustion of nonane.

_____

(1)

(d) Nonane is often found in fuel for jet engines. Combustion in jet engines produces pollutants including nitrogen monoxide (NO).

Explain how this nitrogen monoxide is formed.

_____

_____

_____

_____

_____

(2)

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(e) Nonane can be cracked to form large quantities of propene.

Name the type of cracking used.

_____

(1)

(f) The main use of propene, formed from cracking, is to make poly(propene).

Draw the repeating unit of poly(propene).

(1)

(Total 9 marks)

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