

Carboxyl groups

Question Paper

Level	Pre U
Subject	Chemistry
Exam Board	Cambridge International Examinations
Topic	Carboxyl groups-Higher functional group level
Booklet	Question Paper

Time Allowed: 32 minutes

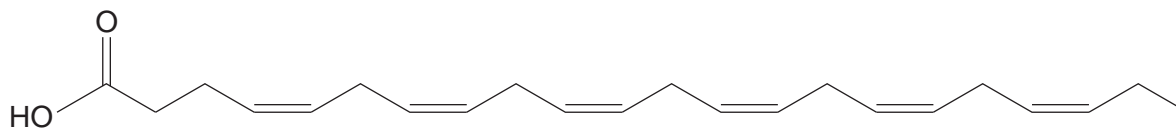
Score: /27

Percentage: /100

Grade Boundaries:

1. Evidence is accumulating that omega-3 oils help to protect us from schizophrenia and depression, and even improve learning and memory. Omega-3 oils are glyceryl esters of omega-3 fatty acids.

One omega-3 fatty acid is cervonic acid.

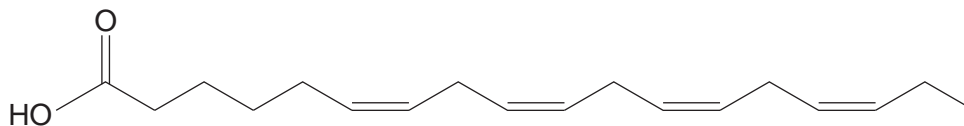


cervonic acid

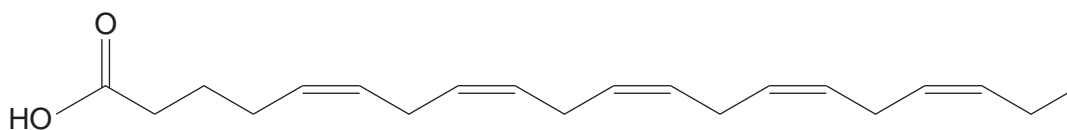
- (a) Which configuration of the C=C double bonds is present in this molecule?

..... [1]

The systematic name of cervonic acid (ignoring geometric isomerism) is docosa-4,7,10,13,16,19-hexaenoic acid. “Docosa” indicates that there is a 22-carbon chain. The numbers indicate the carbon atom where the C=C double bonds start, counting from the carboxylic acid (–COOH) functional group. “Hexaen” indicates that there are six double bonds in the chain. Two other omega-3 fatty acids are stearidonic acid and timnodonic acid.



stearidonic acid



timnodonic acid

- (b) “Octadeca” indicates that there is an 18-carbon chain. Write down the systematic name for stearidonic acid. Ignore the geometric isomerism.

..... [1]

- (c) How many geometric isomers are there of timnodonic acid, including the molecule shown?

..... [1]

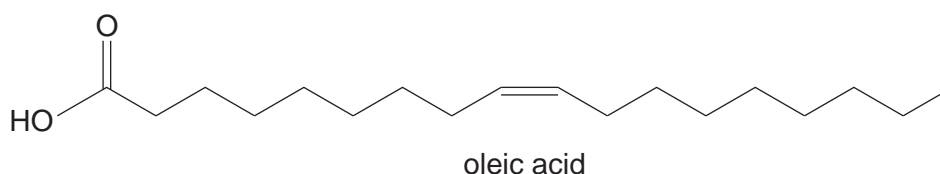
- (d) What is the name of the intermolecular force that will operate between the hydrocarbon chains? Ring the correct option. [1]

permanent dipole-permanent dipole

hydrogen bonding

instantaneous dipole-induced dipole

- (e) Another fatty acid that is believed to have beneficial health effects is oleic acid.



“Omega” is the **last** letter of the Greek alphabet. By comparing oleic acid, which is **not** an omega-3 acid, with the omega-3 fatty acids in part (a), suggest what “omega-3” relates to in the structure of these oils and fatty acids.

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 [1]

- (f) It is possible to differentiate between different types of fatty acids and oils in the laboratory by measuring the degree of unsaturation in the hydrocarbon chains. Halogens react with alkenes in an addition reaction.

Draw the structure of the product when propene reacts with Br₂ and name it systematically.

structure
name

[2]

(g) Table 8.1 shows information about various fatty acids.

Table 8.1

fatty acid	molecular formula	molar mass /g mol ⁻¹	number of C=C double bonds
cervonic acid	C ₂₂ H ₃₂ O ₂	328	6
stearidonic acid	C ₁₈ H ₂₈ O ₂	276	4
timnodonic acid	C ₂₀ H ₃₀ O ₂	302	5
oleic acid		282	1

(i) The degree of unsaturation in a fatty acid is commonly expressed by the mass of iodine that reacts with 100.0g of the acid. Use the information in Table 8.1 to calculate the mass of iodine that would react with 100.0g of cervonic acid. Use an appropriate number of significant figures in your answer.

.....[2]

(ii) Write the molecular formula of oleic acid in Table 8.1.

[1]

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..... [8]

(iv) Explain how you would work out the identity of the fatty acid given the volume of thiosulfate obtained from the experiment.

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[Total: 27]