20.3 Stereoisomerism

Question Paper

Course	DP IB Chemistry
Section	20. Organic Chemistry (HL only)
Topic	20.3 Stereoisomerism
Difficulty	Medium

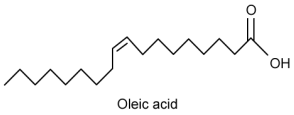
Time allowed: 50

Score: /41

Percentage: /100

Question 1a

a)
A molecule of oleic acid is shown.



Oleic acid

Oleic acid is a fatty acid which occurs naturally in different animals and plants.

Oleic acid exhibits *stereoisomerism*. Explain the meaning of this term and identify why oleic acid has stereoisomers.

[2 marks]

Question 1b

b)
Crotonic acid is another fatty acid which has a similar structure to oleic acid. The molecular formula of crotonic acid is $C_4H_6O_2$.
i)
State the empirical formula of crotonic acid.

ii)
Crotonic acid has a carboxylic acid functional group. Draw the displayed formula of the positional and branch-chain isomers of crotonic acid.

iii)
Identify which of the isomers you have drawn shows E / Z isomerism..

[4 marks]

Question 1c

c)
Give the IUPAC names of the E / Z isomers of crotonic acid.

[1 mark]

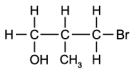
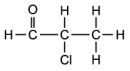
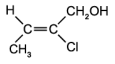
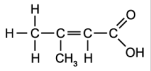
Question 1d

d)
Draw the structure of the Z-isomer of crotonic acid and mark the C-C=C bond angle

[2 marks]

Question 2a

a)
A chemist is analysing a collection of organic compounds. The structural formulae of these compounds are shown.

Compound	Structural Formula	IUPAC Name
1		
2		
3		
4		

Give the IUPAC name for the compounds to complete the table.

[4 marks]

Question 2b

b)
This question refers to the compounds in the table in part (a)

(i)
Identify the compounds which have chain isomers and draw their isomers.

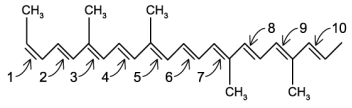
(ii)
State the empirical formula of compound **3.**

(iii)
Does compound 4 exhibit stereoisomerism? Explain your answer.

[5 marks]

Question 2c

c)
Which of the bond(s) shown in the following structure is/are in the *Z* configuration?



[1 mark]

Question 2d

d)
Explain why the reaction between E-but-2-ene and bromine produces the same product as Z-but-2-ene with bromine.

[2 marks]

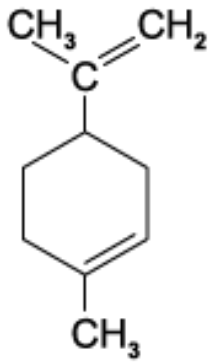
Question 3a

a)
Draw and label the cis / trans isomers of 1,2-dichlorocyclohexane. Explain why this molecule has cis / trans isomers

[2 marks]

Question 3b

b)
Mark the location of any chiral centres in limonene.



Limonene

[1 mark]

Question 3c

c)
Two unsaturated isomers of C_4H_5N, display stereoisomerism.

Draw and name the isomers.

[2 marks]

Question 3d

d)
Draw an isomer of C_4H_5N that does **not** exhibit stereoisomerism.

[1 mark]

Question 4a

a)
2–methylbut-2–ene can be converted into 2–methylbutan-2–ol, a liquid that smells of camphor.

State the reagents needed to convert 2–methylbut-2–ene into 2–methylbutan-2–ol.

[2 marks]

Question 4b

b)
The reaction in part (a) produces a small amount of an isomeric co-product, **X**, which is optically active.

i)
State the meaning of *optical activity.*

ii)
Draw the structure of **X**.

[2 marks]

Question 4c

c)
What does optical activity indicate about the structure of **X**?

[1 mark]

Question 4d

d)
Explain how optical activity can be detected using a polarimeter

[3 marks]

Question 5a

a)
Dichloroethene exists as two stereoisomers. Draw the structures of these isomers.

[1 mark]

Question 5b

b)
Explain why dichloroethene has stereoisomers.

[1 mark]

Question 5c

c)
Draw the structures of the stereoisomers of 1–bromo-1–chloroethane, C_2H_4BrCl, and show the relationship between them.

[1 mark]

Question 5d

d)
Explain the differences in chemical and physical properties between the isomers of C_2H_4BrCl

[3 marks]