20.3 Stereoisomerism

Question Paper

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

Time allowed: 40

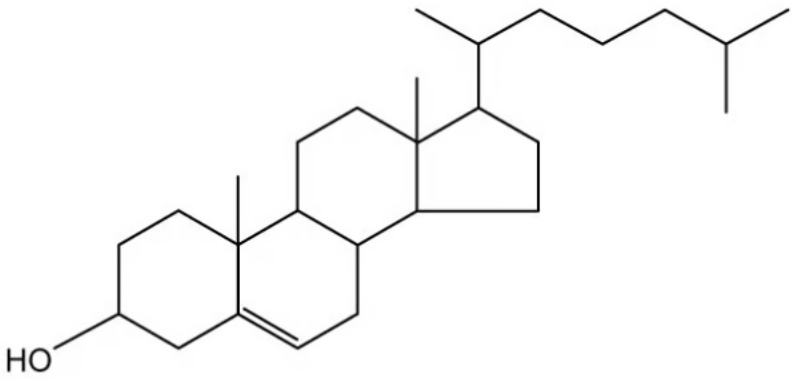
Score: /31

Percentage: /100

Question 1a

a)

Cholesterol, shown below, is a fatty chemical used by the body to build healthy cells.



State the number of chiral carbons in the cholesterol structure.

[1]

[1 mark]

Question 1b

b)

A student suggested that cholesterol could be tested with plane polarised light to show that it contains chiral centres.

Is the student correct? Justify your answer.

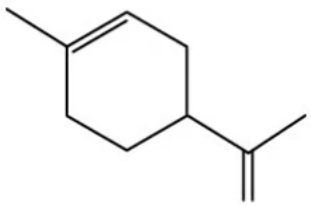
[1]

[1 mark]

Question 1c

c)

Limonene, shown below, is a naturally occurring hydrocarbon with the molecular formula $C_{10}H_{16}$ and is commonly found in the rinds of citrus fruits such as grapefruit, lemon, lime and oranges.



Limonene exists as a pair of enantiomers; one enantiomer is responsible for a strong orange smell while the other is thought to smell like lemons.

Draw 3D representations of the two enantiomers of limonene.

[2]

[2 marks]

Question 2a

a)

1,1,1,2–tetrafluoro-but-2–ene is a compound containing hydrogen, carbon and fluorine atoms.

State the meaning of the term 'stereoisomers' and explain why 1,1,1,2–tetrafluoro-but-2–ene displays stereoisomerism.

[5]

[5 marks]

Question 2b

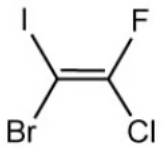
b)
Draw the *E* and *Z* isomers of 1,1,1,2–tetrafluoro-but-2–ene.

[2]

[2 marks]

Question 2c

c)
State the limitation of the cis-trans naming rules when it comes to the molecule shown below.



[1]

[1 mark]

Question 2d

d)
State the name of the molecule shown in part (c).

[1]

[1 mark]

Question 3a

a)

Butenedioic acid is HOOCCH=CHCOOH. It has two stereoisomers, commonly known as malic acid and fumaric acid. Both acids are responsible for the sour taste in fruit.

Draw the two *E*-*Z* isomers of butenedioic acid in **skeletal formulae** and label them as *E*-butenedioic acid and *Z*-butenedioic acid.

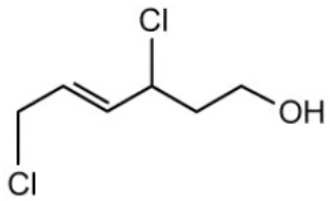
[2]

[2 marks]

Question 3b

b)

A student named the alcohol molecule shown below Z-1,4–dichlorohex-2–ene-6–ol.



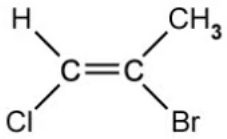
State the errors the student has made in naming the molecule and give the correct IUPAC name.

[3]

[3 marks]

Question 3c

c)
Compounds with a carbon–carbon double bond are unsaturated. The figure below shows an unsaturated hydrocarbon.



i) Name the isomer shown.

[1]

ii) Justify the CIP naming rule for this isomer.

[1]

[2 marks]

Question 4a

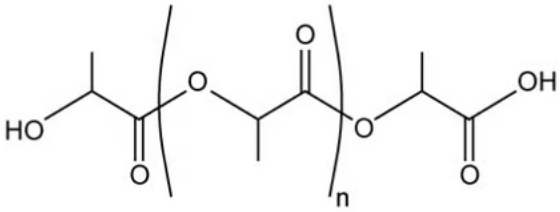
a)
Lactic acid has the molecular formula of $C_3H_6O_3$, and the structural formula of $CH_3CHOHCOOH$.
Illustrate the types of isomerism shown by $C_3H_6O_3$.

[4]

[4 marks]

Question 4b

b)
The general structure of polylactic acid is shown below:



Draw **two** possible structures formed from two repeating units.

Your answer should keep the main polymer chain in the same plane but show the 3D representation of the chiral carbons.

[2]

[2 marks]

Question 4c

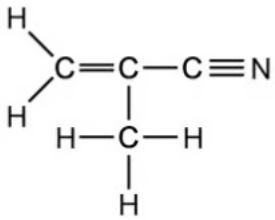
c)
State, why the polymer formed from the uncontrolled condensation polymerisation of lactic acid, is not a racemate.

[1]

[1 mark]

Question 5a

a)
Two isomers of 2–methylprop-2–enenitrile, C_4H_5N, display E/Z isomerism.



Draw and name the isomers.

[2]

[2 marks]

Question 5b

b)

Draw one repeating unit of the polymer formed by addition polymerisation of *(E)*-but-2-ene.

[1]

[1 mark]

Question 5c

c)

Explain why the polymer formed by (*E*)-but-2-ene is the same as the polymer formed by (*Z*)-but-2-ene.

[1]

[1 mark]