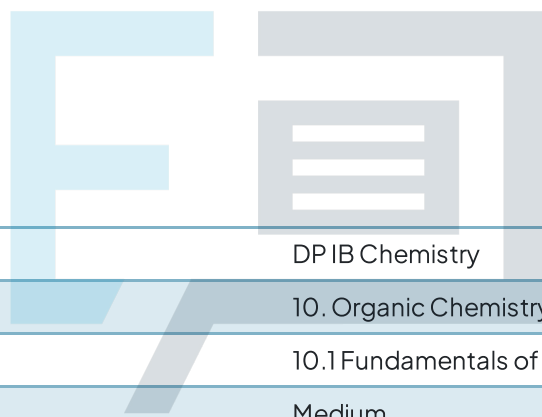




10.1 Fundamentals of Organic Chemistry

Question Paper



Course	DP IB Chemistry
Section	10. Organic Chemistry
Topic	10.1 Fundamentals of Organic Chemistry
Difficulty	Medium

Exam Papers Practice

To be used by all students preparing for DP IB Chemistry SL
Students of other boards may also find this useful

Question 1a

Organic compounds are classified into families called a *homologous series*.

State three features of members belonging to the same *homologous series*.

[3 marks]



Exam Papers Practice

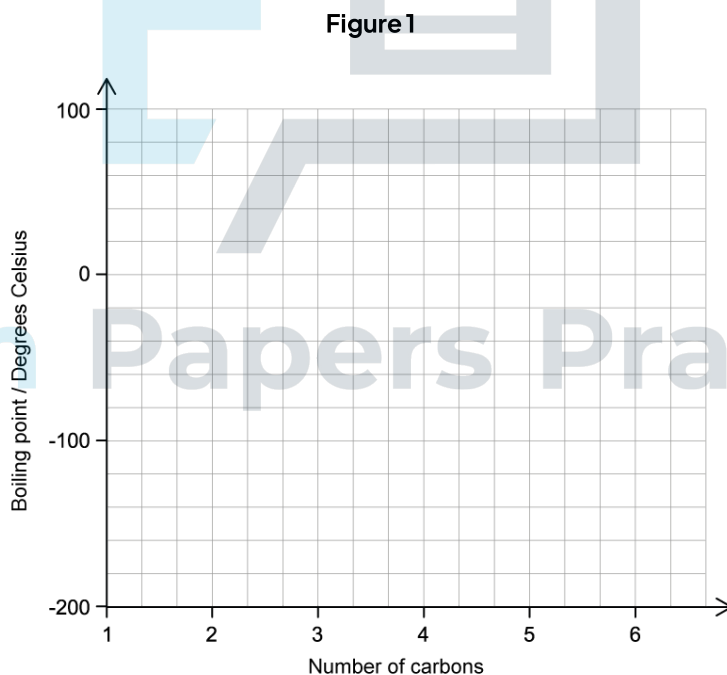
Question 1b

Table 1 shows the boiling points of the first five members of the alkane family.

Table 1

Alkane	Boiling point/°C
methane	-162
ethane	-89
propane	-42
butane	-1
pentane	36

On the axes below in **Figure 1**, draw a graph of boiling point against the number of carbon atoms in the alkanes. Estimate the boiling point of the next member of the homologous series, hexane, C_6H_{14} , and show on your graph how you arrived at your estimated boiling point.



Estimated boiling point of hexane : _____ °C

[4 marks]

Question 1c

State the general formula for an alkyne and give the molecular formula and name of the fifth member of the alkyne family.

[2 marks]

Question 1d

The boiling point of ethyne, C_2H_2 , is $-84\text{ }^\circ\text{C}$.

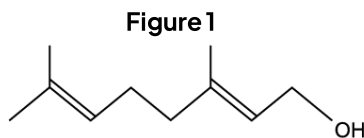
State with, with a reason, whether the boiling point of ethyne would be expected to be higher or lower than the boiling point of ethane, C_2H_6 .

[2 marks]

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Question 2a

Geraniol is a colourless component of rose oil whose structure is shown in **Figure 1**.



i)
State the names of the two functional groups found in geraniol.

ii)
Deduce the molecular formula of geraniol.

iii)
Draw the displayed formula of geraniol.

[3 marks]

Question 2b

Butan-2-ol is an organic compound used industrially to make butanone.

i)
Draw the displayed structure of butan-2-ol.

ii)
Draw the displayed structures of a positional isomer and a functional group isomer of butan-2-ol.

[3 marks]

Question 2c

Draw and name all the branched-chain isomers of butan-2-ol.

[2 marks]

Question 2d

State, with a reason, the class of alcohols which butan-2-ol belongs to.

[1 mark]

Question 3a

The formulae of four organic compounds are given in **Table 1**. Write the names of the compounds in the second column.

Table 1

compound	name
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$	
$\text{CH}_3\text{CH}_2\text{COCH}_3$	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$	

[2 marks]

Question 3b

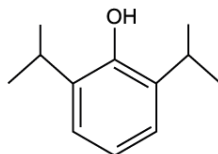
Which of the compounds in part (a) are structural isomers of each other and what type of isomerism do they show?

[2 marks]

Question 3c

Propofol is a drug used to reduce consciousness during medical procedures. The skeletal structure of propofol is given in Figure 1.

Figure 1



- i)
Determine the empirical formula of propofol.
- ii)
Identify the number of positional isomers of propofol (not including propofol).
- iii)
State the names of two functional groups found in propofol.

[3 marks]

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Question 3d

Valeric acid, $C_5H_{10}O_2$, is a straight chain carboxylic acid found in the plant *Valeriana officinalis*.

- i)
State the general formula for a carboxylic acid.
- ii)
Give the systematic name for valeric acid.
- iii)
Draw a condensed structural formula for valeric acid.

[3 marks]

Question 4a

Draw and name all the possible isomers of C_6H_{14} .

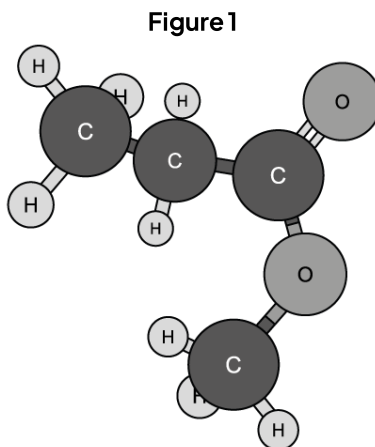
[5 marks]



Exam Papers Practice

Question 4b

Figure 1 below shows a three-dimensional structure of a molecule.



- i)
Using IUPAC rules state the name of this molecule.
- ii)
Draw and name a functional group isomer of this molecule.

[2 marks]

Question 4c

Explain the difference between a tertiary haloalkane and a tertiary amine, using suitable diagrams to illustrate your answer.

[2 marks]

Question 4d

Three important nitrogen containing functional groups used in chemical synthesis are carboxamides, nitriles and amines.

Draw the Lewis structure of each of these functional groups.

[3 marks]

Question 5a

Benzene is an aromatic hydrocarbon which is often drawn as **Figure 1**.

Discuss the physical evidence that justifies this structure for benzene.

Figure 1



[2 marks]

Question 5b

Benzene and cyclohexene are both *unsaturated* molecules, but cyclohexene reacts with bromine water and benzene does not.

i)
State the meaning of the terms *saturated* and *unsaturated* as applied to organic molecules.

ii)
Explain this difference in reactivity and write an equation for the reaction between cyclohexene and bromine.

[3 marks]

Question 5c

Table 1 below shows the enthalpy changes for the hydrogenation of cyclohexene, benzene, and the theoretical molecule 1,3,5-cyclohexatriene.

Table 1

Compound	Enthalpy of hydrogenation
Cyclohexene, C ₆ H ₁₀	-120
Benzene, C ₆ H ₆	-208
1,3,5-cyclohexatriene, C ₆ H ₆	?

The equations for the hydrogenation reactions are:



i)

Use the data in **Table 1** to determine the enthalpy of hydrogenation of the theoretical molecule 1,3,5-cyclohexatriene.

ii)

Discuss the difference between the enthalpy of hydrogenation of benzene and of 1,3,5-cyclohexatriene.

[3 marks]

Exam Papers Practice

Question 5d

An unknown aromatic compound has the molecular formula C₈H₈O₂.

Deduce the structural formula of **two** isomers of this compound which contain an ester group.

[2 marks]