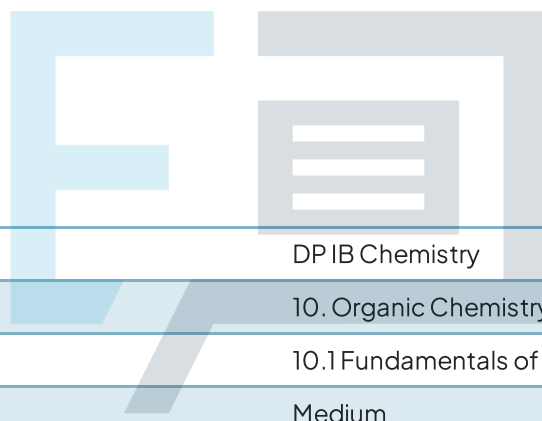




# 10.1 Fundamentals of Organic Chemistry

## 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 HL  
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]



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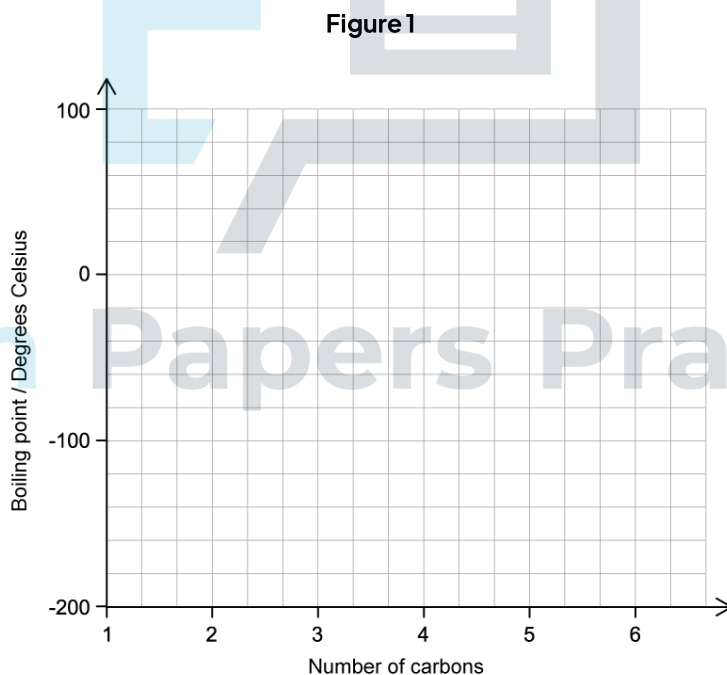
**Question 1b**

**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  $-84\text{ }^\circ\text{C}$ .

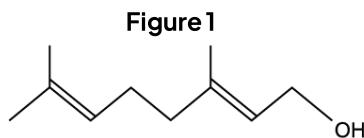
State with, with a reason, whether the boiling point of ethyne would be expected to be higher or lower than the boiling point of ethane,  $C_2H_6$ .

[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

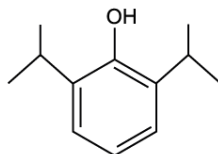
Which of the compounds in part (a) are structural isomers of each other and what type of isomerism do they show?

[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]

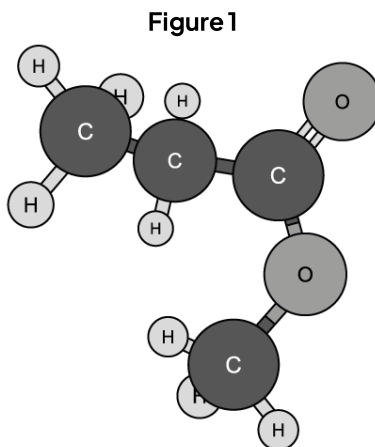


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### Question 4b

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 <sub>6</sub> H <sub>10</sub>	-120
Benzene, C <sub>6</sub> H <sub>6</sub>	-208
1,3,5-cyclohexatriene, C <sub>6</sub> H <sub>6</sub>	?

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]

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### Question 5d

An unknown aromatic compound has the molecular formula C<sub>8</sub>H<sub>8</sub>O<sub>2</sub>.

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

[2 marks]