# Basic Concepts of Organic Chemistry

**1.** This question is about reactions involving alcohols.

Three reactions of an alcohol **E** are shown in **Fig. 25.1**.

i. Complete **Fig. 25.1** to show the structures of the organic products formed in the reactions.

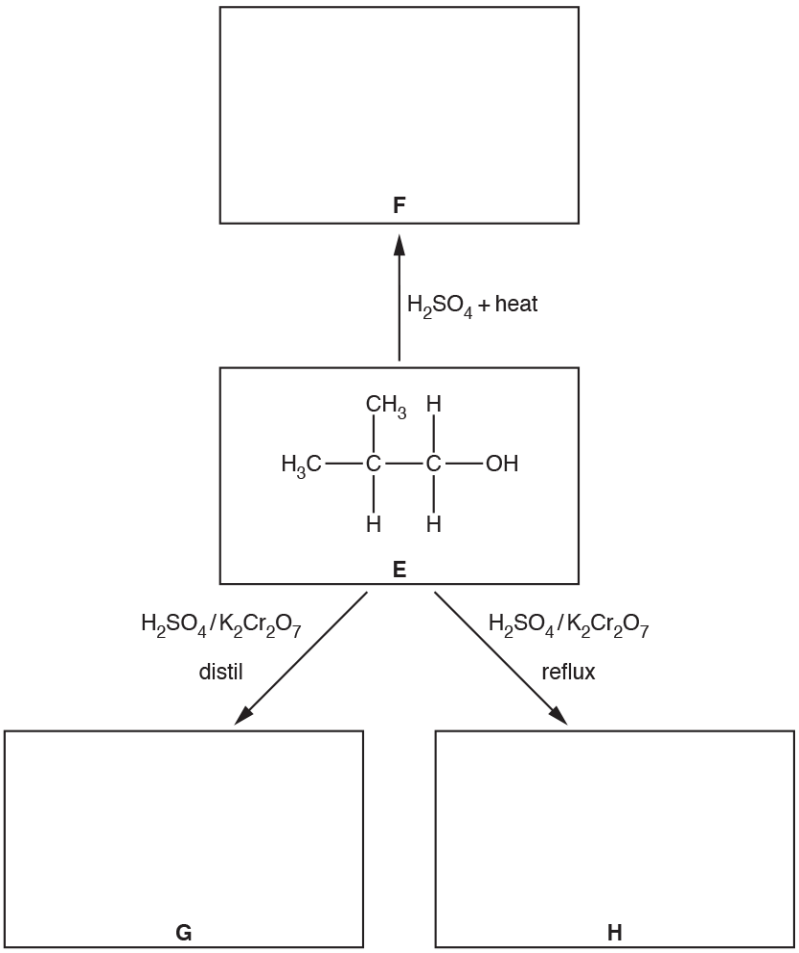


**Fig. 25.1**

**[3]**

ii. What is the systematic name of alcohol **E**?

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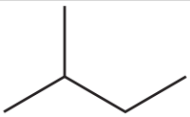
**[1]**

**2(a).** This question is about saturated hydrocarbons.

Compounds **A**, **B** and **C** are saturated hydrocarbons.
The structures and boiling points of **A**, **B** and **C** are shown below.

| | Isomer | Boiling point /°C |
|---|---|---|
| **A** |  | 36 |
| **B** |  | 28 |
| **C** |  | 9 |

- Use the structures to explain what is meant by the term structural isomer.
- Explain the trend in boiling points shown by **A**, **B** and **C** in the table.

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**[5]**

**(b).** Compounds **A**, **B** and **C** all react with chlorine in the presence of ultraviolet radiation to form organic compounds with the formula $C_5H_{11}Cl$.

i. Name the mechanism for this reaction.

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**[1]**

ii. Complete the table to show the number of structural isomers of $C_5H_{11}Cl$ that could be formed from the reaction of chlorine with **A** and **B**.

| | **A** | **B** |
|---|---|---|
| **Number of structural isomers** | ..... | ..... |

**[2]**

iii. The reaction of compound **A** with excess chlorine forms a compound **D**, which has a molar mass of 175.5 g $mol^{-1}$.

Draw a possible structure for compound **D** and write the equation for its formation from compound **A**. Use molecular formulae in the equation.

**Compound D**

Equation **[2]**

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**3.** Iodine monobromide, I–Br, is a polar molecule.

Heterolytic fission of the I–Br bond forms an electrophile.

State the meaning of the term *electrophile* and suggest the formula of the electrophile formed from IBr.

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**[2]**

**4.** Propanoic acid, $CH_3CH_2COOH$, is a member of the homologous series of carboxylic acids.

Suggest the general formula for a carboxylic acid.

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**[1]**

**5(a).** Allyl bromide, $CH_2=CHCH_2Br$, is used in the production of polymers.

Allyl bromide is a member of a homologous series. Compounds in this series have the same general formula.

i. What is meant by the term *homologous series*?

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---**[2]**

ii. What is the general formula of the homologous series that has allyl bromide as a member?

---**[1]**

iii. Give the systematic name for allyl bromide.

---**[1]**

**(b).** Reaction mechanisms use curly arrows and can involve electrophiles and nucleophiles.

i. What does a *curly arrow* represent in mechanisms?

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---**[1]**

ii. What is meant by the term *nucleophile*?

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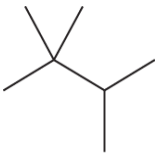
---**[1]**

**6(a).** This question is about different alkanes present in crude oil.

Compound **A**, shown below, is one of the structural isomers of $C_7H_{16}$.



**Compound A**

i. What is meant by the term *structural isomers*?

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---**[1]**

ii. Name compound **A**.

---**[1]**

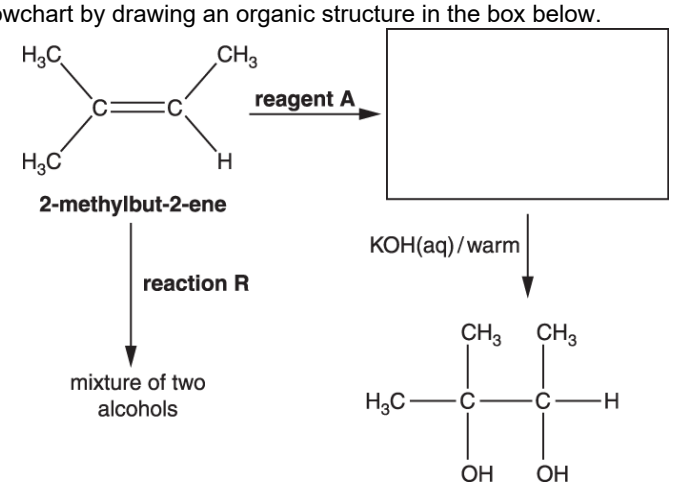
**(b).** The structural isomers of $C_5H_{12}$ have different boiling points.

Draw the **skeletal formula** of the structural isomer of $C_5H_{12}$ with the highest boiling point.

**[1]**

**7(a).** The flowchart shows how 2-methylbut-2-ene can be converted into a number of organic products.

Complete the flowchart by drawing an organic structure in the box below.




**[1]**

**(b).** Identify reagent **A**.

_____ **[1]**

**(c).** In the flowchart, **reaction R** forms a mixture of two alcohols that are structural isomers of $C_5H_{12}O$.

i. State the reagents and conditions needed for **reaction R**.

_____ **[1]**

ii. What is meant by the term *structural isomers*?

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_____ **[1]**

iii. Draw the two structural isomers of $C_5H_{12}O$ formed in **reaction R**.

**[2]**

iv. Suggest why 2-methylbut-2-ene is less soluble in water than either of the structural isomers formed.

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_____ **[2]**

**8(a).** This question is about cyclic organic compounds.

The table shows some information about cycloalkanes.

| Cycloalkane | Skeletal formula | Boiling point / °C |
|---|---|---|
| Cyclopropane |  | −33 |
| Cyclopentane |  | 49 |
| Cyclohexane |  | 81 |

These cycloalkanes are members of the same homologous series and have the same general formula.

i. What is meant by the term *homologous series*?

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---**[2]**

ii. State the general formula for these cycloalkanes.

---**[1]**

iii. Explain the increase in boiling points of the cycloalkanes shown in the table.

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**[2]**

**(b).** **Cyclobutane** is another cycloalkane.

There are several **unsaturated** isomers of cyclobutane that are alkenes.

Two of these isomers are stereoisomers.

i. Explain what is meant by the term *stereoisomers*.

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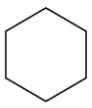
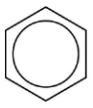
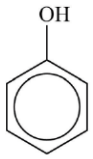
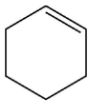
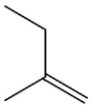
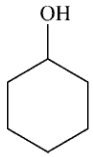
---**[1]**

ii. Draw these **two** stereoisomers.

**[2]**

**9(a).** The organic compounds in the table below can be termed, aliphatic, alicyclic or aromatic.

| **E** | **F** | **G** |
|---|---|---|
|  |  |   |
| **H** | **I** | **J** |
|  |  |   |

Identify, using letters **E**, **F**, **G**, **H**, **I**, **J**, the compound(s) which are the following types.

Each response may contain more than one letter.

aliphatic .....

alicyclic .....

aromatic .....

**[3]**

**(b).** Compound **I** has one alkyl group.

What is the general formula of alkyl groups?

---**[1]**

**(c).** Compound **H** can be prepared in an elimination reaction by heating compound **J** with an acid catalyst.

A student carries out this preparation using 7.65 g of compound **J**.

The student obtains 2.05 g of compound **H**.

i. Write an equation for this reaction, using molecular formulae.

Calculate the percentage yield of compound **H**.

Give your answer to **one** decimal place.

percentage yield = ..... % **[4]**

ii. Describe a simple test that the student could carry out to confirm the presence of the functional group in compound **H**.

Draw the structure of the organic product from the test.

test: _____

_____

organic product =

**[2]**

**END OF QUESTION PAPER**