

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.

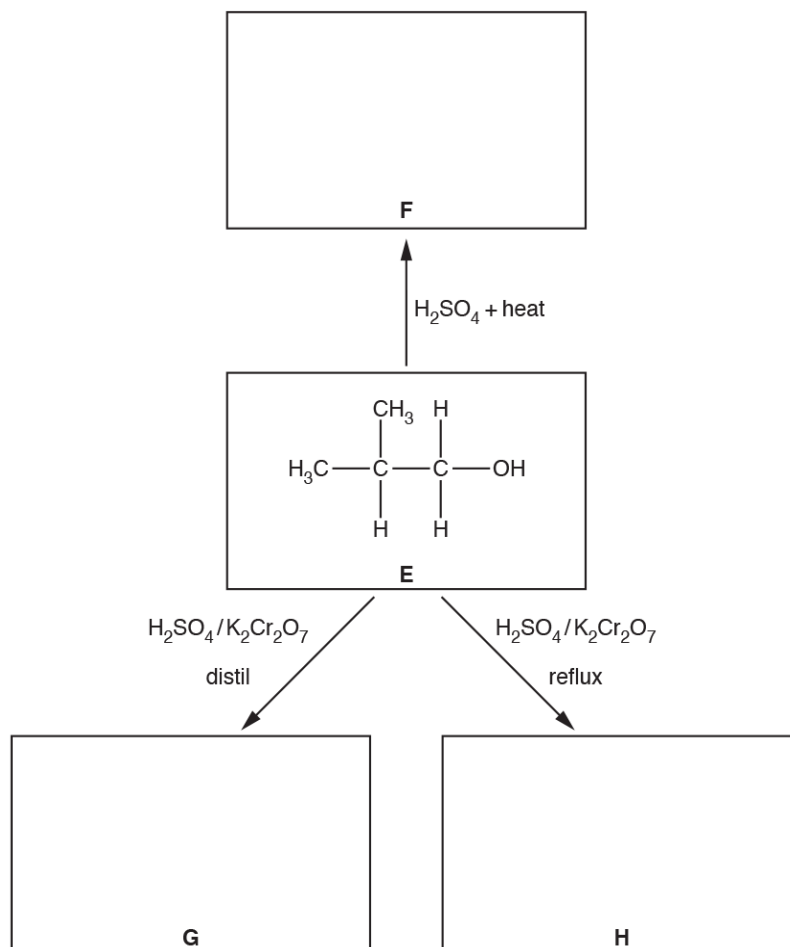


Fig. 25.1

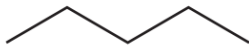
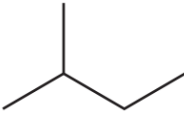

[3]

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

----- [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.

[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.

[1]

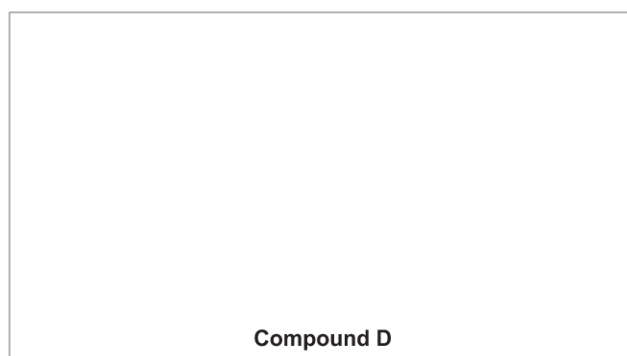
- ii. Complete the table to show the number of structural isomers of $C_5H_{11}Cl$ that could be formed from the reaction of chlorine with **A** and **B**.

	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.



Equation

.....

[2]

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.

.....

[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.

.....

[1]

5(a). Allyl bromide, $\text{CH}_2=\text{CHCH}_2\text{Br}$, 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*?

[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?

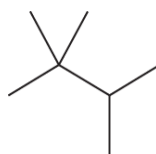
[1]

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

[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*?

.....

.....

..... [1]

ii. Name compound **A**.

..... [1]

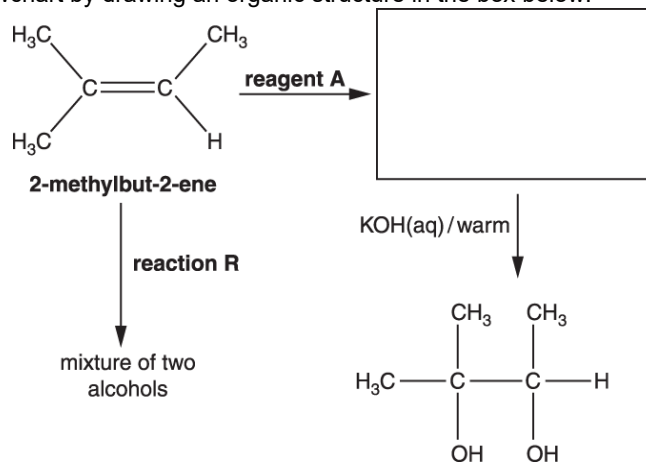
(b). The structural isomers of C_5H_{12} have different boiling points.

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*?

[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.

[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*?

[2]

ii. State the general formula for these cycloalkanes.

[1]

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

[2]

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

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

Two of these isomers are stereoisomers.

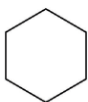


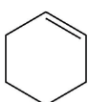
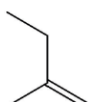
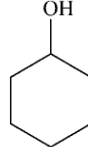
i. Explain what is meant by the term *stereoisomers*.

[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 OH 
H 	I 	J OH 

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