Paper 3

Questions are applicable for both core and extended candidates

1 **(a)** Fig. 6.1 shows the displayed formula of a molecule of crotyl alcohol.

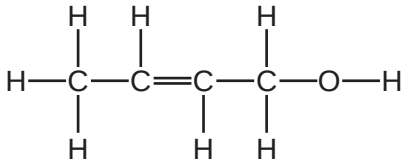


Fig. 6.1

(i) On Fig. 6.1 draw a circle around the alcohol functional group. [1]

(ii) Describe the feature of crotyl alcohol that shows it is an unsaturated compound.

..... [1]

(iii) Deduce the molecular formula of crotyl alcohol.

..... [1]

(iv) Crotyl alcohol is soluble in water.

The boiling point of crotyl alcohol is 121 °C.
The boiling point of water is 100 °C.

Suggest how fractional distillation can be used to separate a mixture of crotyl alcohol and water.

.....

.....

..... [2]

(c) Ethanol can be converted to ethene.

Choose from the list the general formula for the homologous series to which ethene belongs.

Draw a circle around your chosen answer.

C_nH_n C_nH_{2n} C_nH_{2n+2} $C_{2n}H_n$ [1]

2 **(a)** Fig. 7.1 shows the displayed formula of mesaconic acid.

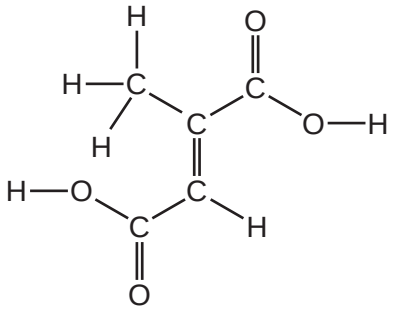


Fig. 7.1

(i) On Fig. 7.1 draw a circle around **one** carboxylic acid functional group. [1]

(ii) Deduce the molecular formula of mesaconic acid.

..... [1]

(iii) Mesaconic acid is a colourless compound.

Describe the colour change when excess mesaconic acid is added to aqueous bromine.

from ..... to ..... [2]

(b) Ethanoic acid belongs to the homologous series of carboxylic acids.

Define the term homologous series.

.....

..... [2]

3 **(a)** Fig. 7.1 shows the displayed formula of compound **S**.

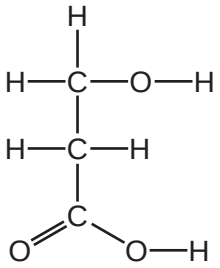


Fig. 7.1

(i) On Fig. 7.1, draw a circle around the carboxylic acid functional group. [1]

(ii) Deduce the molecular formula of compound **S**.

..... [1]

4 (c) One of the organic acids present in milk is lactic acid.
The displayed formula of lactic acid is shown in Fig. 2.2.

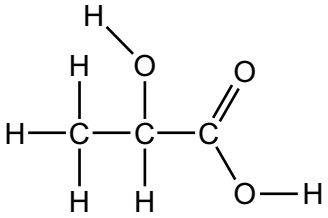


Fig. 2.2

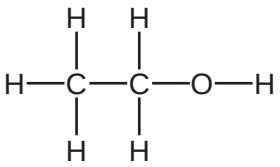
(i) Draw a circle around the carboxylic acid functional group on the structure. [1]

(ii) Deduce the molecular formula of lactic acid.

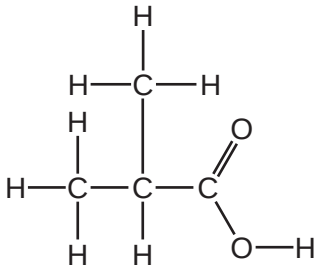
..... [1]

5 **(a)** The structures of four organic compounds, **P**, **Q**, **R** and **S**, are shown.

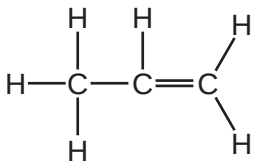
P



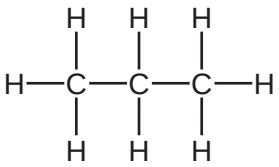
Q



R



S



Answer the following questions about these structures.

Each structure may be used once, more than once or not at all.

(i) State which structure, **P**, **Q**, **R** or **S**, has a carboxylic acid functional group.

..... [1]

(ii) State which structure, **P**, **Q**, **R** or **S**, is in the same homologous series as ethane.

..... [1]

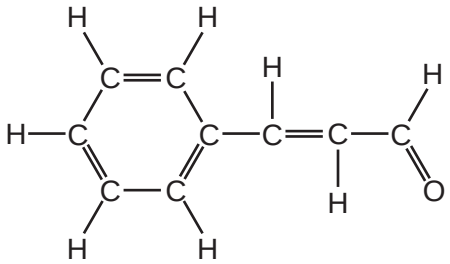
(iii) State which structure, **P**, **Q**, **R** or **S**, decolourises aqueous bromine.

..... [1]

(iv) Deduce the molecular formula of structure **Q** to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

6 (c) Toothpaste also contains cinnamal. The structure of cinnamal is shown.

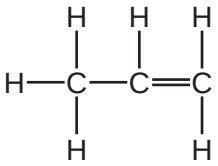


Deduce the formula of cinnamal to show the number of atoms of carbon, hydrogen and oxygen.

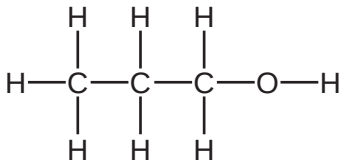
..... [1]

7 **(a)** The structures of four organic compounds, **C**, **D**, **E** and **F**, are shown.

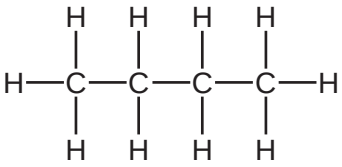
C



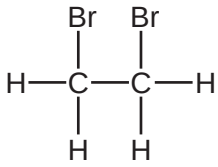
D



E



F



Answer the following questions about these compounds.
Each compound may be used once, more than once or not at all.

State which compound, **C**, **D**, **E** or **F**:

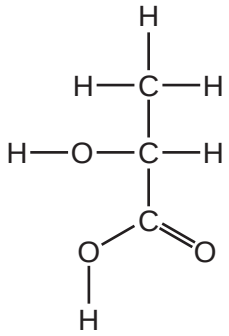
(i) decolourises aqueous bromine ..... [1]

(ii) is an alcohol ..... [1]

(iii) is unsaturated ..... [1]

(iv) is in the same homologous series as ethane. ..... [1]

8 **(a)** The structure of lactic acid is shown.



(i) On the structure, draw a circle around the alcohol functional group. [1]

(ii) Deduce the formula of lactic acid to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

(c) Ethanol and methanol are in the same homologous series.

Explain the meaning of the term *homologous series*.

.....

.....

[2]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

9 Propane, propene, propan-1-ol and propanoic acid are members of different homologous series.

Molecules of these substances contain three carbon atoms.

(a) Explain why members of a homologous series have similar chemical properties. **(extended only)**

..... [1]

(b) Name the homologous series to which propanoic acid belongs.

..... [1]

(c) State the general formula of the homologous series to which propanoic acid belongs.

..... [1]

(d) Propan-1-ol has an unbranched isomer.

- Name this isomer. **(extended only)**

.....

- Draw the displayed formula of this isomer. **(extended only)**

[2]

10 This question is about organic compounds.

(a) Butane reacts with chlorine in a photochemical reaction.

$$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$$

(i) State the meaning of the term photochemical.

..... [1]

(ii) An organic compound with the formula C_4H_9Cl is formed when one molecule of butane reacts with one molecule of chlorine.

Draw the displayed formulae of **two** possible structural isomers with the formula C_4H_9Cl formed in this reaction. **(extended only)**

[2]

(b) The structure of compound **A** is shown in Fig. 7.1.

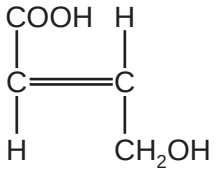


Fig. 7.1

(i) Deduce the molecular formula of compound **A**.

..... [1]

(ii) There are three functional groups in compound **A**.

Name the homologous series of compounds that contain the following functional groups:

–C=C– .....

–OH .....

–COOH. .....

[3]

11 Alkynes and alkenes are homologous series of unsaturated hydrocarbons.

All alkynes contain a C≡C triple bond.

(a) Complete Table 6.1 showing information about the first **three** alkynes.

Table 6.1

formula	C_2H_2	C_3H_4	
structure	H–C≡C–H	H–C≡C–CH_3	H–C≡C–CH_2–CH_3
names	ethyne		but-1-yne

[2]

(b) Compounds in the same homologous series have the same general formula.

(i) Give two **other** characteristics of members of a homologous series. **(extended only)**

1 .....

2 .....

[2]

(ii) Deduce the general formula of alkynes.

Use the information from Table 6.1 to help you.

..... [1]

(iii) Alkynes are unsaturated.

Describe a test for unsaturation.

test .....

result .....

[2]

(c) Ethene and but-2-ene are alkenes.

(i) Draw the displayed formula of but-2-ene.

[2]

(ii) Draw a dot-and-cross diagram to show a molecule of ethene, $CH_2=CH_2$.

Show outer shell electrons only.

[2]

12 The names of four esters are listed.

methyl propanoate

ethyl propanoate

propyl propanoate

butyl propanoate

(a) Esters are a family of organic compounds with similar chemical properties. They can be represented by the formula $C_nH_{2n}O_2$.

(i) State the name given to a family of organic compounds with similar chemical properties.

..... [1]

(ii) Explain why members of a family of organic compounds have similar chemical properties.

(extended only)

..... [1]

(iii) State the name given to a formula such as $C_nH_{2n}O_2$.

..... [1]

(iv) Determine the value of '*n*' in butyl propanoate.

..... [1]

13 Ethanoic acid is manufactured by the reaction of methanol with carbon monoxide.

(e) Ethanoic acid is a member of the homologous series of carboxylic acids.

State the general formula of this homologous series.

..... [1]

(f) Draw the structure of the carboxylic acid containing three carbon atoms. Show all of the atoms and all of the bonds.

[2]

14 Ethene is an alkene which reacts with bromine as shown in the equation.

$$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$$

(a) Write the general formula of alkenes.

..... [1]