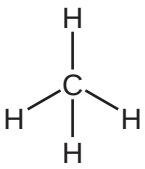
Paper 3

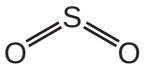
Questions are applicable for both core and extended candidates

1 The structures of seven compounds, **A**, **B**, **C**, **D**, **E**, **F** and **G**, are shown.

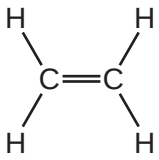
A



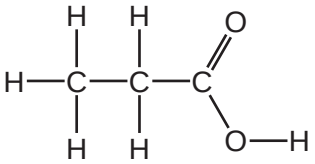
B



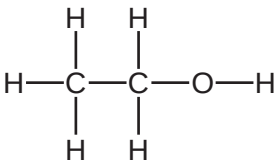
C



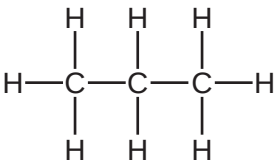
D



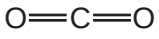
E



F



G



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

(a) State which structure, **A**, **B**, **C**, **D**, **E**, **F** or **G**, represents:

(iv) a carboxylic acid

..... [1]

Paper 4

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

2 Carboxylic acids can be converted into esters.

(a) Propanoic acid and methanol react to form an ester that has the molecular formula $C_4H_8O_2$.

(i) Name this ester and draw its displayed formula. **(extended only)**

name of ester .....

displayed formula

[2]

(ii) Name **another** ester with the molecular formula $C_4H_8O_2$. **(extended only)**

..... [1]

3 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.

..... [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]

(b) All four of the esters in the list are liquids at room temperature.

Name the technique used to separate ethyl propanoate from a mixture of the four esters.

..... [2]

(c) All four esters can be made by reacting different alcohols with the same substance.

(i) Name this substance and draw its structure. Show all of the atoms and all of the bonds.

name ..... **(extended only)**

structure

[2]

(ii) Name the alcohol used to make methyl propanoate. **(extended only)**

..... [1]

(d) Other esters, not in the list, have the same molecular formula as propyl propanoate, but different structures.

(i) State the term used to describe substances with the same molecular formula but different structures.

..... [1]

(ii) Name **two** esters with the same molecular formula as propyl propanoate. **(extended only)**

1 .....

2 .....

[2]

4 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. **(extended only)**

[2]

(g) When carboxylic acids react with alcohols, esters are produced.

The formula of ester **X** is $CH_3CH_2CH_2COOCH_3$.

(i) Name ester **X**. **(extended only)**

..... [1]

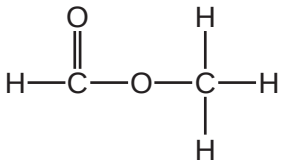
(ii) Give the name of the carboxylic acid and the alcohol that react together to produce ester **X**. **(extended only)**

carboxylic acid .....

alcohol .....

[2]

5 Ester **Y** has the structure shown.



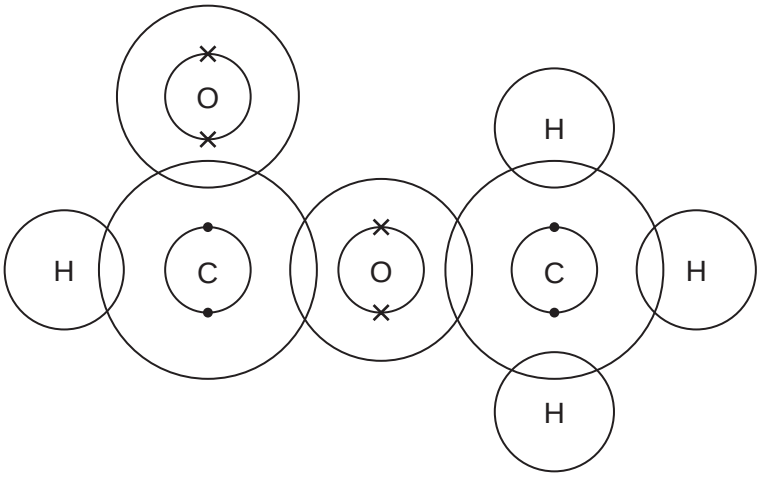
(a) (i) Name ester **Y**. **(extended only)**

..... [1]

(ii) Deduce the empirical formula of ester **Y**.

..... [1]

(b) Complete the dot-and-cross diagram to show the arrangement of electrons in a molecule of ester **Y**.



[3]

(c) Ester **Y** can be made by reacting two organic compounds together.

Name the compounds and draw their structures. **(extended only)**

Show all of the atoms and all of the bonds.

name .....

structure

name .....

structure

[4]

(d) **(i)** Describe what is meant by the term *structural isomer*.

.....

..... [2]

(ii) Name a carboxylic acid which is a structural isomer of ester **Y**. **(extended only)**

..... [1]

[Total: 12]