Paper 3

Questions are applicable for both core and extended candidates

1 (f) Ethene reacts with steam to produce ethanol.

(i) Complete the symbol equation for this reaction.

C_2H_4 + ... → ..... [2]

(ii) Choose the word which describes the type of catalyst used in this reaction.

Draw a circle around your chosen answer.

acid **alkali** **metal** **salt** [1]

2 Fig. 7.1 shows the displayed formula of mesaconic acid.

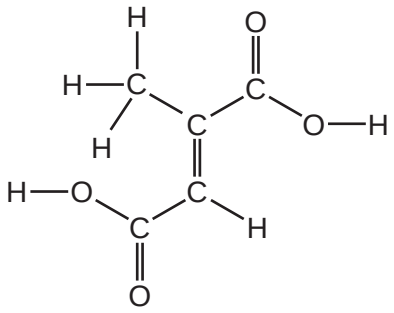


Fig. 7.1

(e) Ethanol can be manufactured by fermentation.

Complete the word equation for one **other** method of manufacturing ethanol.

..... + ... → ethanol [2]

3 (d) Ethanoic acid can be converted to ethanol.

Name the **two** products formed when ethanol undergoes complete combustion.

..... and ..... [2]

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

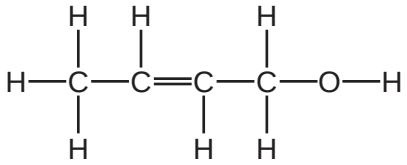


Fig. 6.1

(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]

(b) Ethanol is also an alcohol.

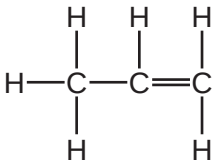
Describe **two** conditions for the manufacture of ethanol by the fermentation of aqueous glucose.

1 .....

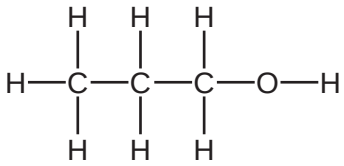
2 .....
[2]

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

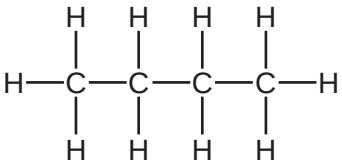
C



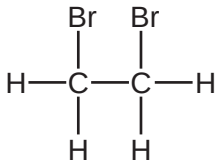
D



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**:

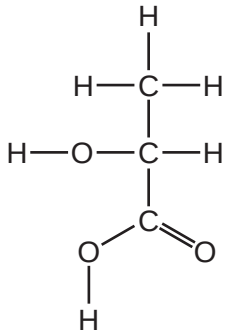
(i) decolourises aqueous bromine ..... [1]

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

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

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

6 **(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]

(b) Ethanol is an alcohol.

(i) Complete the sentence about ethanol using a word from the list.

ethane **ethene** **methane** **poly(ethene)**

Ethanol is manufactured by fermentation or from ..... . [1]

(ii) State **two** conditions needed for fermentation.

1 .....

2 .....
[2]

(iii) Ethanol is used in drinks and as a fuel.

State one **other** use of ethanol.

..... [1]

(iv) Name **one** physical property that can be used to determine if a sample of ethanol is pure or impure.

..... [1]

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

Explain the meaning of the term *homologous series*.

.....

.....
[2]

[Total: 9]

Paper 4

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

7 Some symbol equations and word equations, **A** to **J**, are shown.

A $Fe^{3+} + 3OH^- \rightarrow Fe(OH)_3$

B $H^+ + OH^- \rightarrow H_2O$

C ethane + chlorine → chloroethane + hydrogen chloride

D $C_{12}H_{26} \rightarrow C_8H_{18} + C_4H_8$

E ethene + steam → ethanol

F chlorine + aqueous potassium iodide → iodine + aqueous potassium chloride

G $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

H ethanoic acid + ethanol → ethyl ethanoate + water

I calcium carbonate → calcium oxide + carbon dioxide

J $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Use the equations to answer the questions that follow.
Each equation may be used once, more than once, or not at all.

Give the letter, **A** to **J**, for the equation that represents:

(e) fermentation ..... [1]

8 Ethanol is manufactured by **two** methods:

method 1 fermentation of aqueous glucose

method 2 catalytic addition of steam to an alkene.

(a) Method 1 takes place at room temperature and pressure.

State **two** other conditions needed in method 1.

1 .....

2 .....

[2]

(b) (i) State the typical temperature and pressure used in method 2.

temperature ..... °C

pressure ..... kPa

[2]

(ii) Name the alkene used in method 2.

..... [1]

(iii) State why the reaction in method 2 is referred to as an addition reaction.

..... [1]

(c) The catalyst in method 2 is phosphoric acid, H_3PO_4. Dilute phosphoric acid is a weak acid which contains phosphate ions, PO_4^{3-}.

(i) State what is meant by the term acid.

..... [1]

(ii) State the meaning of weak in the term weak acid.

..... [1]

(iii) Determine the oxidation number of phosphorus in the PO_4^{3-} ion.

Show your working.

oxidation number = ... [2]

(d) Give **one** advantage of each method of production of ethanol. **(extended only)**

method 1 .....

method 2 .....

[2]

(e) Ethanol can be converted to ethanoic acid by reacting it with an acidified oxidising agent.

(i) Name the acidified oxidising agent.

..... [1]

(ii) State, in terms of redox, what type of reagent ethanol is in this reaction.

..... [1]

9 Alkynes and alkenes are homologous series of unsaturated hydrocarbons.

All alkynes contain a C≡C triple bond.

(d) Ethene can be converted to ethanoic acid by a two-stage process.

In stage one, ethene is converted to ethanol by catalytic addition.

$$C_2H_4 + H_2O \rightarrow C_2H_5OH$$

(i) Suggest why stage one is called an addition reaction.

..... [1]

(ii) A catalyst is used in stage one.

State one **other** condition that must be used.

..... [1]

(iii) State what must be reacted with ethanol to form ethanoic acid.

..... [2]

10 The names of four esters are listed.

methyl propanoate

ethyl propanoate

propyl propanoate

butyl propanoate

(c) All four of the 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 .....

structure

[2]

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

..... [1]

11 A list of substances is shown.

aluminium oxide	**carbon dioxide**	**chlorine**	**diamond**	**ethanol**
glucose	**iron(III) oxide**	**limestone**	**nitrogen**	**oxygen**

Answer the questions using the list of substances.

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

State which of the substances:

(c) are **two** products of fermentation

..... and ..... [2]