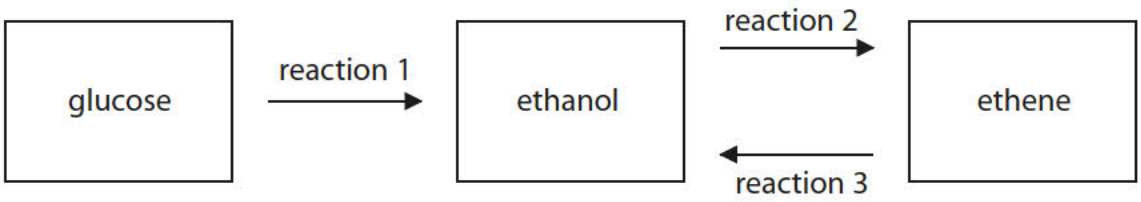
1 The scheme shows some reactions involving ethanol.



(a) (i) Two conditions used in reaction 1 are

- a temperature of about 30 °C
- the use of water as a solvent for the glucose

State the name of the catalyst used in this reaction.

(1)

.....

(ii) Complete the equation for reaction 1.

(1)

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + \text{.....}$$

(b) Ethanol can also be manufactured by reaction 3, which uses steam, a catalyst of phosphoric acid and a pressure of about 65 atm.

State the temperature used in reaction 3.

(1)

.....

(c) State the type of reaction that occurs in

(2)

reaction 1 .....

reaction 3 .....

(d) State two advantages of using reaction 3 to manufacture ethanol rather than reaction 1.

(2)

1 .....

.....

2 .....

.....

(e) e a reason why some countries use reaction 1 to manufacture ethanol.

(1)

.....

.....

(f) Reaction 2 may be used in the future to manufacture ethene.

(i) Write an equation for this reaction.

(1)

.....

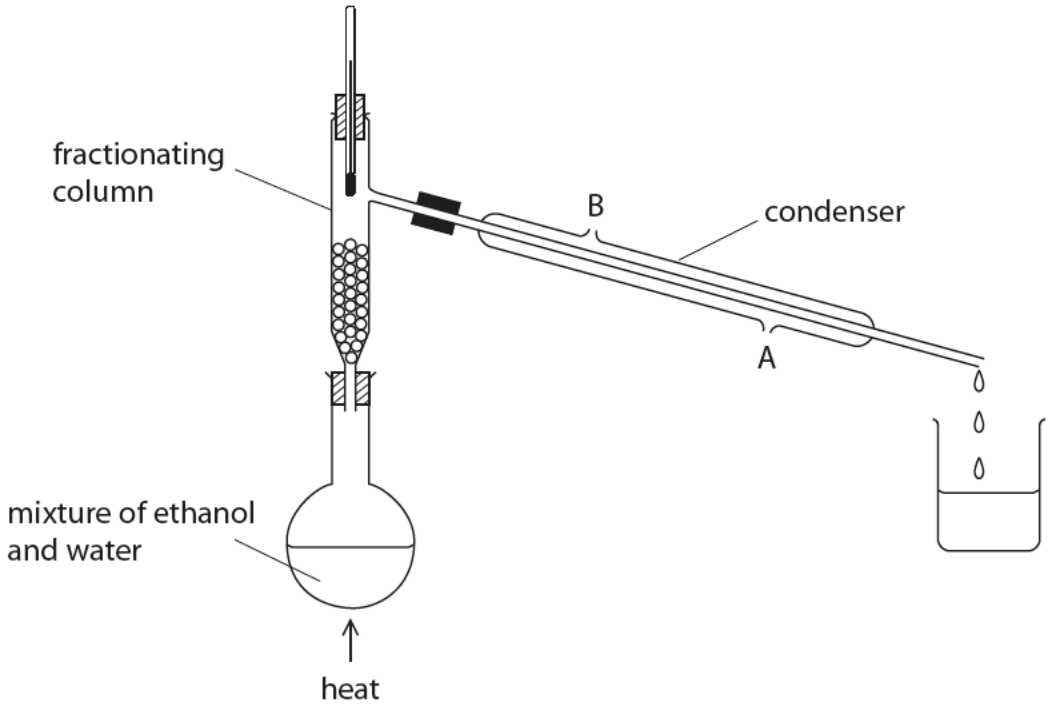
(ii) What type of reaction is this?

(1)

.....

(Total for Question 1 = 10 marks)

2 This apparatus is used to separate a mixture of ethanol (boiling point 78 °C) and water (boiling point 100 °C).



(a) What is the name of this method of separation?

(1)

.....

(b) Why can ethanol and water be separated by this method?

(1)

.....

.....

(c) Suggest why water should enter the condenser at A rather than B.

(1)

.....

.....

(d) Explain why the first liquid to be collected in the beaker is mostly ethanol.

(1)

.....

.....

(Total for Question 2 = 4 marks)

3 (a) The first two members of the homologous series of alcohols are methanol and ethanol.

(i) Give two characteristics of the compounds in a homologous series.

(2)

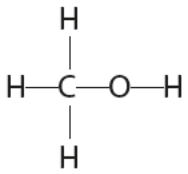
1 .....

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2 .....

.....

(ii) The displayed formula for methanol is



Suggest a displayed formula for ethanol, CH_3CH_2OH

(1)

(b) The table shows the two different processes for making ethanol on a large scale.

Process	Explanation
batch process	the fermentation of sugars with yeast
continuous process	the hydration of ethene (produced from crude oil) with steam

Compare the two processes in terms of

- the rate at which the ethanol can be produced
- the purity of the product
- the use of finite resources

(3)

(c) The equation for the fermentation of glucose is

$$C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2$$

A mass of 3600 kg of glucose was completely fermented.

(i) Calculate the amount, in moles, of glucose that was fermented.
(M_r of glucose = 180)

(2)

amount of glucose = ... mol

(ii) Deduce the amount, in moles, of ethanol produced in this reaction.

(1)

amount of ethanol = ... mol

(iii) Calculate the volume, in dm^3 at rtp, of carbon dioxide produced in this reaction.
(1 mol of carbon dioxide occupies 24 dm^3 at rtp)

(2)

volume of carbon dioxide = ... dm^3

(Total for Question 3 = 11 marks)

4 (a) Ethanol can be manufactured by two different processes.

Process 1 sucrose $\xrightarrow{\text{stage 1}}$ glucose $\xrightarrow{\text{stage 2}}$ ethanol

Process 2 ethene $\longrightarrow$ ethanol

(i) What is the general name for compounds such as sucrose and glucose?

(1)

.....

(ii) What type of reaction occurs in stage 2?

(1)

.....

(iii) What is the catalyst used in stage 2?

(1)

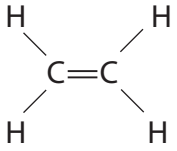
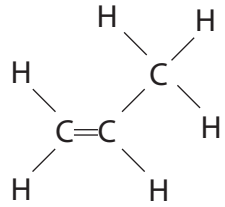
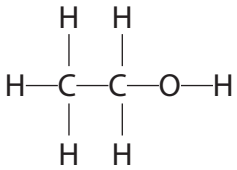
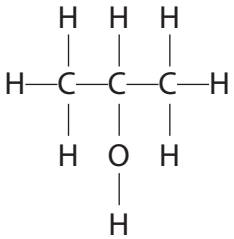
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(iv) What type of reaction occurs in process 2?

(1)

.....

(b) The table shows the displayed formulae of four organic compounds.

ethene	propene
	
ethanol	**compound D**
	

Ethanol and compound D are members of the homologous series of alcohols.

(i) The first member of this homologous series is methanol.

Draw the displayed formula of methanol.

(1)

(ii) Suggest the name of compound D.

(1)

.....

(c) In industry, the conversion of propene to compound D uses the same conditions as those used in the conversion of ethene to ethanol.

Identify a suitable catalyst and temperature for these conversions.

(2)

catalyst .....

temperature ..... °C

(d) Ethene and acetylene can both be used for welding metals.

The equations for the reactions of these gases in welding are

ethene $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

acetylene $C_2H_2 + 2.5O_2 \rightarrow 2CO_2 + H_2O$

One problem with using hydrocarbons as fuels is incomplete combustion.

(i) Incomplete combustion is a bigger problem with ethene than with acetylene.

Suggest why.

(1)

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(ii) One of the gases produced during incomplete combustion is dangerous to humans.

Identify this gas and explain how it is dangerous.

(3)

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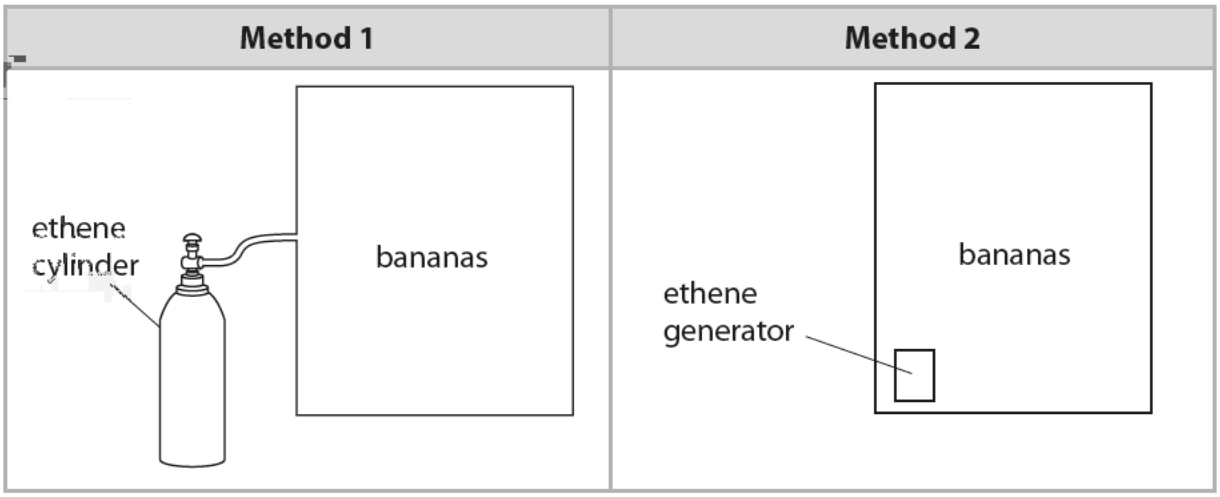
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(e) Ethene can be used to ripen bananas.

Bananas are placed in a large container and ethene is added. The ethene can be added in two different ways.



(i) In method 1, ethene is stored under pressure and passed through a pipe into the container.

Suggest one risk in using this method.

(1)

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.....

(ii) In method 2, the generator contains a known quantity of ethanol that is slowly decomposed to ethene using a catalyst.

Write a chemical equation for this decomposition.

(1)

.....

(Total for Question 4 = 14 marks)

5 There are two important ways to manufacture ethanol.

Reaction 1 $C_2H_4 + H_2O \rightarrow C_2H_5OH$

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

(a) (i) Identify one raw material that could be used as the source of $C_6H_{12}O_6$

(1)

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(ii) Reaction 2 uses a catalyst called zymase, which is present in yeast.

Identify the catalyst used in reaction 1.

(1)

.....

(iii) In both reactions it is important to control the temperature.

State why the temperature in reaction 2 is kept below 35 °C.

(1)

.....

.....

(b) A manufacturing company plans to build a factory to produce ethanol on a large scale. The factory will be near an oilfield. The ethanol will be used as a solvent for perfume.

Suggest why the company should use reaction 1 rather than reaction 2.

(3)

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(c) In the future, it may be necessary to convert the ethanol (produced by reaction 2) into ethene.

Write the equation for this reaction and state the type of reaction that occurs.

(2)

Equation .....

Type of reaction .....

(Total for Question 5 = 8 marks)