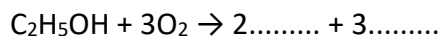


ALCOHOLS & CARBOXYLIC ACIDS 2

Q1. Ethanol, C₂H₅OH, burns to release heat energy.

Complete the balanced symbol equation by writing in the formulae of the two products.



(2 marks)

Q2. Alcohols have the general formula C_nH_{2n+1}OH.

The OH group is known as the functional group for alcohols.

Alcohols with a value of 'n' less than 4 burn completely in air without producing any carbon particles. Alcohols with a value of 'n' greater than 4 do not burn completely in air and produce carbon particles.

Some properties of alcohols are listed in the table.

'n' value of the alcohol	Melting point in °C	Boiling point in °C	Solubility in water
2	-117	79	Very soluble
4	-89	117	Soluble
6	-47	158	Slightly soluble
8	-17	195	Insoluble

(a) Which of the following formulae represents the alcohol with a value of n = 4?

- 1 C₄H₅OH
- 2 C₄H₈OH
- 3 C₄H₉OH
- 4 C₄H₁₀OH

(1 mark)

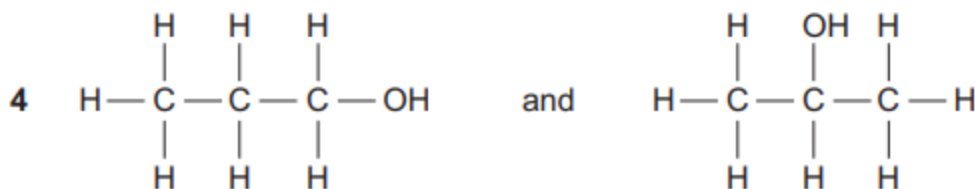
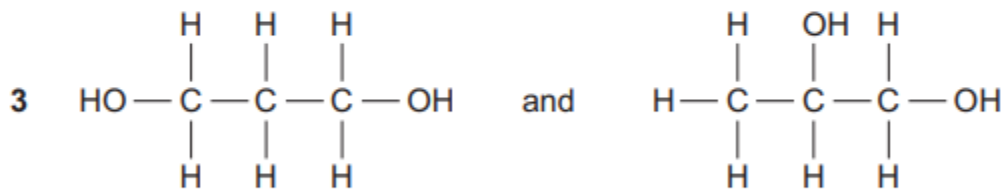
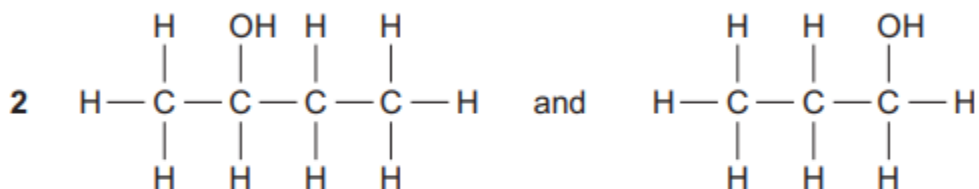
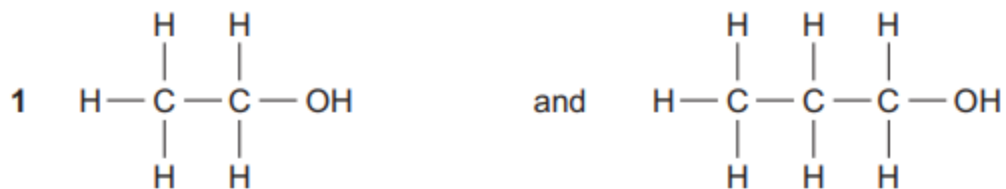
(b) An alcohol has a value of $n = 10$.

Which row in the table shows the likely properties of this alcohol?

	Melting point in °C	Boiling point in °C	Solubility in water
1	10	230	Insoluble
2	-4	235	Slightly soluble
3	0	200	Insoluble
4	5	200	Slightly soluble

(1 mark)

(c) There are two possible structures for an alcohol with a value of $n = 3$. Which are the two correct structures?



(1 mark)

(d) What are the likely products from burning in air an alcohol with a value of $n = 8$?

- 1 carbon dioxide and water only
- 2 carbon dioxide, carbon particles and water
- 3 carbon dioxide and carbon particles
- 4 carbon dioxide, sulfur dioxide and water

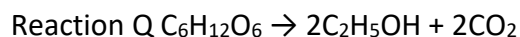
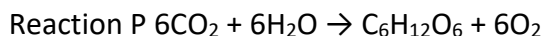
(1 mark)

Q3. About 90 % of the world's supply of ethanol is produced by using yeast for the fermentation of sugars obtained from plants. A solution of about 8 % ethanol in water is obtained. Ethanol can be used to produce ethene.

Reaction P shows carbon dioxide being removed from the atmosphere by plants to make sugar.

Reaction Q shows carbon dioxide being released by yeast into the atmosphere during respiration.

Reaction R shows the formation of ethene from ethanol.



(a) In these reactions, what is the net change in the number of molecules of carbon dioxide in the atmosphere during the production of one molecule of ethene?

- 1 1
- 2 2
- 3 4
- 4 6

(1 mark)

Ethanol can also be produced by the reaction of ethene with steam.

This is a continuous process because the reactants flow steadily into the reactor and the ethanol flows out.

(b) How is the ethene for this process obtained?

- 1 by fractional distillation of crude oil
- 2 by cracking fractions from crude oil
- 3 by polymerisation of crude oil
- 4 by vaporisation of crude oil

(1 mark)

(c) An advantage of producing ethanol from ethene rather than by fermentation is that . . .

- 1 higher temperatures are required.
- 2 catalysts are used.
- 3 the ethanol is purer.
- 4 the reaction is slower.

(1 mark)

(d) It may be better to obtain ethene from biologically-produced ethanol rather than from crude oil. One reason for this is that . . .

- 1 ethene can be produced in unlimited quantities.
- 2 crude oil is a non-renewable resource.
- 3 poly(ethene) made from biologically produced ethanol will be biodegradable.
- 4 the fermentation of sugar is done in batches, whereas production of ethene from crude oil is continuous.

(1 mark)

Q4. The table shows two different processes that are used to make ethanol.

	Process 1	Process 2
Reaction	Fermentation of a sugar solution using yeast	Reaction of ethene with steam
Method	Batch – the reaction vessel is emptied and refilled every few days	Continuous – ethanol flows from the reaction vessel for many years
Product	Dilute solution of ethanol	Pure ethanol
Rate of Production	Slow	Fast

(a) The most important advantage of producing the ethanol by Process 1 is that . . .

- 1 there is no waste to dispose of.
- 2 the dilute solution of ethanol is not hazardous to handle.
- 3 the raw materials are renewable.
- 4 the reaction vessel can be kept clean.

(1 mark)

(b) The ethene for Process 2 is obtained . . .

- 1 by fractional distillation of crude oil.
- 2 by cracking alkanes that have large molecules.
- 3 by cracking alkenes that have large molecules.
- 4 by polymerisation of small alkene molecules.

(1 mark)

(c) One advantage of producing ethanol using Process 2 is that . . .

- 1 lower temperatures are needed for the reaction.
- 2 crude oil can be transported in larger quantities than sugar.
- 3 large quantities can be produced in a short time.
- 4 no expensive catalysts are needed.

(1 mark)

(d) In some countries, many cars are powered by ethanol. These countries produce large amounts of ethanol using Process 1. Production of ethanol using Process 1 is probably of economic benefit only if a country . . .

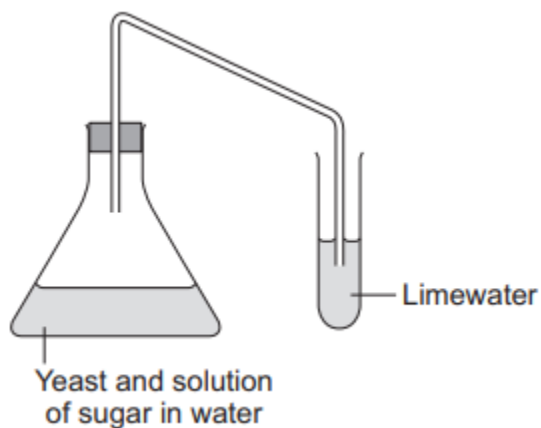
- 1 has large reserves of crude oil.
- 2 has a large workforce to regularly fill and empty the reaction vessels.
- 3 has agricultural land and a climate suitable for growing sugar cane.
- 4 has sufficient wealth to import crude oil.

(1 mark)

Q5. Two fuels that can be used for cars are:

- petrol from crude oil
- ethanol made from sugar in plants.

(a) A student used the apparatus shown to investigate the reaction to make ethanol from sugar.



(i) Draw a ring around the correct answer to complete the sentence.

This reaction to make ethanol from sugar is

combustion.
decomposition.
fermentation.

(1 mark)

(ii) Complete the sentences.

The limewater turns _____.

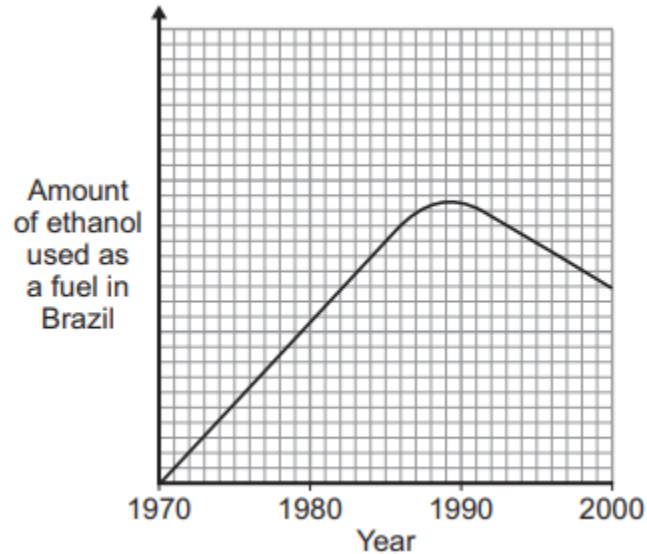
This happens because _____.

(2 marks)

(b) In 1970, the Brazilian Government stated that all petrol must contain more than 25 % ethanol. The reasons for this statement in 1970 were:

- Brazil did not have many oilfields
- Brazil has a climate suitable for growing sugar cane.

The graph shows the amount of ethanol used as a fuel in Brazil from 1970 to 2000.



(i) Use the graph to describe the changes in the amount of ethanol used as a fuel in Brazil from 1970 to 2000.

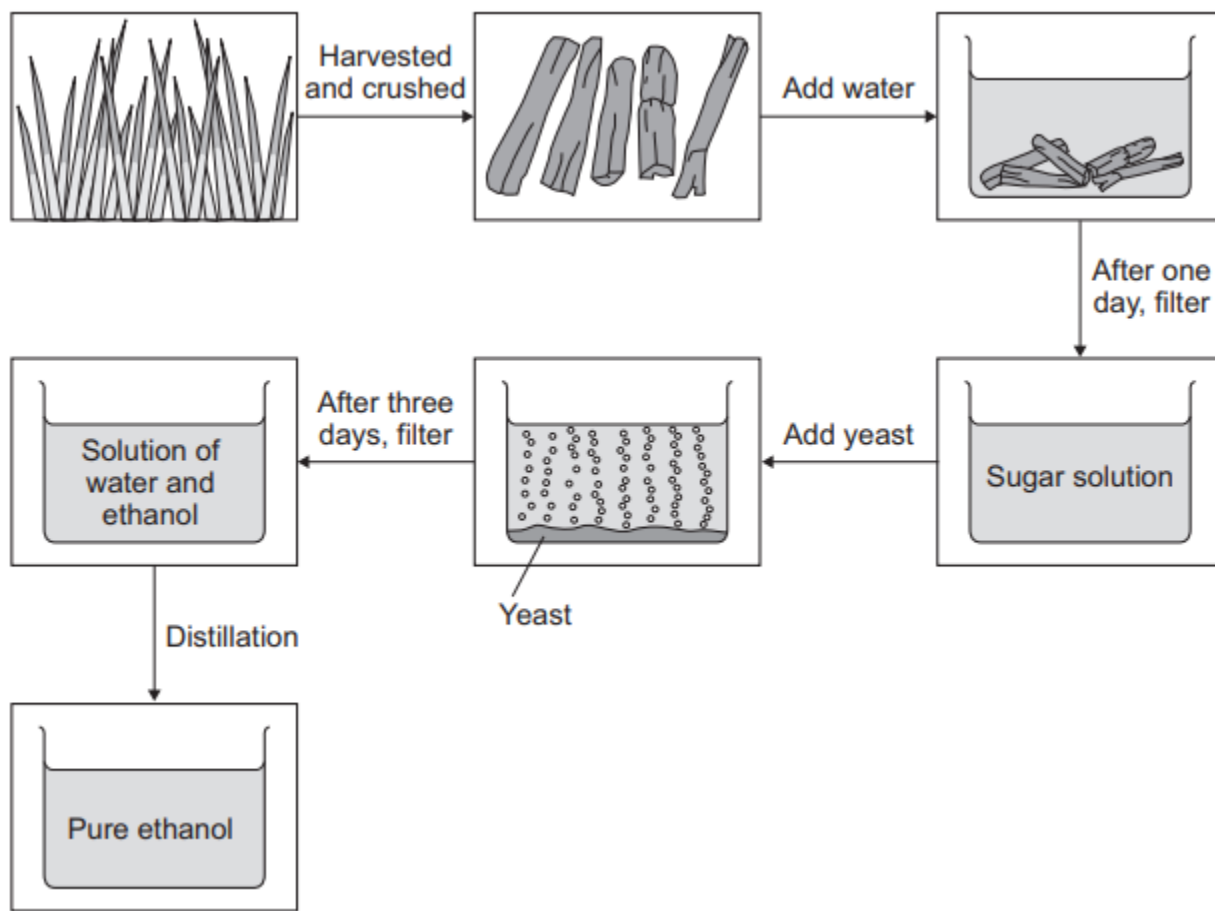
(2 marks)

(ii) In 2011, the Brazilian Government decided to reduce the amount of ethanol in petrol to 18 %. Suggest one reason for their decision.

(1 mark)

Q6. Most petrol used in cars contains about 5% ethanol (C_2H_5OH).

Ethanol can be produced from sugar cane.



(i) Draw a ring around the correct answer to complete the sentence.

The reaction to produce ethanol from sugar solution is

- combustion.
- displacement.
- fermentation.

(1 mark)

(ii) Some people say that increasing the production of ethanol from sugar cane will be good for the environment. Suggest two reasons why.

(2 marks)

- (iii) Other people say that increasing the production of ethanol from sugar cane will be bad for the environment. Suggest two reasons why.

(2 marks)

- Q7.** Ethanol (C₂H₅OH) can be made from ethene or from sugar.

Complete the table which shows the number of atoms of each element in the formula of ethanol.

Use the Chemistry Data Sheet to help you to complete the table.

Element	Symbol	Number of atoms in the formula C ₂ H ₅ OH
Carbon	C	2
Hydrogen	H
.....	O	1

(2 marks)

- Q8.** Two different processes are used to produce ethanol.

Process 1
Fermentation of a sugar solution by yeast in a reaction vessel.
The reaction vessel has to be emptied, cleaned and refilled every few days.
The process produces a 15% ethanol solution in water.

Process 2
Reaction of ethene (from crude oil) with steam in a reactor.
The reaction is only stopped if there is a fault in the reactor.
The process produces 100% ethanol.

(i) Give one advantage that Process 1 has over Process 2.

(1 mark)

(ii) What advantages to a manufacturer of ethanol, does Process 2 have over Process 1?

(2 marks)

Total marks (30)