

## 10: Organic 2 – Topic questions

## Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	November	33
6	2016	June	33
7	2015	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

3 Ethanol can be manufactured by fermentation and from ethene.

(a) Describe the manufacture of ethanol by fermentation **and** from ethene.  
In your answer include

- the essential conditions required for each reaction,
- **one** or more relevant word equations.

.....

.....

.....

.....

.....

..... [5]

(b) The table shows some properties of different alcohols.

alcohol	formula	melting point/°C	boiling point/°C	relative viscosity
methanol	CH <sub>4</sub> O	−94	65	0.54
ethanol	C <sub>2</sub> H <sub>6</sub> O	−117	79	1.08
propanol	C <sub>3</sub> H <sub>8</sub> O	−126	98	1.94
butanol	C <sub>4</sub> H <sub>10</sub> O	−89	117	2.54
pentanol	C <sub>5</sub> H <sub>12</sub> O	−79		3.47

(i) Deduce the state of methanol at room temperature.  
Explain your answer.

.....

..... [2]

(ii) Predict the boiling point of pentanol.

..... [1]

(iii) Describe how the relative viscosity changes with the number of carbon atoms in the alcohol.

..... [1]

(c) (i) Draw the structure of ethanol. Show all of the atoms and all of the bonds.

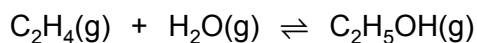
[2]

(ii) Give **one** major use of ethanol.

..... [1]

[Total: 12]

- 6 Ethanol can be manufactured by reacting ethene with steam.



- (a) What is the meaning of the symbol  $\rightleftharpoons$  ?

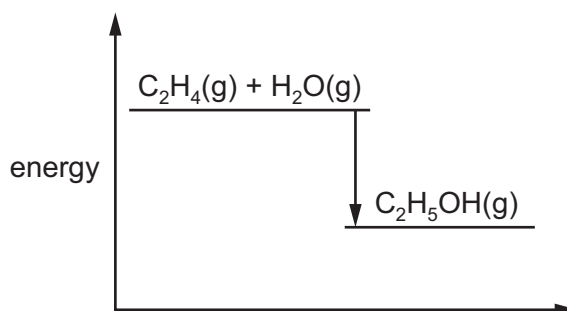
..... [1]

- (b) State **two** conditions needed for this reaction.

.....

..... [2]

- (c) The energy level diagram for this reaction is shown.



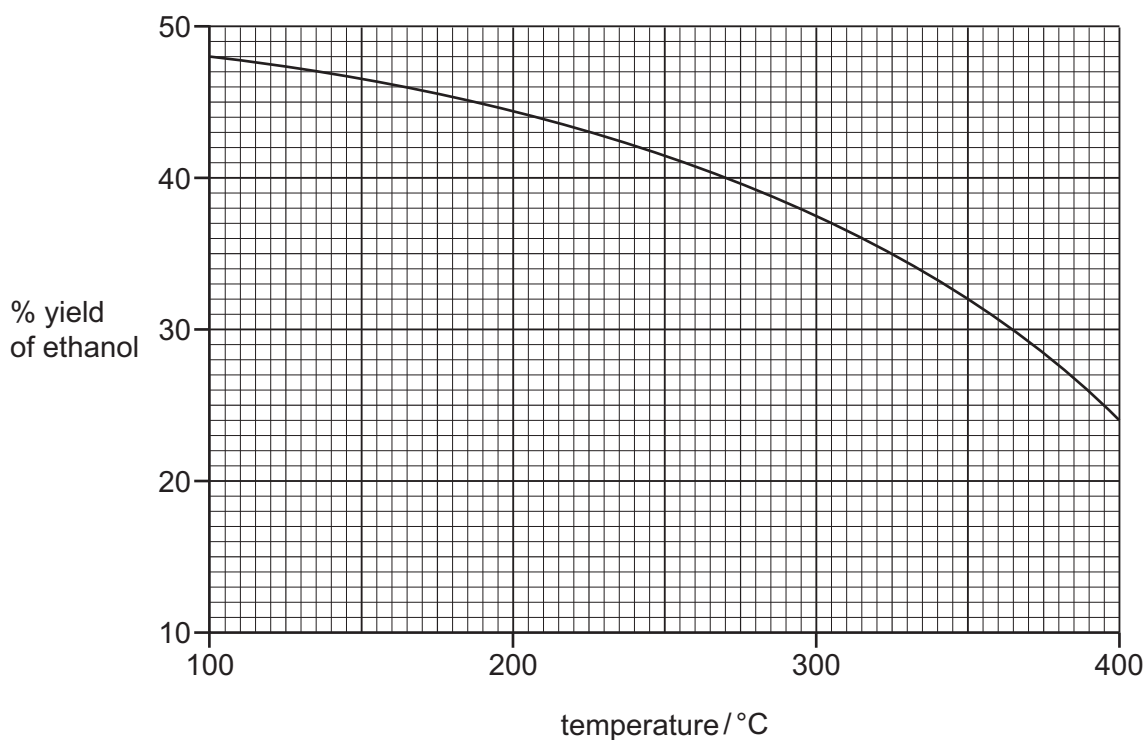
Is this reaction exothermic or endothermic?

Give a reason for your answer.

.....

..... [2]

- (d) The graph below shows how the percentage yield of ethanol changes with temperature when the pressure is kept constant.



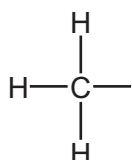
- (i) Describe how the percentage yield changes with temperature.

.....  
..... [1]

- (ii) Determine the percentage yield when the temperature is 350 °C.

..... [1]

- (e) (i) Complete the structure of ethanol,  $C_2H_5OH$ , to show all atoms and all bonds.

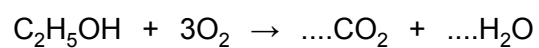


[1]

- (ii) Give **one** use of ethanol.

..... [1]

(iii) Complete the chemical equation for the complete combustion of ethanol.



[2]

[Total: 11]

- 7 Ethanol is manufactured from glucose,  $C_6H_{12}O_6$ , by fermentation according to the following equation.



- (a) State the conditions required for this reaction.

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

- (b) In an experiment, 30.0 g of glucose was fermented.

- (i) Calculate the number of moles of glucose in 30.0 g.

..... mol [2]

- (ii) Calculate the maximum mass of ethanol that could be obtained from 30.0 g of glucose.

..... g [2]

- (iii) Calculate the volume of carbon dioxide at room temperature and pressure that can be obtained from 30.0 g of glucose.

.....  $dm^3$  [1]

- (c) Ethanol can also be manufactured from ethene.

- (i) Name the raw material which is the source of ethene.

..... [1]

- (ii) Write a balanced equation for the manufacture of ethanol from ethene.

..... [1]

[Total: 9]

Question	Answer	Marks
3 (a)	<p><i>conditions required for ethanol manufacture by fermentation</i> (max = [3])</p> <ul style="list-style-type: none"> <li>• uses yeast</li> <li>• uses glucose / sugar(s)</li> <li>• anaerobic / no oxygen present</li> <li>• room temperature / quoted temperature between 10 (°C)–40 (°C) (inclusive)</li> <li>• aqueous conditions / water needed</li> <li>• pH 7 / near pH 7 / neutral</li> </ul> <p><i>conditions required for ethanol manufacture by hydration of ethene</i> (max = [3])</p> <ul style="list-style-type: none"> <li>• uses high temperature / heat</li> <li>• uses a catalyst</li> <li>• uses high pressure</li> <li>• uses water / steam</li> </ul> <p><i>equation</i> (max = [2])</p> <ul style="list-style-type: none"> <li>• ethene + water / steam → ethanol</li> <li>• glucose → ethanol + carbon dioxide</li> </ul>	5
3 (b) (i)	Liquid	1
	room temperature is between the melting point and boiling point (of methanol) / room temperature is above the melting point but below the boiling point (of methanol)	1
3 (b) (ii)	Values between 125(°C)–145(°C) inclusive	1
3 (b) (iii)	Increases with (increasing) number of carbon atoms	1
3 (c) (i)	Structure of ethanol showing all of the atoms and all of the bonds OH instead of O—H and rest of structure correct = [1]	2
3 (c) (ii)	Any suitable use, e.g. fuel / sterilisation / antiseptic solvent / making a named chemical, e.g. ethanoic acid	1
Total: 12		



Question	Answer	Marks
6 (a)	reversible reaction;	1
6 (b)	high temperature / heat; catalyst / correctly named catalyst;	2 1 1
6 (c)	exothermic; products have less energy than reactants;	2 1 1
6 (d) (i)	(percentage yield) decreases as temperature increases;	1
6 (d) (ii)	32%;	1
6 (e) (i)	structure of ethanol completed to show all atoms and all bonds;	1
6 (e) (ii)	any suitable use, e.g. fuel / solvent	1
6 (e) (iii)	2 (CO <sub>2</sub> ); 3 (H <sub>2</sub> O);	2 1 1
Total: 11		

Question	Answer	Marks
7 (a)	any <b>two</b> from: yeast / 20–40 °C / anaerobic or without oxygen or without air / (aqueous) solution or water or aqueous	2
7 (b) (i)	$M_r = 180$ (1) $(30/180) = 0.167$ (1)	2
7 (b) (ii)	$2 \times 0.167$ or $2 \times 46$ or $0.333$ or $92$ $(2 \times 0.167 \times 46) = 15.3(33)$ (g)	1 1
7 (b) (iii)	$(2 \times 0.167 \times 24) = 8$ (dm <sup>3</sup> )	1
7 (c) (i)	crude oil / petroleum	1
7 (c) (ii)	$C_2H_4 + H_2O \rightarrow C_2H_5OH / CH_3CH_2OH$	1
Total: 9		