OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE

A173/01

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

Module C7 (Foundation Tier)

THURSDAY 20 JUNE 2013: Afternoon
DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	

Centre number					Candidate number				

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

None

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. Please write clearly and in capital letters.

- Use black ink. HB pencil may be used for graphs and diagrams only.

- Answer <u>ALL</u> the questions.

- Read each question carefully. Make sure you know what you have to do before starting your answer.

- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).

- The number of marks is given in brackets [ ] at the end of each question or part question.

- The total number of marks for this paper is <u>60</u>.

- Any blank pages are indicated.

- The Periodic Table is printed on the back page.
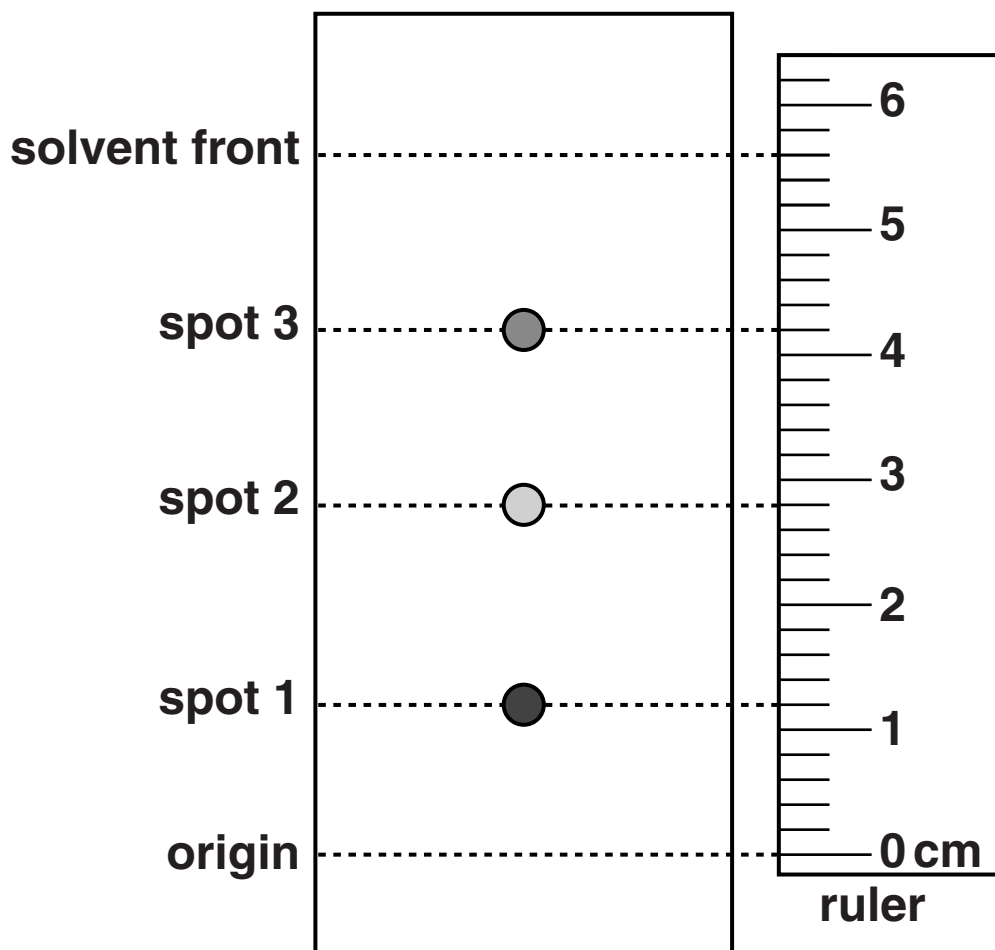
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Answer ALL the questions.

1 Peter is testing the food colourings in soft drinks made by different companies.

He wants to find out if any of these drinks contain banned food colourings.

Peter uses chromatography.

Here is a diagram of the chromatogram from soft drink A.

(a) Use the ruler on the diagram.

Work out the Rf value for SPOT 3 on this chromatogram.

Use the formula in the box.

$$Rf = \frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

Show your working.

Rf value for spot 3 = _____ **[2]**

(b) Peter tests five soft drinks.

Write your Rf value for spot 3 of soft drink A in the table with the others.

SOFT DRINK	Rf VALUE SPOT 1	Rf VALUE SPOT 2	Rf VALUE SPOT 3
A	0.21	0.50	
B	0.38	0.65	0.72
C	0.38	0.72	0.88
D	0.29	0.65	0.82
E	0.38	0.44	0.65

Peter does a chromatogram of the banned food colouring.

He finds that it gives two spots, with Rf values 0.38 AND 0.65.

Which of the soft drinks contain the banned food colouring?

answer _____ [2]

(c) Peter does another chromatogram of the banned food colouring.

This time he uses alcohol instead of water as the solvent.

The table shows his results.

SOLVENT	Rf VALUES FOR SPOTS
water	0.38 and 0.65
alcohol	0.25 and 0.90

He writes this conclusion.

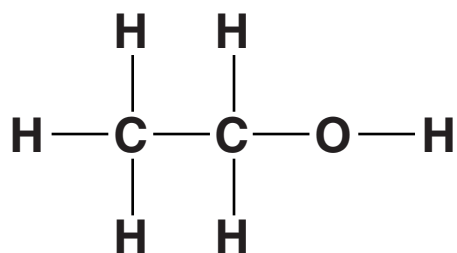Both of the dyes in the food colouring move further when alcohol is used.

Do you think Peter's conclusion is correct? Explain your reasoning.

_____
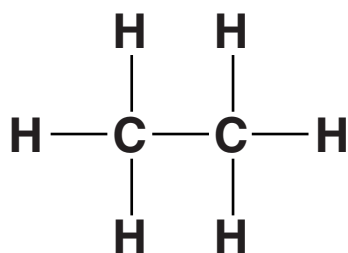
_____

_____

_____ [2]

[Total: 6]

2 **Look at the formulae of these five organic compounds.**

A

H—C—C—O—H
(with H above and below each C; CH₃CH₂OH structure)

B

H—C—C—H
(with H above and below each C; CH₃CH₃ structure)

C

H—C—C—Br
(with H above and below each C; CH₃CH₂Br structure)

D

H₂C=CH₂
(C=C with two H on each carbon)

E

H—C—C with =O and —O—H
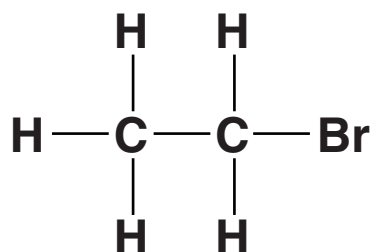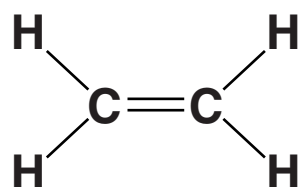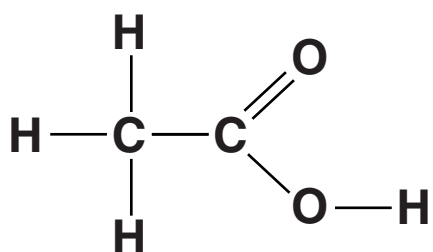(with H above and below the first C; CH₃COOH structure)

Use the letters A, B, C, D and E to answer the questions.

(a) Which compound is a saturated hydrocarbon?

answer _____ [1]

(b) Which compound is an unsaturated hydrocarbon?

answer _____ [1]

(c) Which two compounds react with each other to make an ester?
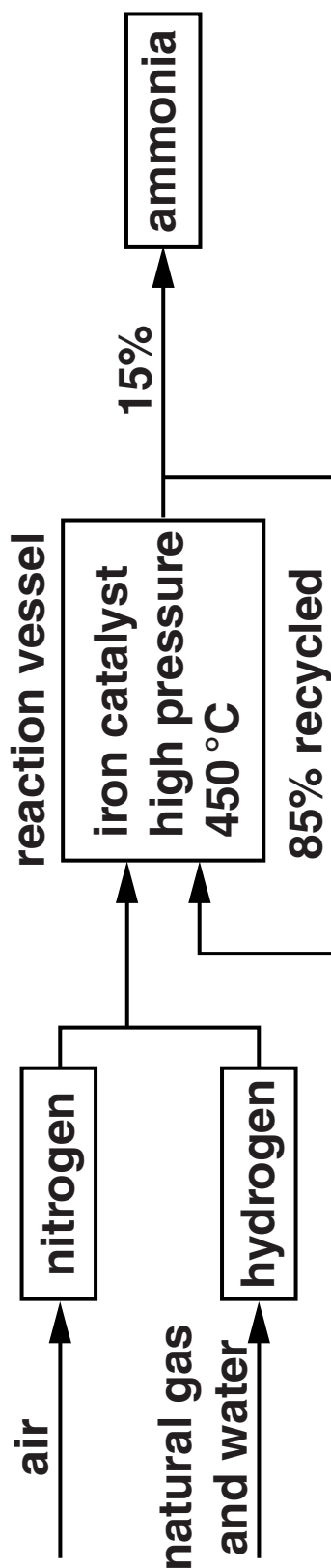
answer _____ and _____ [2]

(d) Which compound is a weak acid?

answer _____ [1]

[Total: 5]

3 **Ammonia, NH_3, is made by the Haber process.**

nitrogen + hydrogen $\rightleftharpoons$ ammonia

reaction vessel

iron catalyst
high pressure
450 °C

air → nitrogen

natural gas
and water → hydrogen

85% recycled

15% → ammonia

(a) The Haber process uses:

a catalyst

a temperature of 450 °C

a high pressure

recycling of unreacted gases.

Explain how these help to make more ammonia.

🖉 **The quality of written communication will be assessed in your answer.**

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(b) Look at the bar chart.

WORLD PRODUCTION OF AMMONIA

ammonia production in millions of tons (y-axis), year (x-axis)
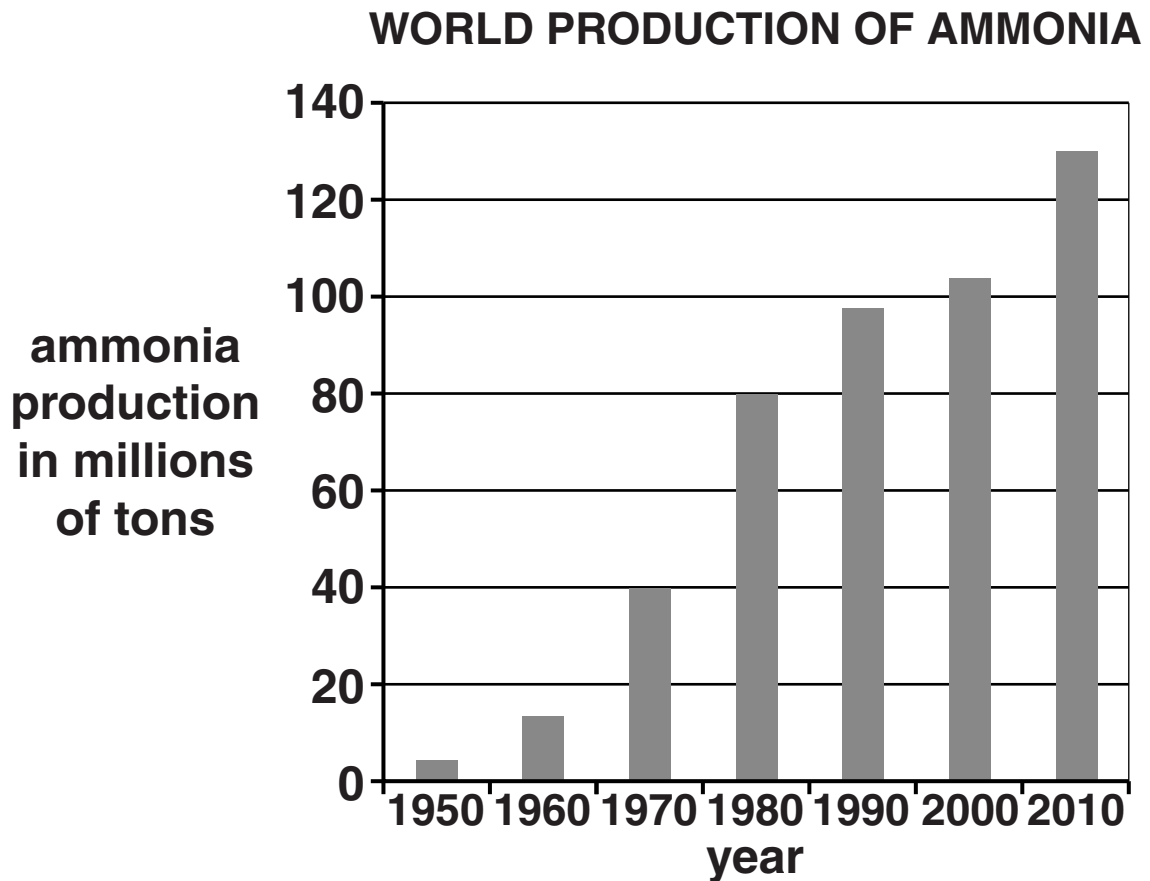
The main use of ammonia is to make fertilisers.

Large scale use of fertilisers made from ammonia causes environmental problems.

Write about these problems, and explain why they have got worse over the last 60 years.

_____

_____

_____

_____

_____

_____ **[3]**

[Total: 9]

4 **Citric acid reacts with sodium hydrogencarbonate.**

citric acid + sodium hydrogencarbonate $\longrightarrow$ sodium citrate + carbon dioxide + water

The diagram shows the energy change that takes place in this reaction.
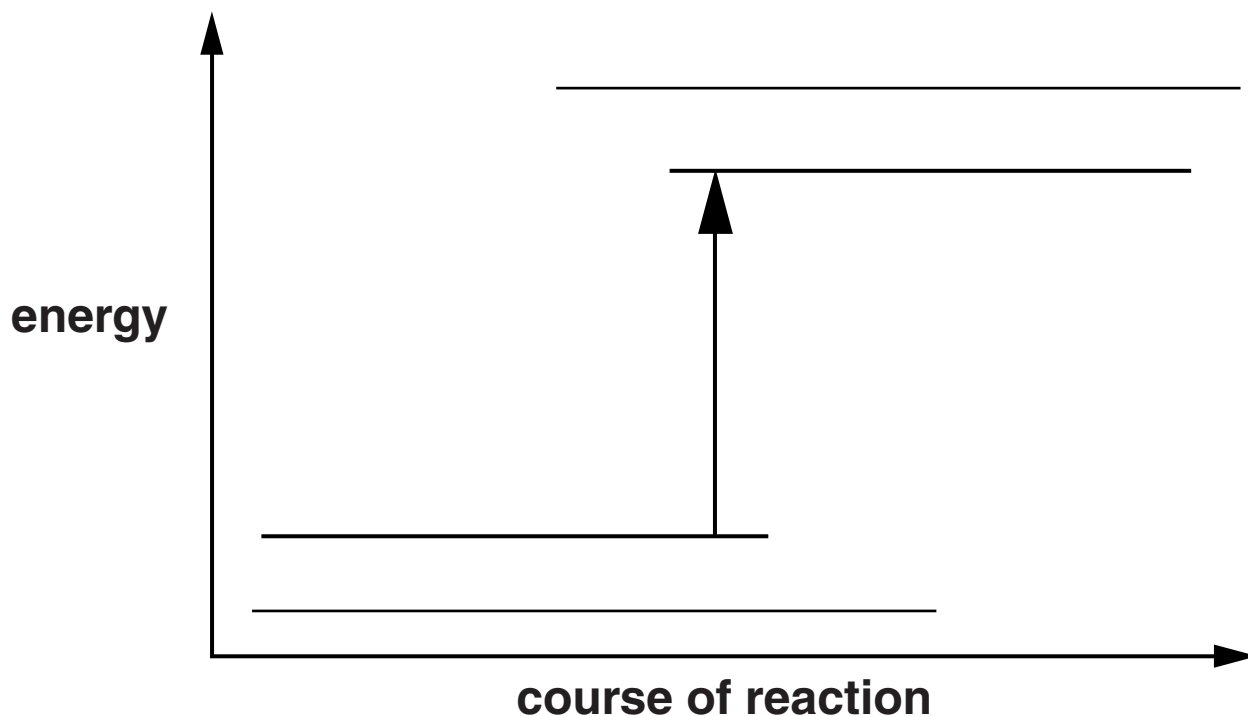
(a) Write the names of the reactants and the products of the reaction in the correct places on this diagram. [2]

(b) **Finish these sentences to describe what happens in the reaction.**

Use words or phrases from the list.

ENDOTHERMIC

EXOTHERMIC

GAINED FROM

LESS

LOST TO

MORE

The reactants have _____ energy

than the products, so during the reaction, energy

is _____ the surroundings.

The reaction is _____ . [3]

(c) A solution of citric acid is added to a solution of sodium hydrogencarbonate in a test tube.

Sam says that the solution will bubble and the tube will get hot.

Sally says that there will be no bubbles and the tube will get cold.

Both are wrong. Explain why.

_____

_____

_____ **[2]**

[Total: 7]

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5 Titration is a technique used for quantitative analysis.

    (a) (i) Describe the general procedure for carrying out an acid-base titration and explain the purpose of each step.

             🖉 The quality of written communication will be assessed in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(ii) How can the uncertainty in a set of repeated titration results be assessed?

_____

_____

_____

_____ [2]

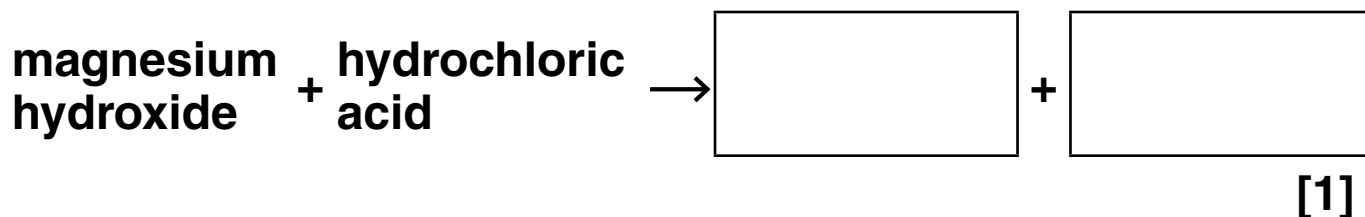(b) Emma works for a company making indigestion tablets.

Her job is to test tablets from each batch.

(i) The tablets contain magnesium hydroxide.

Emma titrates each tablet with hydrochloric acid.

This reaction makes a salt and water.

Finish this word equation for the reaction.

magnesium hydroxide + hydrochloric acid → [   ] + [   ]

[1]

(ii) **Work out the relative formula mass (RFM) of magnesium hydroxide, $Mg(OH)_2$.**

Show your working.

(Relative atomic masses: H = 1; Mg = 24; O = 16)

RFM of magnesium hydroxide = _____ [1]

(iii) **Emma uses hydrochloric acid with 73.0 g of hydrogen chloride in each $1.0 \, dm^3$ of the acid solution.**

It takes $15.1 \, cm^3$ of this hydrochloric acid to react with the tablet.

Look at the formula in the box.

---

mass of hydrogen chloride = volume in cm^3 $\times$ $\dfrac{\text{mass in } 1.0 \, dm^3}{1000}$

Use the formula to work out the mass of hydrogen chloride in $15.1 \, cm^3$ of this hydrochloric acid.

Give your answer to the nearest 0.1 g.

Show your working.

mass of hydrogen chloride in $15.1 \, cm^3$ solution = _____ g [2]

(iv) Look at the formula in the box below.

$$\text{mass of Mg(OH)}_2 = \begin{array}{c}\text{mass of}\\ \text{hydrogen chloride in}\\ \text{15.1 cm}^3 \text{ solution}\end{array} \times \frac{\text{RFM Mg(OH)}_2}{73}$$

Use this formula, and your answers to (ii) and (iii), to work out the mass of magnesium hydroxide in the tablet.

Show your working.

mass of magnesium
hydroxide in the tablet = _____ g [2]

(c) Emma analyses six tablets from each batch.

The table shows Emma's results for four batches of tablets.

TABLET NUMBER	MASS OF MAGNESIUM HYDROXIDE IN g					
	1st	2nd	3rd	4th	5th	6th
BATCH A	0.95	0.93	0.95	0.96	0.94	0.93
BATCH B	0.88	0.86	0.89	0.87	0.89	0.87
BATCH C	1.13	1.16	1.14	1.15	1.13	1.16
BATCH D	1.03	1.13	1.05	1.04	1.15	1.03

The label on each pack of indigestion tablets says that each tablet contains 1.0 g of magnesium hydroxide.

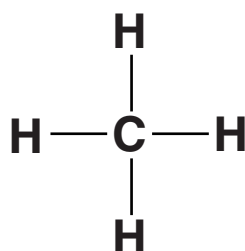The standard set by the company is that each tablet must be within 0.1 g of this figure.

For each batch decide whether it meets the standard and explain your answers.

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

[Total: 18]

6 Methanol has the formula CH_3OH.

(a) (i) This is the structural (displayed) formula for methane, CH_4.

$$H-\overset{\displaystyle H}{\underset{\displaystyle H}{C}}-H$$

Draw the structural (displayed) formula for methanol, CH_3OH.

[1]

(ii) To which type of organic compound does methanol belong?

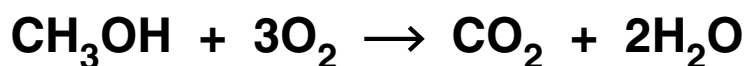Put a (ring) around the correct answer.

ALCOHOL

ALKANE

CARBOXYLIC ACID

ESTER [1]

(b) **Methanol burns to make carbon dioxide and water.**

$$CH_3OH + 3O_2 \longrightarrow CO_2 + 2H_2O$$

Finish this table to show the number of MOLECULES of each chemical in the equation.

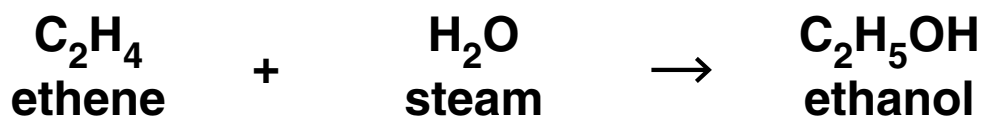|	methanol	oxygen	carbon dioxide	water
number of molecules in the equation				

[2]

(c) **Give a use of methanol.**

_____ [1]

[Total: 5]

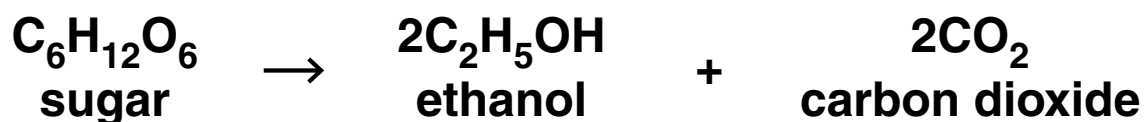**7**   Ethanol can be made by the reaction of ethene with steam or by fermentation of sugar.

METHOD 1 – reaction of ethene with steam:

$$C_2H_4 \quad + \quad H_2O \quad \rightarrow \quad C_2H_5OH$$
ethene $\qquad$ steam $\qquad$ ethanol

Ethene is obtained from crude oil.
The ethene is reacted with steam at about 300 °C and 60 atmospheres pressure.

METHOD 2 – fermentation:

$$C_6H_{12}O_6 \quad \rightarrow \quad 2C_2H_5OH \quad + \quad 2CO_2$$
sugar $\qquad$ ethanol $\qquad$ carbon dioxide

The sugar is obtained from crops such as sugar beet or sugar cane.
The sugar is fermented with yeast at a temperature of about 30 °C.

(a) The sustainability of chemical processes depends on a number of factors.

One of these factors is the renewability of raw materials.

Consider this, and other factors, to compare the sustainability of making ethanol by these two methods.

🖉 The quality of written communication will be assessed in your answer.

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(b) Fermentation makes a solution containing less than 20% of ethanol.

(i) Which of these statements explains why it is not possible to make a more concentrated solution?

Put a tick (✓) in the box next to the best statement.

☐ Yeast stops making ethanol when it runs out of sugar.

☐ The reaction is too slow at 30 °C.

☐ Yeast is killed by a high concentration of ethanol.

☐ Too much carbon dioxide is made.

[1]

(ii) What process is used to concentrate the ethanol solution?

Put a ⬭ring around the correct answer.

CRYSTALLISATION

DISTILLATION

FILTRATION

REDUCTION   [1]

(c) The reaction of ethene with steam is carried out at about 300 °C.

Fermentation is carried out at about 30 °C.

Suggest reasons for this difference.

_____

_____

_____

_____

_____

_____ **[2]**

[Total: 10]

END OF QUESTION PAPER

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The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
						1 **H** hydrogen 1											4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **A***l* aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **C***l* chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **T***l* thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

32