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Wednesday 21 June 2017 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A/FURTHER ADDITIONAL SCIENCE A

A173/01 Module C7 (Foundation Tier)

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)

Duration: 1 hour

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** 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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The 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 **60**.
- The Periodic Table is printed on the back page.
- This document consists of **20** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Dee works for a company that uses sodium hydrogencarbonate to make medicines.

(a) Dee uses several stages to make a standard solution of sodium hydrogencarbonate.

Each stage uses different equipment.

Draw straight lines to join each **stage** with the correct **equipment needed**.

Stage	Equipment needed
	burette
measure mass of solid	volumetric flask
dissolve solid in water and stir	beaker and glass rod
make solution up to exactly 250 cm^3	balance
	thermometer

[3]

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(b) The company makes tablets from the sodium hydrogencarbonate to sell as medicines.

The tablet making process goes on all day, every day, to make a very large number of tablets.

Dee's job is to choose representative samples of tablets, make them into a solution and test them to check that they all contain the same amount of sodium hydrogencarbonate.

Write down some standard procedures for Dee to follow to make sure that her tests are fair.

Your answer should include:

- how she chooses which tablets to sample
- how she stores and handles the tablets
- what she should control when she makes each tablet into a solution.

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

[6]

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(c) Medicines that contain sodium hydrogencarbonate are used to neutralise excess acid in the stomach.

In the stomach, sodium hydrogencarbonate reacts with hydrochloric acid.

(i) Complete the word and symbol equation for the reaction.

sodium hydrogencarbonate	+	hydrochloric acid	$\rightarrow$	[ ]	+	carbon dioxide	+	water
$NaHCO_3$	+	[HCl]	$\rightarrow$	[$NaCl$]	+	[ ]	+	H_2O

[2]

(ii) One of the side-effects of taking medicines which contain sodium hydrogencarbonate is pain caused by a build-up of gas in the stomach.

Use the equation to explain how sodium hydrogencarbonate causes a build-up of gas in the stomach.

....

....

.... **[2]**

[Total: 13]

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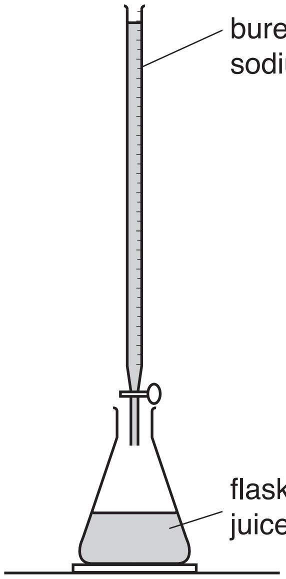
2 Lemon juice contains an acid.

Joe does some titrations to find the concentration of acid in a bottle of lemon juice from a shop.

He uses a measuring cylinder to measure 5 cm^3 samples of lemon juice.

He adds an indicator to the lemon juice, then does a titration using dilute sodium hydroxide.

The diagram shows how he sets up his titration.



For each sample of lemon juice, Joe does a rough titration and then several titration repeats.

These are Joe's results.

	Rough	**Titration repeats**			
		1	**2**	**3**	**4**
Volume dilute sodium hydroxide used (cm^3)	25.0	24.0	26.5	27.0	19.0

(a) **(i)** Joe thinks that the data from his titrations is poor quality.

Explain why he is right.

....

....

.... **[2]**

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(ii) Joe thinks that his data is poor quality because the measuring cylinder does not give a precise measurement of small amounts of lemon juice.

What could Joe use to measure the lemon juice more precisely?

Put a tick (✓) in the box next to the correct answer.

a larger measuring cylinder ☐

a pipette ☐

a small beaker ☐

a different indicator ☐

[1]

(b) Joe repeats his titrations.

These are his new results.

	Rough	**Titration repeats**			
		1	**2**	**3**	**4**
Volume dilute sodium hydroxide used (cm^3)	23.0	21.0	25.0	20.5	21.5

(i) Joe thinks one of his results is an outlier.

He ignores the outlier and uses three titration results to calculate the mean of the true volume of dilute sodium hydroxide used.

Put a ring around the **three** results in the table he uses. **[1]**

(ii) Use the results to calculate a mean for the volume of dilute sodium hydroxide.

mean = ... cm^3 **[2]**

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(c) Joe completes similar titrations to test samples from a bottle of fruity lemon drink. The juice has this label.

Fruity drink contains **5%** lemon juice

Joe uses his titration results to work out a best estimate of the volume of sodium hydroxide needed.

Best estimate = 20.0 cm^3

Joe uses the following equation to work out the concentration of the lemon juice in the drink.

$$\text{concentration of lemon juice in drink} = \frac{\textbf{best estimate}}{5}\ \%$$

Use the equation to find out if Joe's best estimate gives the same concentration of lemon juice as the label.
Explain your answer.

....

.... **[2]**

[Total: 8]

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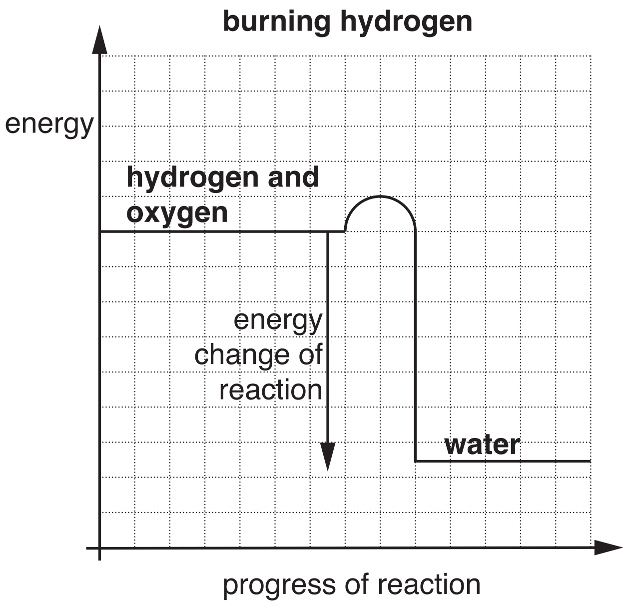
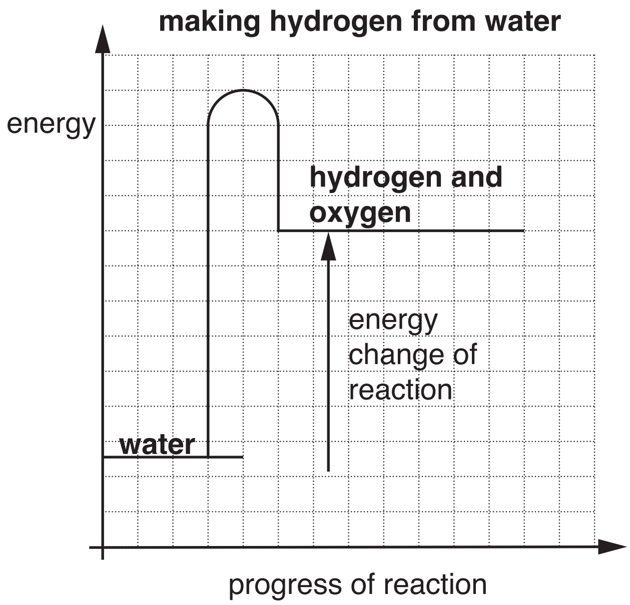
3 Hydrogen can be burned as a fuel. It can be made from water.

The energy level diagrams below show the energy changes when hydrogen burns and when it is made from water.





Describe and explain the **similarities** and **differences** between the energy changes shown on the two diagrams.

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

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.... **[6]**

[Total: 6]

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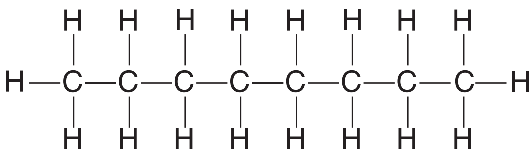
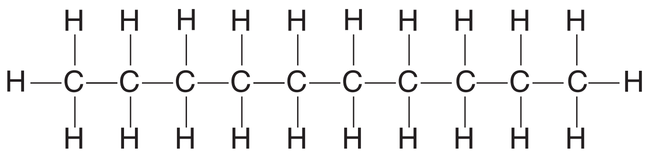
4 Octane and decane are alkanes that are used in car fuels.

(a) The diagrams show the structures of octane and decane.



octane



decane

(i) The formula for octane is C_8H_{18}.

Write down the formula for decane. .... **[2]**

(ii) Which statements about octane and decane are **true** and which are **false**?

Put a tick (✓) in one box in each row.

	True	**False**
decane has a higher relative formula mass than octane		
both molecules contain double bonds		
both molecules are hydrocarbons		
both molecules give off carbon dioxide gas when they burn		

[3]

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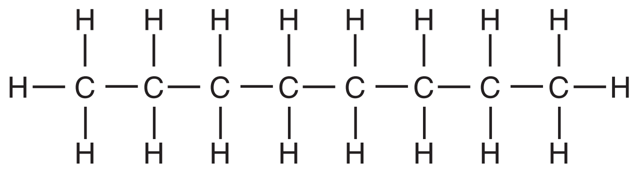
(b) Cracking is a reaction used in a petrol refinery to make smaller molecules from long-chain alkanes.

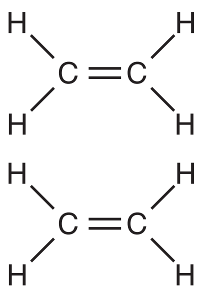
The diagram shows what happens when cracking is used to make two molecules of ethene from an octane molecule.

One other molecule is also made.

In the box provided **draw** the structure and give the **name** of the other molecule.



octane



ethene

+

name...

[2]

[Total: 7]

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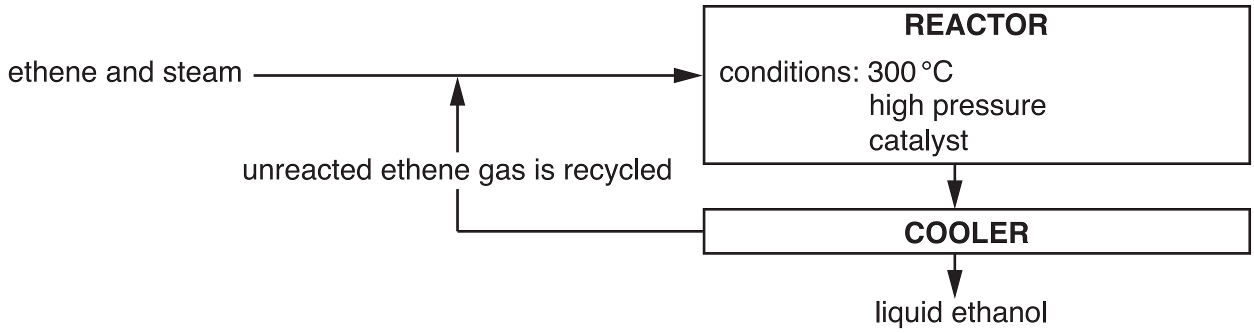
5 Ethene is used in an industrial process to make ethanol.

This is the equation for the main reaction in the process.

$$C_2H_4 + H_2O \rightleftharpoons C_2H_5OH$$

This flow diagram summarises the process.



(a) What does the symbol $\rightleftharpoons$ in the equation mean?

....

....

.... **[1]**

(b) Explain why ethene gas needs to be recycled in the process.

....

....

.... **[2]**

(c) How is the rate of the reaction increased during the process?

....

....

.... **[2]**

(d) The ethanol leaves the reactor as a gas.

What happens to the ethanol so that it changes into liquid ethanol?

....

....

.... **[2]**

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(e) Ethanol can be made in other processes.

Which two processes can be used to make ethanol?

Put ticks (✓) in the boxes next to the **two** correct answers.

fermentation of sugar	☐
using genetically modified bacteria on biomass	☐
in the Haber process	☐
using gas chromatography	☐
by titration	☐

[2]

[Total: 9]

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6 The alkanes are a family of chemical compounds.

Some alkanes are used in car fuel.

When choosing a car fuel it is important to think about its state, its flashpoint and the energy it gives out when it is burned.

Fuels with low flashpoints ignite more easily than fuels with higher flashpoints. Fuels with flashpoints above 20 °C do not ignite easily at room temperature. Fuels with very low flashpoints are very flammable and may cause a fire risk.

The table shows some information about three alkanes: methane, octane and decane.

Name of alkane	Formula	State at room temperature	Flashpoint in °C	Energy given out when burned in kJ/mol
methane	CH_4	gas	–188	840
octane	C_8H_{18}	liquid	14	4800
decane	$C_{10}H_{22}$	liquid	46	6800

Use the table to discuss the **benefits** and **risks** of using methane, octane and decane in car fuel.

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

.... **[6]**

[Total: 6]

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7 Over 10 million tonnes of phenol are made worldwide every year. Phenol is used to make many plastic products for buildings and packaging.

Phenol has been manufactured for over 100 years. The table gives information about an older process to make phenol and a modern process.

	Older process	**Modern process**
Raw materials	Benzene (from fossil fuels) Sulfuric acid Sodium hydroxide	Benzene Propene (both from fossil fuels)
Yield	82%	87%
Atom economy	37%	100%
Waste products	Sodium sulfite (toxic)	None, by-products are useful
Conditions	High temperature and pressure	High temperature and pressure

(a) Use the information to explain why the atom economy of the two processes are different.

....

....

....

.... **[2]**

(b) The modern process involves more green chemistry than the older process.

Use the information to explain why.

....

....

....

.... **[3]**

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(c) A team of scientists are investigating how to make the modern process even greener.

(i) What factors could they investigate to make the process more green?

Put ticks (✓) in the boxes next to the **two** correct answers.

Using renewable raw materials. ☐

Using a higher temperature and pressure. ☐

Finding more uses for phenol. ☐

Finding ways to increase the yield of phenol. ☐

[2]

(ii) Scientists in the team share their data with each other.

Why do they do this?

Put ticks (✓) in the boxes next to the **two** correct answers.

To make sure that other scientists do not take credit for their work. ☐

To reduce the safety risks during their experiments. ☐

So that other scientists can check their data. ☐

So that they can discuss their conclusions. ☐

To stop other scientists from working on the same idea. ☐

[2]

(d) Some green chemical processes use enzymes as catalysts.

Which statements are **advantages** and which are **disadvantages** of using enzyme catalysts?

Put a tick (✓) in one box in each row.

	Advantage	**Disadvantage**
Enzymes speed up reactions		
Reactions with enzymes can work at a lower temperature		
Enzymes only work in narrow ranges of ph and temperature		
Enzymes can be denatured		

[2]

[Total: 11]

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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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 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** 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 **Tl** 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.

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