OCR
Oxford Cambridge and RSA

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Thursday 18 May 2017 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A/SCIENCE A

A171/02 Modules C1 C2 C3 (Higher 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

A171102

6717411664

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

1 The table shows some information about how the Earth's atmosphere has changed over time.

Gas	Approximate percentage composition of atmosphere in %		
	4 billion years ago	500 years ago	Today
Carbon dioxide	20	0.03	0.04
Water vapour	50	small	small
Nitrogen	3	78	78
Oxygen	0	21	21

(a) The atmosphere 4 billion years ago contained other gases in addition to those named in the table. The other gases contained mainly methane.

Use the data in the table to estimate the percentage of methane gas in the atmosphere 4 billion years ago.
Explain your reasoning.

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

(b) Describe and give reasons for the changes in the percentages of carbon dioxide, water vapour and oxygen from 4 billion years ago until today.

Use data from the table to support your answer.

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

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..... **[6]**

[Total: 8]

2 The exhaust gases of cars contain pollutants.

(a) The pollutants include nitrogen monoxide and carbon monoxide.

(i) Describe how nitrogen monoxide is formed in a car engine.

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

(ii) Describe how carbon monoxide is formed in the car engine.

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

(iii) Nitrogen monoxide and carbon monoxide are removed from exhaust gases in a catalytic converter.

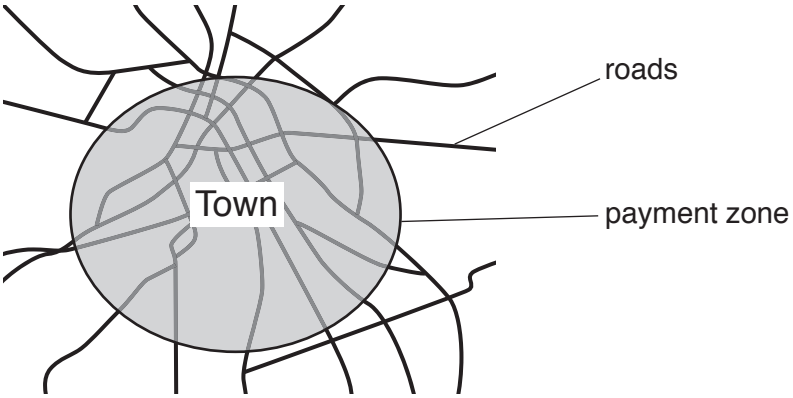
In the converter, nitrogen monoxide reacts with carbon monoxide to form carbon dioxide and nitrogen.

Complete the diagram to show the missing molecules.

nitrogen monoxide + carbon monoxide → carbon dioxide + nitrogen

[3]

(b) A town council wanted to reduce the amount of air pollutants in a town.
The council decided to introduce a payment zone for cars.



Alex works for the town council.

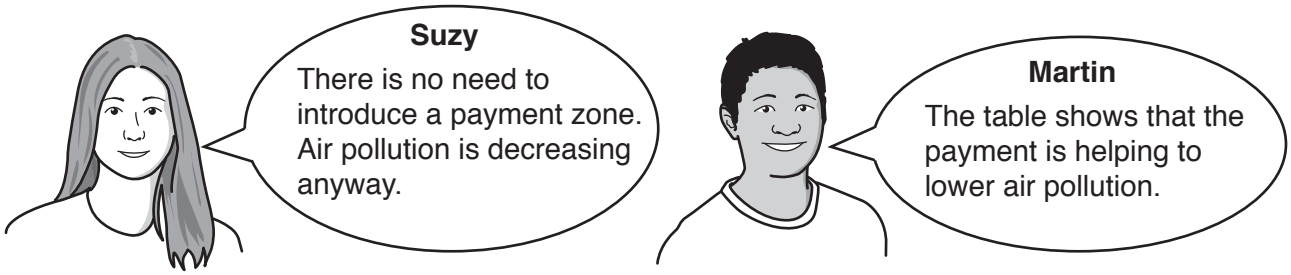
Alex measured the amount of pollutants in the air inside the payment zone and outside the payment zone.

He recorded data every day for a year before the payment was introduced and every day for a year afterwards.

The table shows Alex's data.

Site	Pollutant	Daily mean amount before the payment was introduced in $\mu g/m^3$	Daily mean amount after the payment was introduced in $\mu g/m^3$	Percentage change in %
Outside the payment zone	nitrogen oxides	560	476	–15
	carbon monoxide	25	22	–12
Inside the payment zone	nitrogen oxides	600	480	–20
	carbon monoxide	30	24	–20

Suzy and Martin talk about the data in the table.



Explain how the data in the table supports the ideas of both Suzy and Martin.

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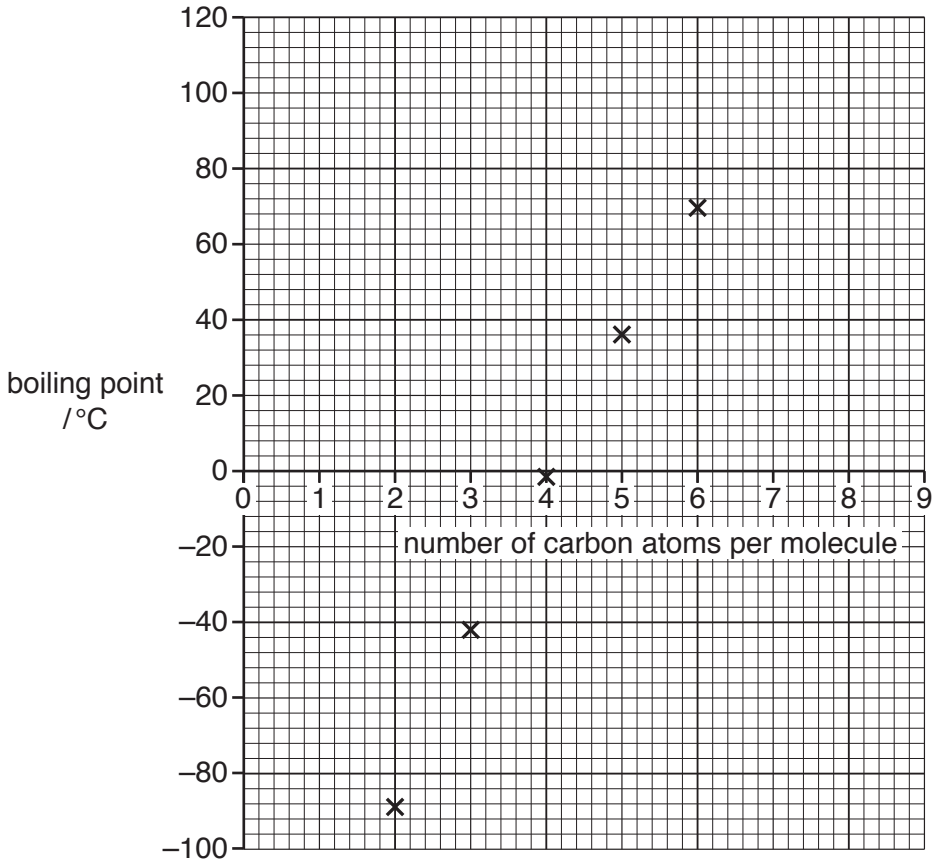
..... **[3]**

[Total: 9]

3 Crude oil contains hydrocarbons.

The graph shows the relationship between the number of carbon atoms in some hydrocarbons and their boiling points.



7

Describe the relationship shown by the graph and use ideas about forces between molecules to explain this relationship.

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

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..... **[6]**

[Total: 6]

4 Nanoparticles are very small particles.

(a) Put a (ring) around the correct range for the size of nanoparticles.

0.1 to 1 nm **1 to 100 nm** **100 to 200 nm** **200 to 1000 nm** **[1]**

(b) Which statements about nanoparticles are **true** and which are **false**?

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

	True	False
Nanoparticles can be used to make sports equipment stronger.		
Nanoparticles can occur naturally.		
Nanoparticles have the same properties as larger particles.		
Nanoparticles are about the same size as some molecules.		

[2]

(c) Doctors use stitches to hold together large cuts so that they can heal properly.

A hospital is considering buying a new type of material to use for stitches.
They need to choose between a material that contains silver nanoparticles and a material that does not.

Which material should they choose?
Justify your answer by explaining the risks and benefits of using each.

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..... **[3]**

[Total: 6]

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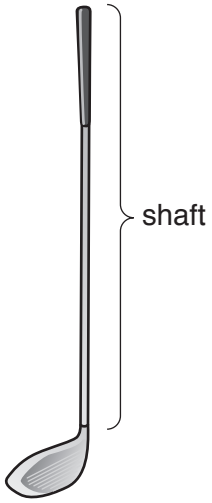
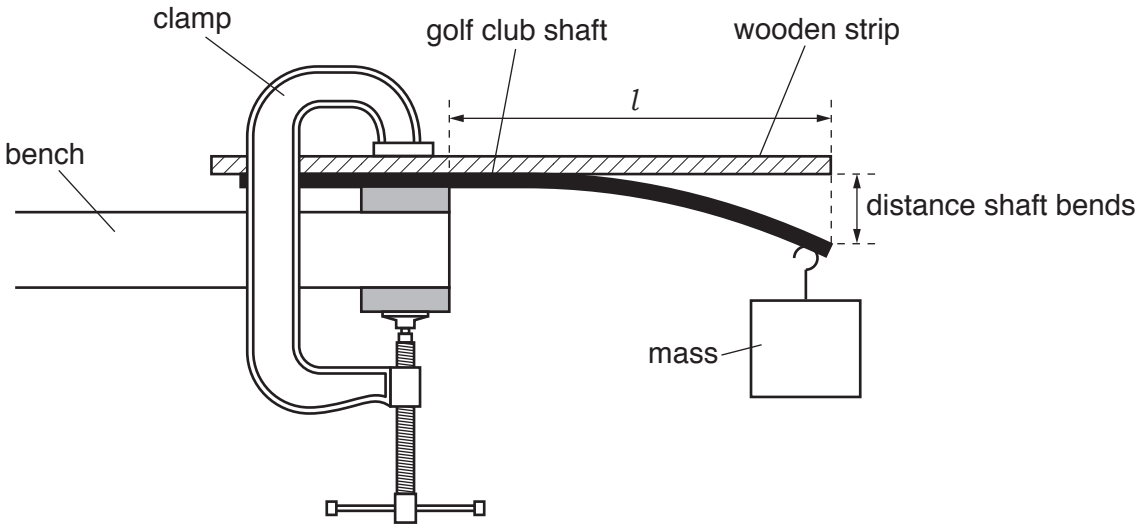
5 Chris works for a company that makes golf clubs.

The flexibility of the shaft of the golf club is important.



Golf clubs are given a Flex Rating as a measure of the flexibility of the shaft.

Chris measures the flexibility of a shaft using the following apparatus.



He measures the distance that the shaft bends when the mass is added.

(a) Chris tests the flexibility of several different shafts.
He wants to make sure that his tests are 'fair tests'.

Give **two** factors that he needs to control when he tests each shaft and explain how these controls make his tests fair.

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..... **[3]**

(b) Chris repeats his test five times for the same shaft.

These are his results.

Distance shaft bends in mm				
Test 1	**Test 2**	**Test 3**	**Test 4**	**Test 5**
86	89	87	88	87

(i) Calculate the mean value for the distance the shaft bends.

mean = ... mm **[2]**

(ii) The Flex Rating for a shaft can be worked out using the distance the shaft bends in metres.
This is the formula:

$$\text{Flex Rating} = \frac{10}{3 \times \text{distance shaft bends in m}}$$

Ladies' golf club shafts must have a Flex Rating in the range 38–39.
Men's golf club shafts must have a Flex Rating in the range 45–46.

Is the shaft in **(b)(i)** suitable to be used for a men's or a ladies' golf club?
Use a calculation to support your answer.

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..... **[3]**

[Total: 8]

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6 Large salt deposits are found deep underground in some parts of the World.

(a) Describe how these salt deposits formed.

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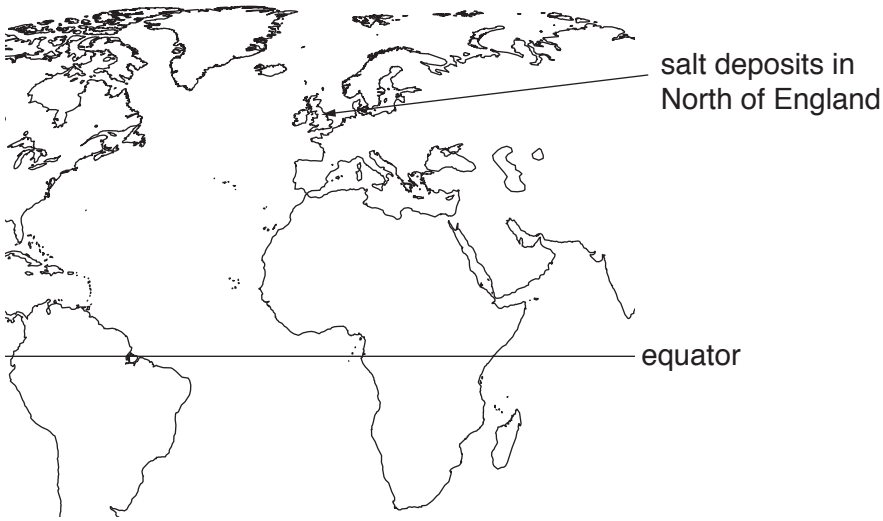
..... **[2]**

(b) There are large salt deposits in the North of England.
Scientists think these salt deposits formed much nearer to the equator.



Suggest how the salt deposits came to be in the North of England if they were formed nearer to the equator.

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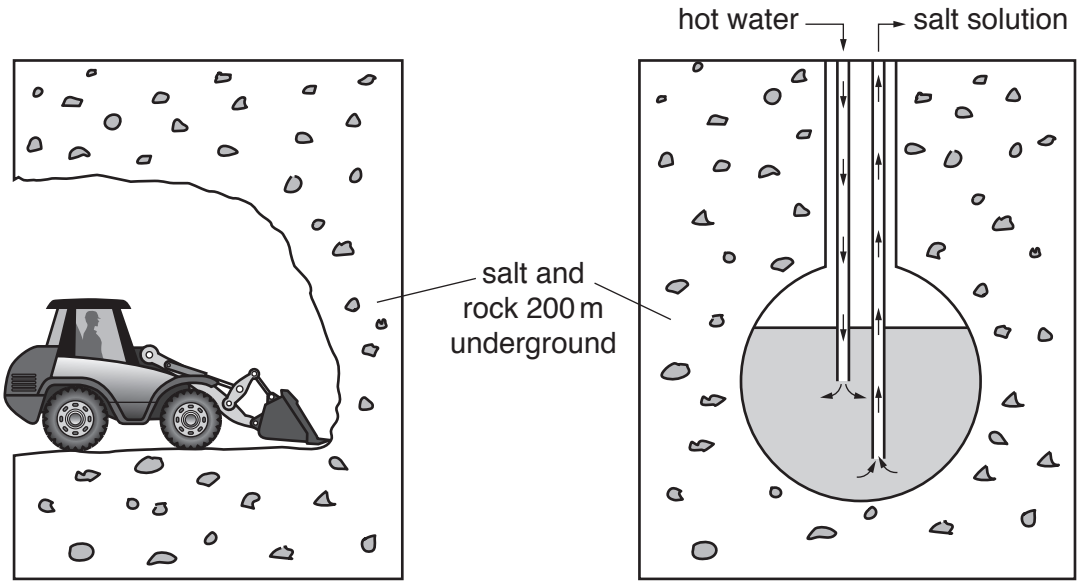
..... **[2]**

(c) A company wants to extract the salt from underground and use it for making chemicals. Salt used for making chemicals needs to have a high purity.

The salt deposits are 200 m underground.
Salt can be extracted by two methods.



Method 1
Salt mixed with rocks is dug out from underground and brought up to the surface.

Method 2
Water is heated and pumped into the salt and rock. Salt dissolves and salt solution is pumped back to the surface.

Compare the advantages and disadvantages of each method and explain which would be the best method to extract salt for making chemicals.

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

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..... **[6]**

[Total: 10]

7 Sodium carbonate was used as an alkali before the development of a modern chemical industry.

(a) **(i)** Give **one** example of how alkalis were used before the modern chemical industry developed.

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

(ii) One traditional source of alkalis was from burnt wood.

Name another traditional source of alkalis.

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

(b) In the 19th century sodium carbonate was made in a process which reacted sodium chloride (salt) and sulfuric acid with calcium carbonate (from limestone) and carbon (from coal).

The process had 2 stages

Stage 1:
sodium chloride + sulfuric acid → sodium sulfate + hydrogen chloride

Stage 2:
sodium sulfate + calcium carbonate + carbon → sodium carbonate + calcium sulfide + carbon dioxide

(i) The process makes unwanted waste products that may cause harm to the environment.

One of these waste products is hydrogen chloride.

Name two **other** waste products that are made.

1 .....

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

(ii) Waste hydrogen chloride from the process can be oxidised to make a useful chemical.

Give the name of this useful chemical and explain why it is useful.

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

[Total: 6]

8 PVC is a polymer that used to be used to make shoes and clothing.

(a) The chemical name for PVC is polychloroethene.
Name the elements in PVC.

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

(b) Plasticised PVC contains plasticisers to make it suitable for making clothing.
Plasticisers change the properties of polymers.

(i) Explain how and why plasticisers change the properties of polymers.

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..... **[3]**

(ii) Some countries have banned the use of plasticised PVC for making containers for food or drinks.

Explain why polymers that contain plasticisers are not considered to be safe for making containers for food or drink.

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

[Total: 7]

END OF QUESTION PAPER

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).

The Periodic Table of the Elements

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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.