

Thursday 18 May 2017 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A/SCIENCE A**

A171/02 Modules C1 C2 C3 (Higher Tier)

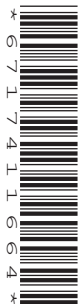
Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
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Centre number							Candidate number				
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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.

.....

.....

..... [2]

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.

.....

 [2]

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

.....
 [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.

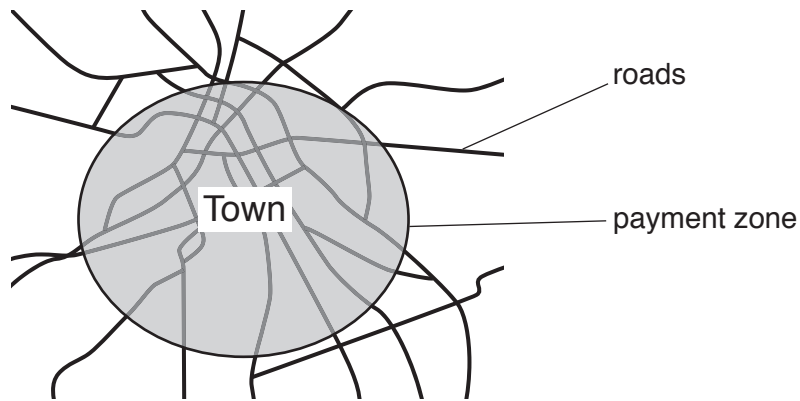
Complete the diagram to show the missing molecules.

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.

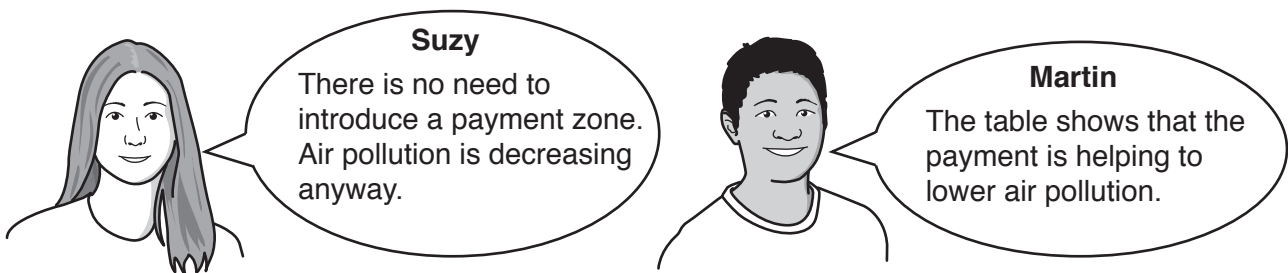
Alex measured the amount of pollutants in the air inside the payment zone and outside the payment zone.

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 $\mu\text{g}/\text{m}^3$	Daily mean amount after the payment was introduced in $\mu\text{g}/\text{m}^3$	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.

.....

.....

.....

.....

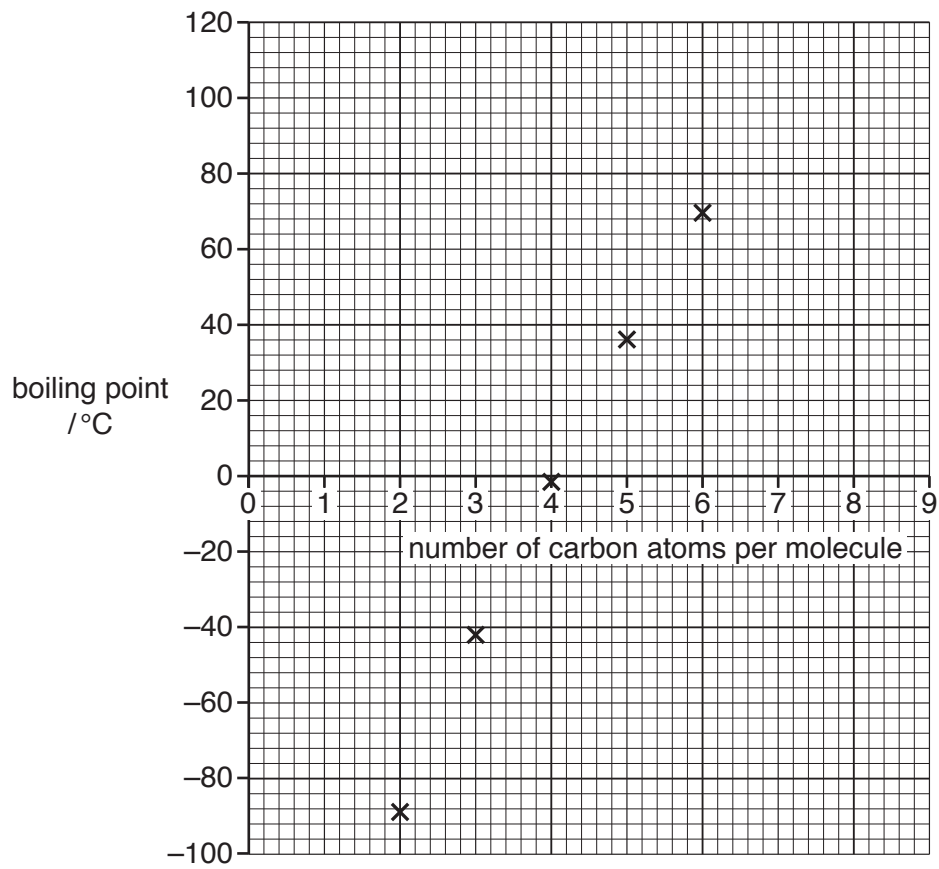
..... [3]

[Total: 9]

Turn over

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.

..... [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.

.....

.....

.....

..... [3]

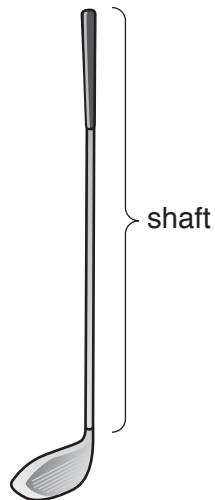
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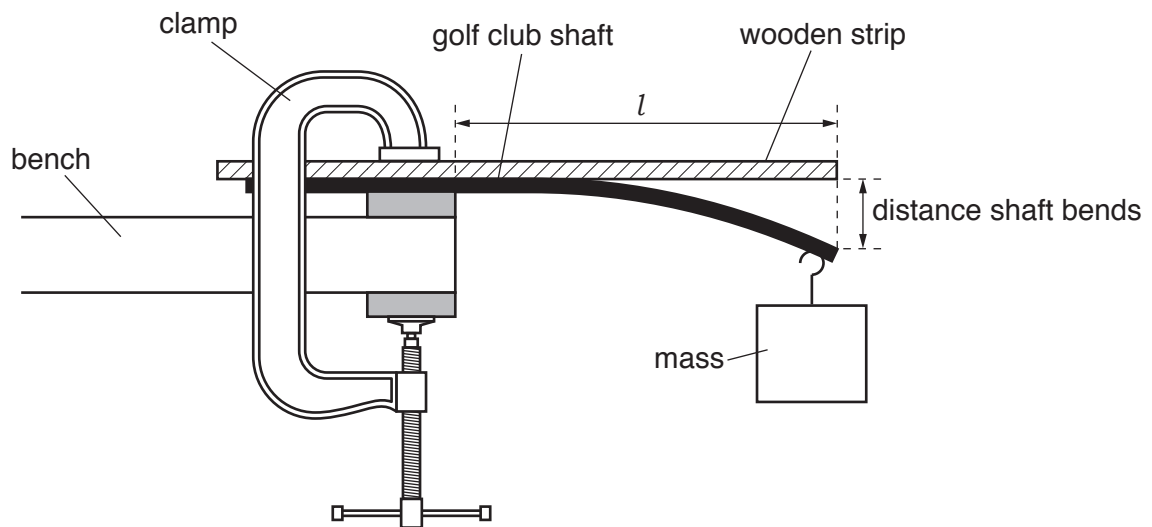
5 Chris works for a company that makes golf clubs.

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.

.....

.....

.....

..... [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.

.....

.....

..... [3]

[Total: 8]
Turn over

12
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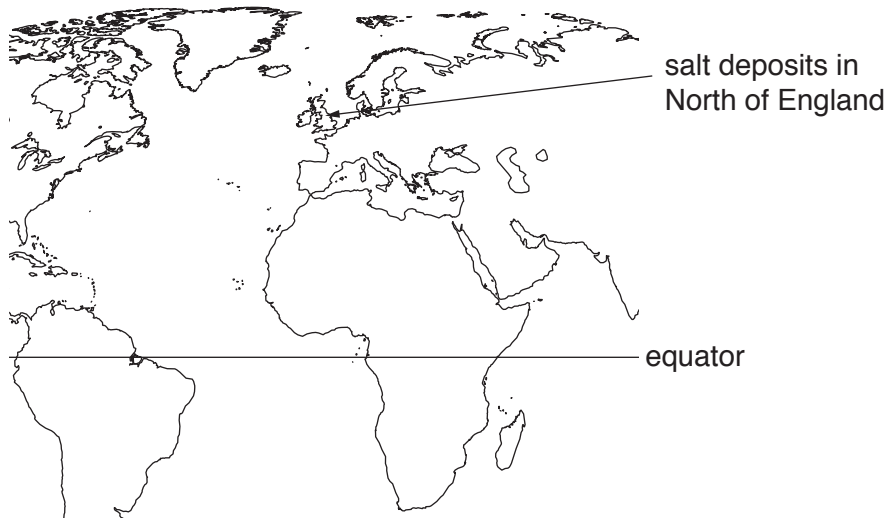
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6 Large salt deposits are found deep underground in some parts of the World.

(a) Describe how these salt deposits formed.

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

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

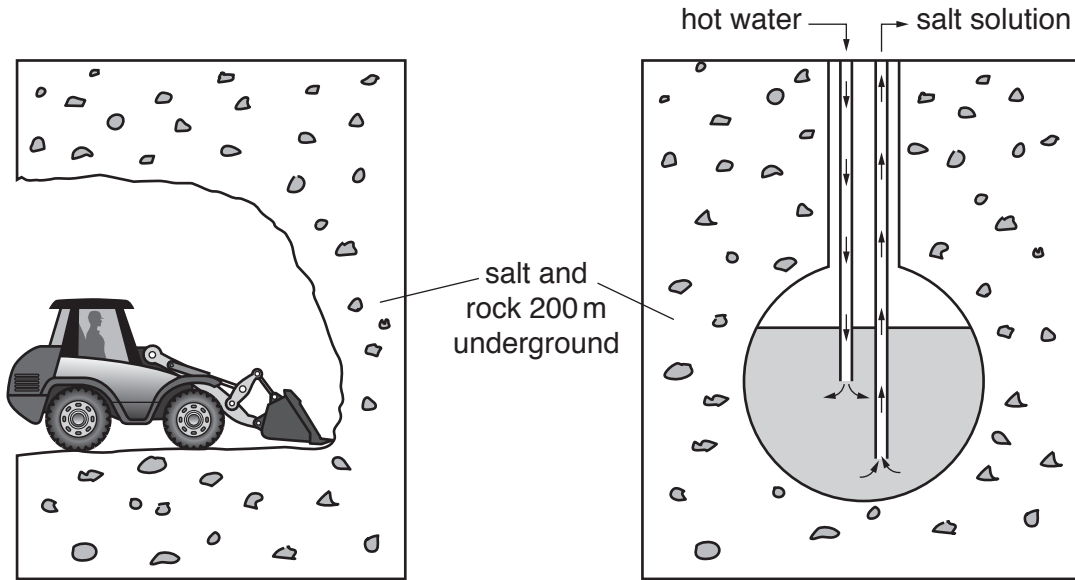


Suggest how the salt deposits came to be in the North of England if they were formed nearer to the equator.

.....
.....
..... [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.

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.

.....

.....

..... [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.

.....
.....
.....
..... [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.

.....
.....
..... [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).

A large area of lined paper for writing. It consists of horizontal dotted lines spaced evenly down the page. A vertical solid line runs down the left side of the page, creating a margin. The entire area is intended for providing additional answer space.

A large rectangular area with a solid vertical line on the left side and horizontal dotted lines extending across the page, providing a space for writing answers.



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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> 1 H hydrogen 1 </div>					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	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Key relative atomic mass atomic symbol <small>name</small> atomic (proton) number </div>					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.