OCR
Oxford Cambridge and RSA

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Thursday 14 May 2015 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A/SCIENCE A

A171/02 Modules C1 C2 C3 (Higher Tier)

4823811130

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

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. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

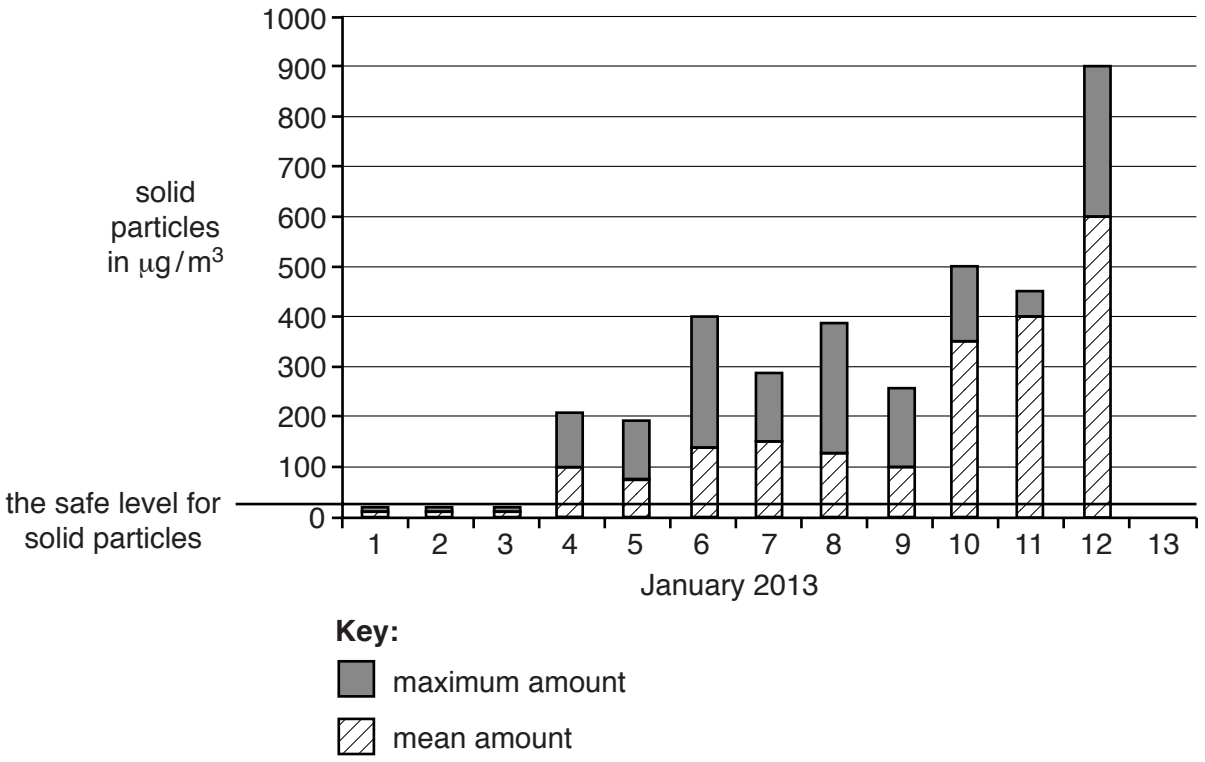
- The quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table is printed on the back page.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Beijing is a city in China where there are many coal-fired power stations.

Coal-fired power stations pollute the air with solid particles.

(a) The chart shows pollution from solid particles in Beijing for the first 12 days of January 2013.



The safe level for solid particles is a daily average of $25\,\mu g/m^3$.
An emergency health warning is triggered when the level of solid particles is greater than $300\,\mu g/m^3$.

(i) Use this information and the chart to find out if these statements are **true** or **false** over these 12 days.

Put ticks (✓) in the correct boxes.

	True	**False**
There are 3 days when the solid particles are **below** the safe level.		
The **maximum** pollution shown on the chart is 36 times the safe level.		
The **mean** is always more than half the **maximum** on any day.		
The level of solid particles triggers an emergency health warning on 6 days.		

[2]

(ii) The table shows solid particles in six samples of air taken on 13th January.

Solid particles in μg/m³	150	200	250	500	400	300

What is the mean of this data?
Show your working.

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

(iii) Use data in the table and your answer to **(ii)** to complete the chart on the **opposite page**.

Show **maximum** and **mean** solid particles for 13th January. **[2]**

(iv) Joe and Tanya look at the chart on the opposite page.
Joe says the chart shows pollution in Beijing is increasing.
Tanya says that the chart does not give enough evidence for this conclusion.

Explain why both Joe and Tanya could be correct.

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

(b) Which of these statements explains why solid carbon particles may be made when coal burns?

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

Sulfur in the coal reacts with carbon. ☐

Coal is mainly carbon atoms. ☐

Coal is made up of carbon and hydrogen atoms. ☐

There is not enough oxygen for all the carbon to react. ☐

Carbon dioxide is reduced by nitrogen in the air. ☐

The hydrogen atoms react more slowly than the carbon atoms. ☐

[2]

[Total: 10]

2 The early atmospheres on Earth and on Mars were similar.
They **both** contained mainly **carbon dioxide** and **water vapour**.

The atmospheres on the two planets are now very different.

The table shows the composition of the atmosphere on Mars now.

Gas	**Composition now (%)**
carbon dioxide	95
oxygen	traces
water vapour	traces
other gases	4

The average surface temperature of Mars is now –55 °C.

Use the information to describe how the atmosphere on Mars has changed. Compare these changes to what has happened to the atmosphere on Earth. Give reasons for the changes to the Earth's atmosphere.

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

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

[Total: 6]

3 Nitrogen dioxide is an air pollutant.

(a) Here are some statements about how cars make nitrogen dioxide.
Not all the statements are correct.

A	Nitrogen from the fuel reacts with oxygen in the air.
B	Nitrogen and oxygen from the air react together.
C	Fuel burning in the engine gives high temperatures.
D	Nitrogen oxide is oxidised in the air.
E	Nitrogen dioxide is reduced by carbon monoxide.
F	Nitrogen oxide is made.
G	Nitrogen dioxide is made.

Choose the **five** correct statements from **A**, **B**, **C**, **D**, **E**, **F** and **G**.

Put these in the correct order in the boxes. One has been done for you.

				G

[3]

(b) Nitrogen dioxide does not stay in the air.

How is nitrogen dioxide removed from the air?

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

It is used by plants to make nitrogen.	
It is oxidised to nitrogen in catalytic converters.	
It reacts with carbon deposited on surfaces.	
It reacts with water and oxygen.	

[1]

[Total: 4]

4 Tennis balls used in competitions must have a similar bounce.
The balls are dropped onto concrete and the height of the bounce is measured.

(a) Why must the tennis balls be dropped onto the same surface?

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

Tennis courts are made of different materials. ☐

Changing the surface affects the outcome. ☐

So that the bounce height can be measured accurately. ☐

So that the balls do not bounce too high. ☐

[1]

(b) Ben needs 120 tennis balls for a local competition.
He measures the bounce of 100 tennis balls.
This is what he finds.

Height of bounce	Number of tennis balls
up to 130 cm	4
131 to 135 cm	16
136 to 140 cm	52
141 to 145 cm	28
146 to 150 cm	0
greater than 150 cm	0

For the competition the bounce range must be between 136 cm and 145 cm.

(i) How many tennis balls would you expect Ben to check before he has 120 suitable for the competition?

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

(ii) Josie watches Ben test the tennis balls.
Josie says he should test each tennis ball more than once.
Is she right? Explain why.

.....

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

(c) The polymer used to make tennis balls has been modified.
It reacts with sulfur to form cross-links.
Plasticisers are added.

How do these modifications affect the properties of the polymer?

Complete the table. Choose from these words.

decreases
increases
stays the same

	Hardness	**Melting point**	**Stiffness**
Cross-linking			
Adding a plasticiser			

[2]

[Total: 6]

Turn over for the next question

5 **(a)** Dave is buying new ropes for his boat.

Look at the properties of four synthetic fibres used to make ropes.

	Kevlar	Nylon	Polyester	Polypropene
Tensile strength in N/mm^2	210	70	70	65
Stiffness in MN m/kg	80	2	3	1
Density in g/cm^3	1.44	1.14	1.38	0.91
Floats on water or sinks	sinks	sinks	sinks	floats
Water absorbency in %	4.5	6.0	0.5	negligible

The best ropes are made from fibres which are strong, flexible and light, even when wet.

Which fibre would make the best rope for Dave's boat?
Use the data to help you explain why you would choose that fibre and not the others.

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

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

(b) In countries where there is no chemical industry, ropes are made from plant material. Suggest reasons why plant material, and not synthetic material, is used to make ropes.

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

[Total: 8]

Turn over for the next question

6 This is a question about crude oil.
Crude oil is separated by fractional distillation.
This is possible because the compounds in crude oil boil at different temperatures.

(a) These sentences are about what happens in fractional distillation.

Which **two** sentences explain why the compounds in crude oil boil at **different** temperatures?

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

Energy is needed to break the molecules.	☐
Energy is needed to heat each compound to its boiling point.	☐
Gas molecules have stronger forces between them than liquid molecules.	☐
Larger molecules have larger forces between them.	☐
More energy is needed to overcome strong forces than weak ones.	☐
The forces between atoms in a molecule depend on the size of that molecule.	☐

[2]

(b) The fractions from crude oil have many **uses**.

Name **two** uses of fractions from crude oil.

1) .....

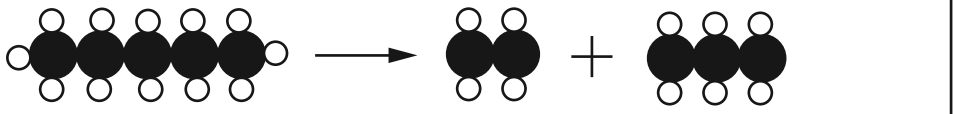
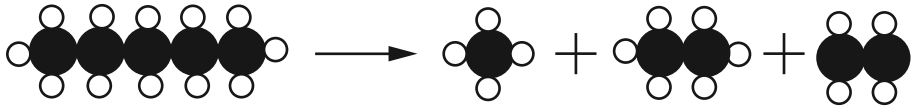
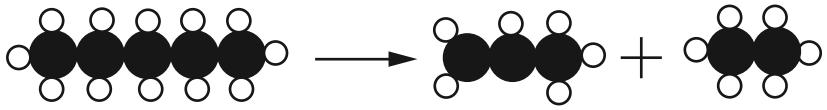
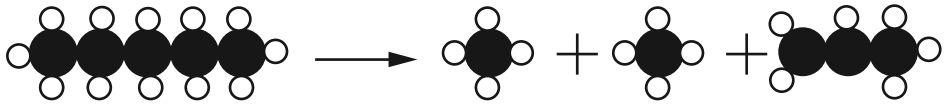
2) .....

[2]

(c) Pentane is a hydrocarbon found in crude oil.
Pentane can be broken up in a refinery.

The diagrams represent the rearrangement of atoms when pentane is broken up.
Only **one** of them is correct.

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

[1]

[Total: 5]

Turn over for the next question

7 The Food Standards Agency (FSA) wants us to eat less salt in our diet.

(a) Why should people eat less salt?

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

(b) **(i)** Most breakfast cereals contain salt.
The table shows the salt content of four brands of breakfast cereals, **A**, **B**, **C** and **D** in 2005 and 2013.

Cereal	Salt content in g per 100 g	
	2005	**2013**
A	2.40	1.20
B	2.60	1.20
C	1.48	0.72
D	0.62	0.30

The Food Standards Agency (FSA) says that the salt in all breakfast cereals is at least 50% lower in 2013 than in 2005.
Use the data to show whether or not the FSA statement is correct for these cereals.

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

(ii) What additional data would you need to increase your confidence that the FSA statement is true?

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

(c) Researchers are developing nanoparticle salt.
Nanoparticle salt tastes 2000 times more salty than ordinary salt.

(i) How many grams of nanoparticle salt will be in 100 g of cereal **A** to give the same flavour as in 2013?

Put a (ring) around the correct answer.

2.4×10^{-3} 6.0×10^{-3} 6.0×10^{-4} 2.4×10^{-5} 6.0×10^{-5}

[1]

(ii) Some people think nanoparticle salt should replace normal salt.
Other people do not.

Use ideas of risk and benefit to explain why people do not agree about adding nanoparticle salt to food.

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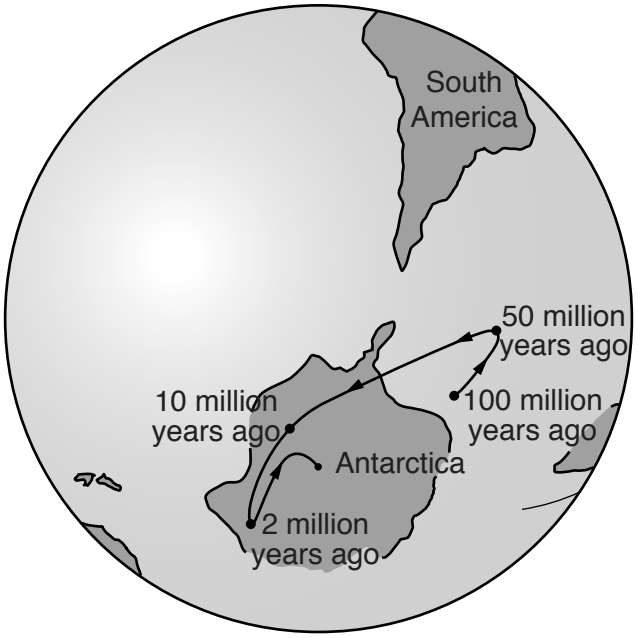
..... **[2]**

[Total: 9]

Turn over for the next question

8 The diagram shows the position of Antarctica today.



The line shows how Antarctica has moved across the surface of the Earth over the past 100 million years.

(a) Geologists use data on the direction of magnetism of some rocks to show movement of continents.

Explain how geologists would use this data to show the movement of Antarctica.

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

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

(b) How do continents such as Antarctica move over the surface of the Earth?

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

Sediment is laid down over millions of years.	☐
Continents are parts of tectonic plates.	☐
There are hot-water springs on the ocean floor where tectonic plates meet.	☐
Earthquakes and volcanoes occur at the edges of tectonic plates.	☐
Tectonic plates move.	☐

[2]
[Total: 8]

9 Mercury has been used in the chemical industry for hundreds of years.
Nowadays its use is strictly regulated because it is toxic.

(a) How do some toxic chemicals cause environmental and health problems?

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

(b) Mercury was known to harm humans 150 years ago.
It was widely used until very recently.

Suggest reasons why people continued to use mercury even though they knew it was harmful.

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..... **[2]**
[Total: 4]

END OF QUESTION PAPER

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.