Candidate forename					Candidate surname				

Centre number					Candidate number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE

A171/02

TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A

Modules C1 C2 C3 (Higher Tier)

WEDNESDAY 18 JANUARY 2012: Morning
DURATION: 1 hour

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

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

- Where you see this icon you will be awarded marks for the quality of written communication in your answer.

- The Periodic Table is provided.

- 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>.

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1 **Scientists measure the concentration of particulates in the air in a town centre.**

They do this on several days.

They also count the number of people seeking medical attention for asthma on the same days.

They plot their results on a scatter graph.

number of people seeking medical
attention for asthma

concentration of particulates
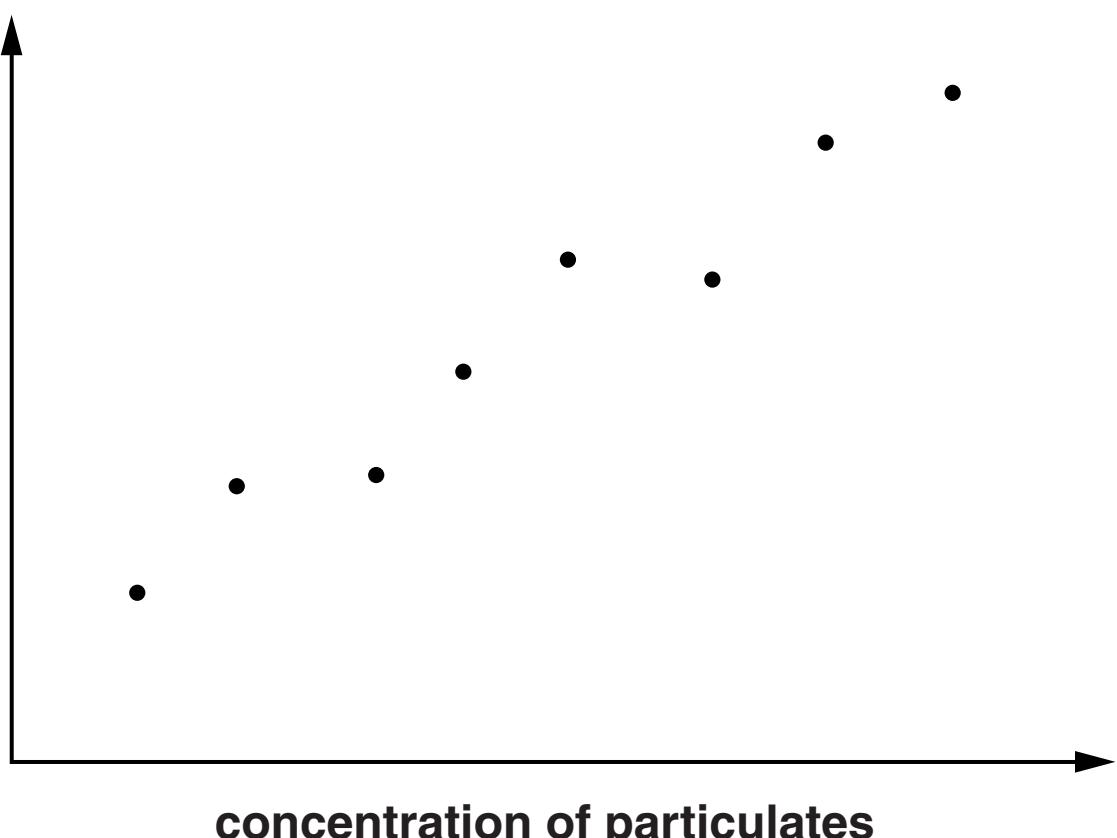
(a) **The data show a correlation.**

Describe this correlation.

_____

_____ **[1]**

(b) A journalist talks to the scientists about their data before it is published.

The journalist writes a newspaper article using the scientists' data.

The article makes this claim.

'Asthma is caused by particulates in the air'.

How much confidence can be placed in the newspaper claim?

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

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(c) The particulates that pollute the air are made of carbon.

Explain how carbon particulates get into the air.

Use ideas about the combustion of fuels in motor vehicles.

_____

_____

_____

_____ **[3]**

(d) Carbon particulates do not remain in the air.

(i) What happens to these particulates?

_____ **[1]**

(ii) How could you see that this has happened in the town?

_____

_____ **[1]**

[Total: 12]

2 Scientists analyse samples of dry air from a town centre.

They find the concentration of nitrogen dioxide.

They take eight samples at different times during one day.

Their results are shown in the table opposite.

NITROGEN DIOXIDE CONCENTRATION IN µg/m^3

sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	sample 7	sample 8
38	42	41	39	42	38	43	40

(a) In the UK the concentration of nitrogen dioxide in the air should not be more than 40 µg/m^3.

Use a best estimate to decide whether the true value was above the UK concentration limit on this day. Explain how much confidence the data give you that your decision is correct.

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

_____

_____

_____

_____

_____

_____

_____ **[6]**

(b) Which two chemicals does nitrogen dioxide react with to form acid rain?

_____ **and**

_____   **[1]**

(c) Most of the nitrogen dioxide in the air is from the burning of fuels in car engines.

Look at these statements.

A Oxygen from air reacts with nitrogen from petrol to make nitrogen monoxide.

B Oxygen and nitrogen from air react to make nitrogen monoxide.

C Oxygen and nitrogen from air react to make nitrogen dioxide.

D Nitrogen dioxide is given out from the car exhaust.

E Nitrogen monoxide reacts with oxygen in air to make nitrogen dioxide.

F Nitrogen monoxide is given out from the car exhaust.

Which three statements, WHEN TAKEN TOGETHER, explain how this nitrogen dioxide is made?

Write the letters for these statements IN THE CORRECT ORDER in the boxes.

|		

[3]

[Total: 10]

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3 **A company wants to manufacture plastic rulers.**

Scientists test sample rulers made from four different polymers that the company could use.

They use this apparatus.
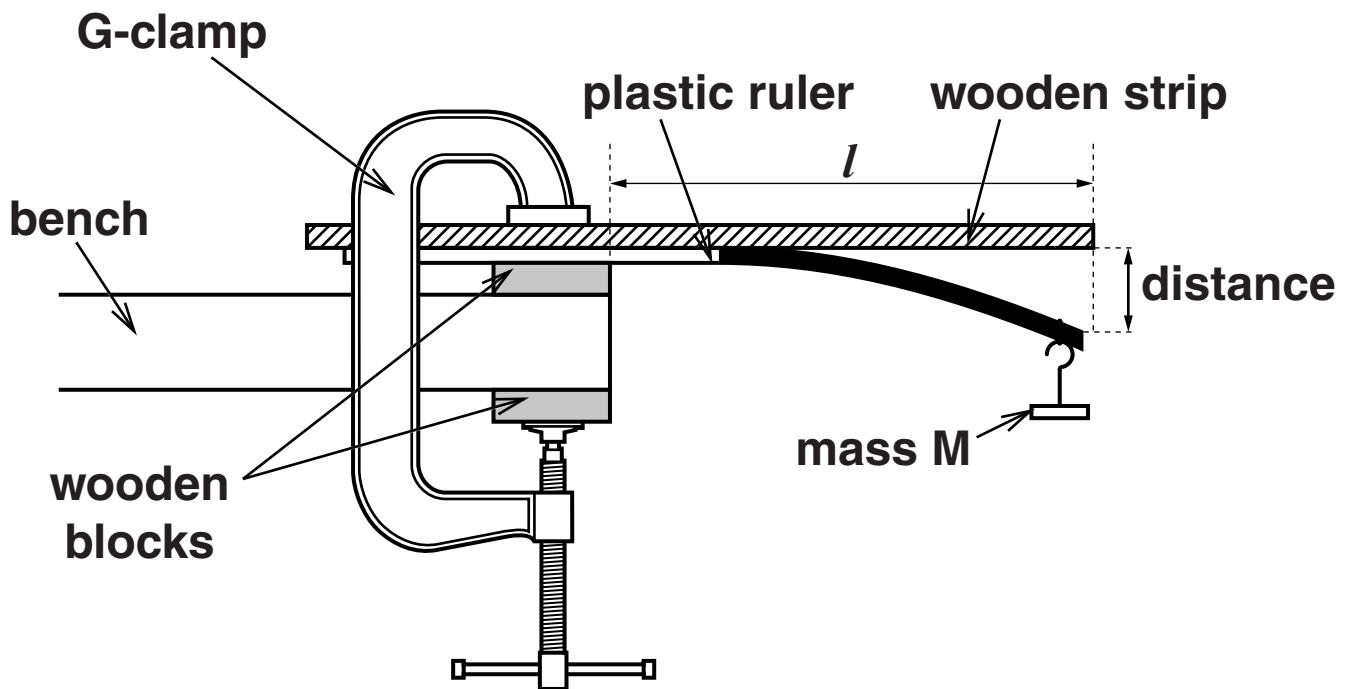
The scientists hang a mass, M, from the end of each sample.

They measure the distance that each ruler bends.

Their results are shown in the table opposite.

DISTANCE THE RULER BENDS IN mm

	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	best estimate
polymer A	23	25	27	38	24	26	25
polymer B	12	11	13	11	10	11	11
polymer C	38	40	42	37	38	39	39
polymer D	69	66	42	45	43	42	43

15

(a) Which property of the polymers is being measured in this experiment?

Put a (ring) around the correct answer.

DENSITY

HARDNESS

STIFFNESS

STRENGTH

[1]

(b) The scientists calculate the best estimate for polymer A.

They do NOT use the result for sample 4.

Explain how they could justify this decision.

_____

_____

_____ [2]

(c) (i) Polymer A and polymer B are made from the same monomers.

One polymer is MORE CRYSTALLINE than the other.

Use the data in the table to compare the two polymers and explain why their properties are different.

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

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

(ii) Which of the following could also cause the difference in properties between polymer A and polymer B?

Put ticks (✔) in the boxes next to the correct answers.

Polymer A has fewer cross-links than polymer B. ☐

Polymer A has less plasticizer than polymer B. ☐

Polymer A has shorter chains than polymer B. ☐

[1]

(d) Which of the four polymers would be the best choice for making rulers?

Explain your choice.

_____

_____ [1]

(e) The first two samples for polymer D are faulty.

Suggest one way that the polymerisation process could have gone wrong to cause the fault.

_____ [1]

(f) The company originally made their rulers from wood.

What are the advantages of using plastic instead of wood?

_____

_____

_____ **[2]**

[Total: 14]

4 **Many new products involve the use of nanotechnology.**

(a) Explain the meaning of the term NANOTECHNOLOGY.

_____

_____

_____ **[2]**

(b) (i) State one example of the use of nanoparticles to improve the properties of a product.

_____ **[1]**

(ii) How does this improve the product?

_____

_____ **[1]**

(c) Nanoparticles are used in a wide variety of products.

Some scientists are worried about this.

Which two statements give reasons for their concern?

Put ticks (✔) in the boxes next to the TWO correct answers.

Nanoparticles do not occur in nature. ☐

Nanoparticles have a smaller surface area than larger particles. ☐

The effects of nanoparticles have not yet been fully investigated. ☐

Nanoparticles are larger than 1000 nm. ☐

Nanoparticles may be harmful to health. ☐

Nanoparticles are too small to be seen by the unaided eye. ☐

[2]

[Total: 6]

5 A new chemical industry developed in the North West of England because large deposits of salt (sodium chloride) were found buried underground.

(a) Describe how these salt deposits were formed elsewhere and how they came to be buried in the North West of England.

_____

_____

_____

_____

_____

_____

_____ **[4]**

(b) Sodium chloride can be used to make sodium carbonate, a valuable chemical.

In the 19th century sodium carbonate was made by the Leblanc process.

This process has two stages

- sodium chloride reacts with sulfuric acid to make sodium sulfate and hydrogen chloride gas

- sodium sulfate reacts with calcium carbonate and carbon to make sodium carbonate, calcium sulfide and carbon dioxide.

(i) The Leblanc process caused a great deal of pollution to the local area.

Which of these statements explain why?

Put ticks (✔) in the boxes next to the TWO best answers.

Sulfuric acid is a strong acid that harms living things. ☐

Hydrogen chloride is an acidic gas that is very harmful. ☐

Sodium sulfate is a poisonous chemical. ☐

The carbon used was in the form of coke. ☐

Calcium sulfide is a solid waste that gives off poisonous hydrogen sulfide gas. ☐

Carbon dioxide is an acidic gas that is toxic. ☐

[2]

(ii) Pollution problems can sometimes be solved by turning waste materials into useful chemicals.

One of the waste materials from the Leblanc process was used to make the useful chemical chlorine.

Which waste material was this?

_____ [1]

(iii) Sodium carbonate reacts with sulfuric acid.

What are the three products of this reaction?

1 _____

2 _____

3 _____ [3]

[Total: 10]

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6 **Typhoid is a disease that can be spread through contaminated drinking water.**

The chart shows the incidence of typhoid in a city from 1910 to 1960.

typhoid cases per thousand population
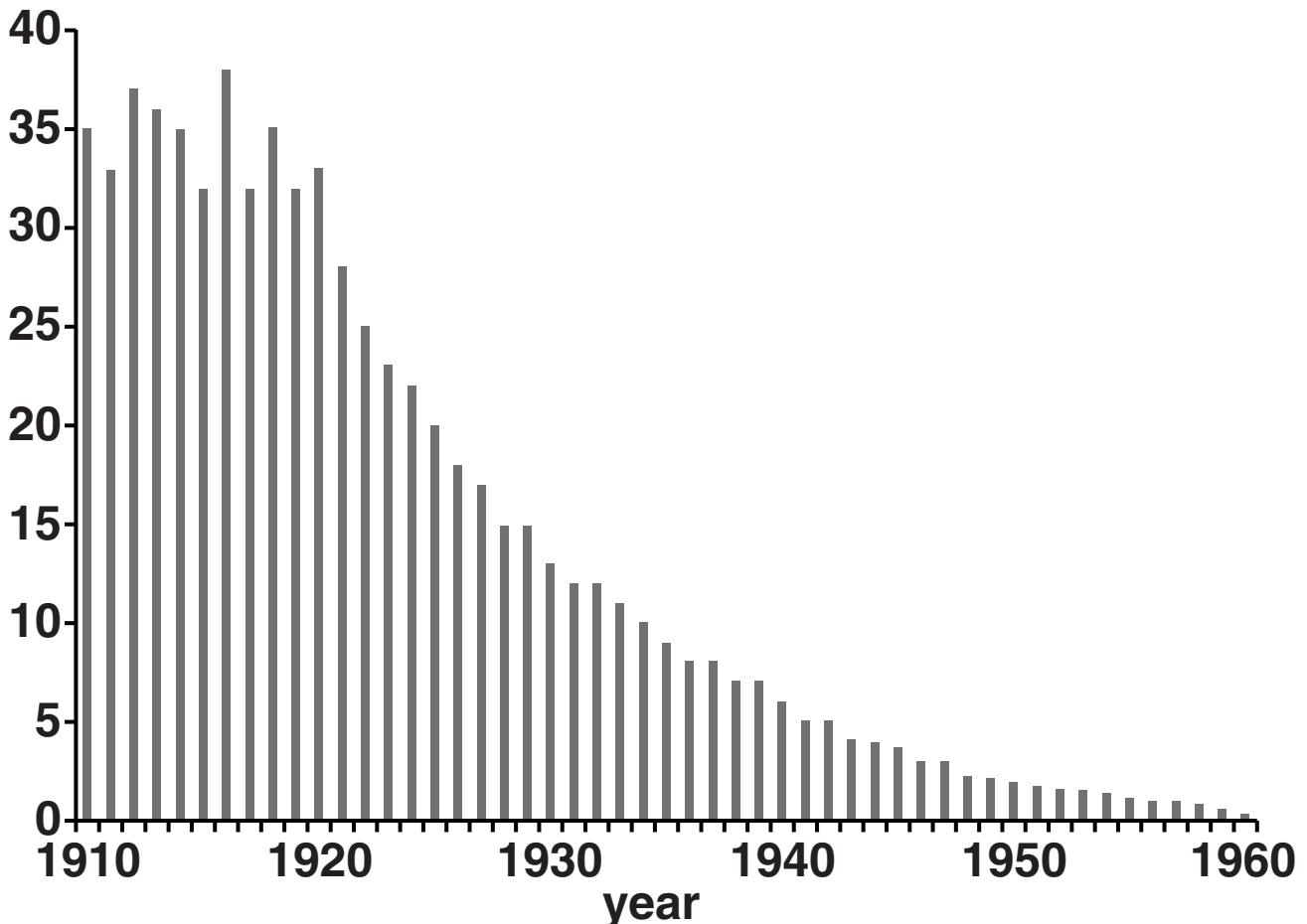
The city began to chlorinate its water supply in 1920.

(a) **Describe and explain how the incidence of typhoid in this city changed from 1910 to 1960.**

_____

_____

_____

_____

_____

_____ **[4]**

(b) **Chlorination has helped to stop typhoid infections.**

Now some people are worried about harmful side effects of chlorination.

(i) **Explain one possible harmful side effect of chlorination.**

_____

_____

_____ **[2]**

(ii) Chlorination of drinking water should be continued despite possible harmful side effects.

Which two statements explain why?

Put ticks (✔) in the boxes next to the TWO correct answers.

Chlorine is a very poisonous chemical. ☐

Diseases spread by other methods, not just through drinking water. ☐

There is a high risk of death from some of the diseases spread through drinking water. ☐

Incidence of typhoid is very rare in industrialised countries. ☐

The harmful side effects of chlorination pose only a small risk to health. ☐

[2]

[Total: 8]

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
																		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.