

Wednesday 18 January 2012 – Morning

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A171/02 Modules C1 C2 C3 (Higher Tier)

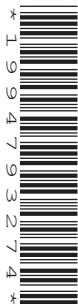
Candidates answer on the Question Paper.
A calculator may be used for this paper.

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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MODIFIED LANGUAGE

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

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

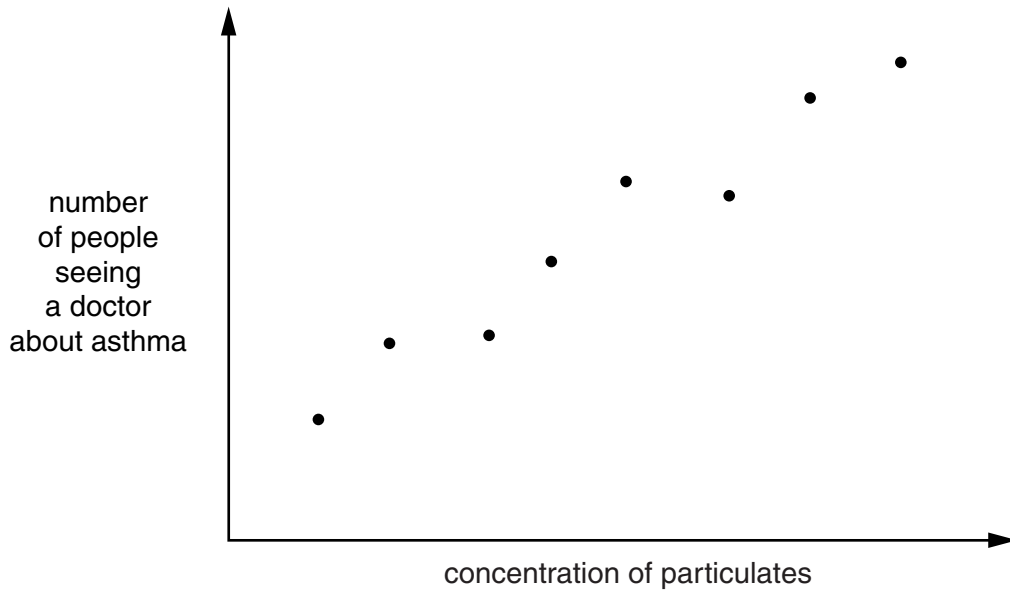
Answer **all** the questions.

1 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 seeing a doctor about asthma on the same days.

They plot their results on a scatter graph.



(a) The data show a correlation.

Describe this correlation.

.....

..... [1]

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.

nitrogen dioxide concentration in $\mu\text{g}/\text{m}^3$							
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 $40\ \mu\text{g}/\text{m}^3$.

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.

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..... [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.

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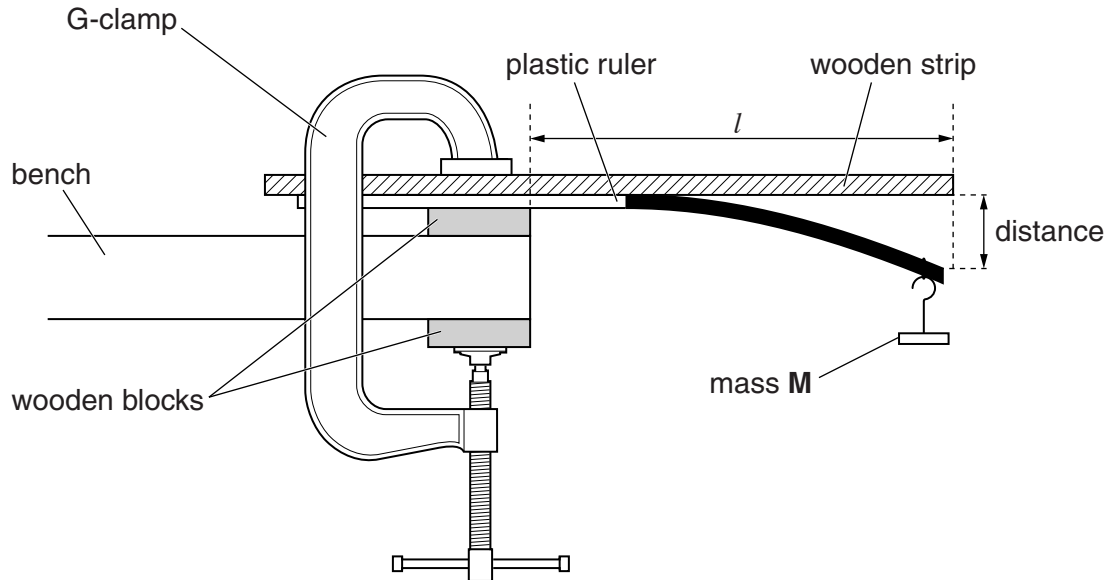
[3]

[Total: 10]

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.

	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

(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.

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..... [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**.

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..... [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 many different 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 were buried in the North West of England.

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..... [4]

(b) Sodium chloride can be used to make sodium carbonate, which is 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 lot 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

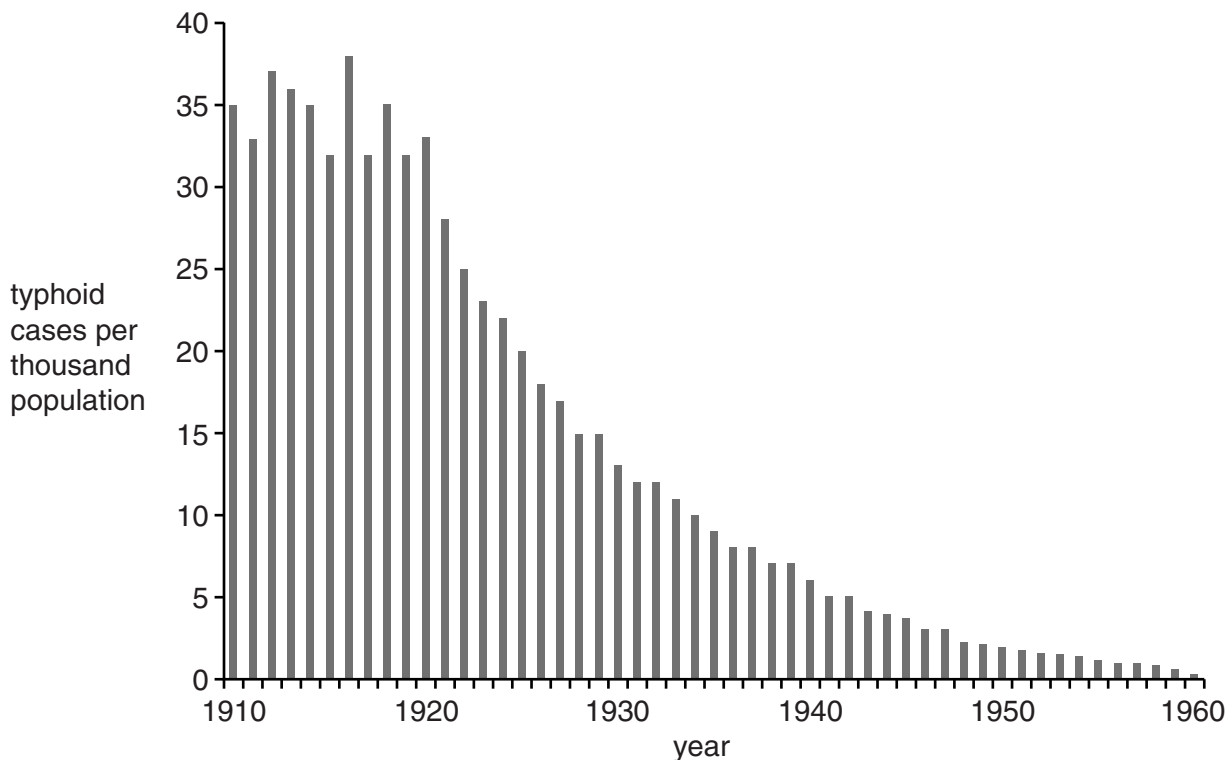
3

[3]

[Total: 10]

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

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



The city began to chlorinate its water supply in 1920.

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

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..... [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.

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..... [2]

(ii) Even though there are possible harmful side effects, chlorination of drinking water should be continued.

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.
- The number of typhoid cases is very rare in industrialised countries.
- The harmful side effects of chlorination bring only a small risk to health.

[2]

[Total: 8]

END OF QUESTION PAPER

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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	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18								
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27	30 Ni nickel 28	31 Cu copper 29	32 Zn zinc 30	33 Ga gallium 31	34 Ge germanium 32	35 As arsenic 33	36 Se selenium 34	37 Br bromine 35	38 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Cd cadmium 48	48 In indium 49	49 Sn tin 50	50 Sb antimony 51	51 Te tellurium 52	52 I iodine 53	53 Xe xenon 54	54 Rn radon 86
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 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						

1	H hydrogen 1
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relative atomic mass
atomic symbol
name
atomic (proton) number

Key

* 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.