

**Wednesday 18 January 2012 – Morning**

**GCSE TWENTY FIRST CENTURY SCIENCE  
CHEMISTRY A**

**A171/02** Modules C1 C2 C3 (Higher Tier)

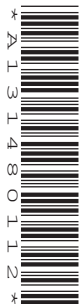
Candidates answer on the Question Paper.  
A calculator may be used for this paper.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** 1 hour




Candidate forename		Candidate surname	
-----------------------	--	----------------------	--

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**

-  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.

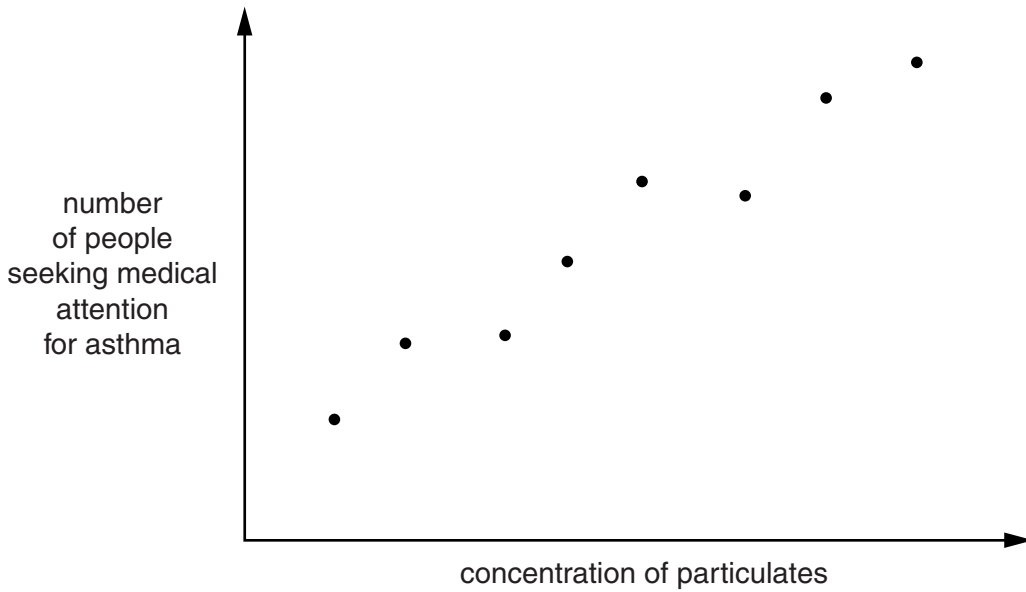
Answer **all** the questions.

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 seeking medical attention for 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.*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [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.

--	--	--

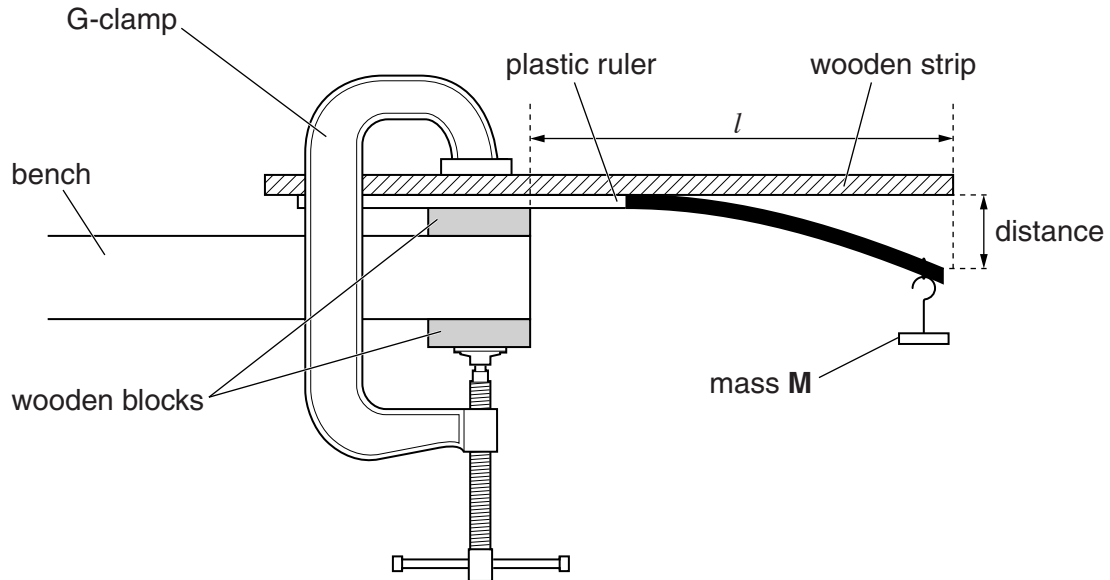
[3]

[Total: 10]

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.*

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

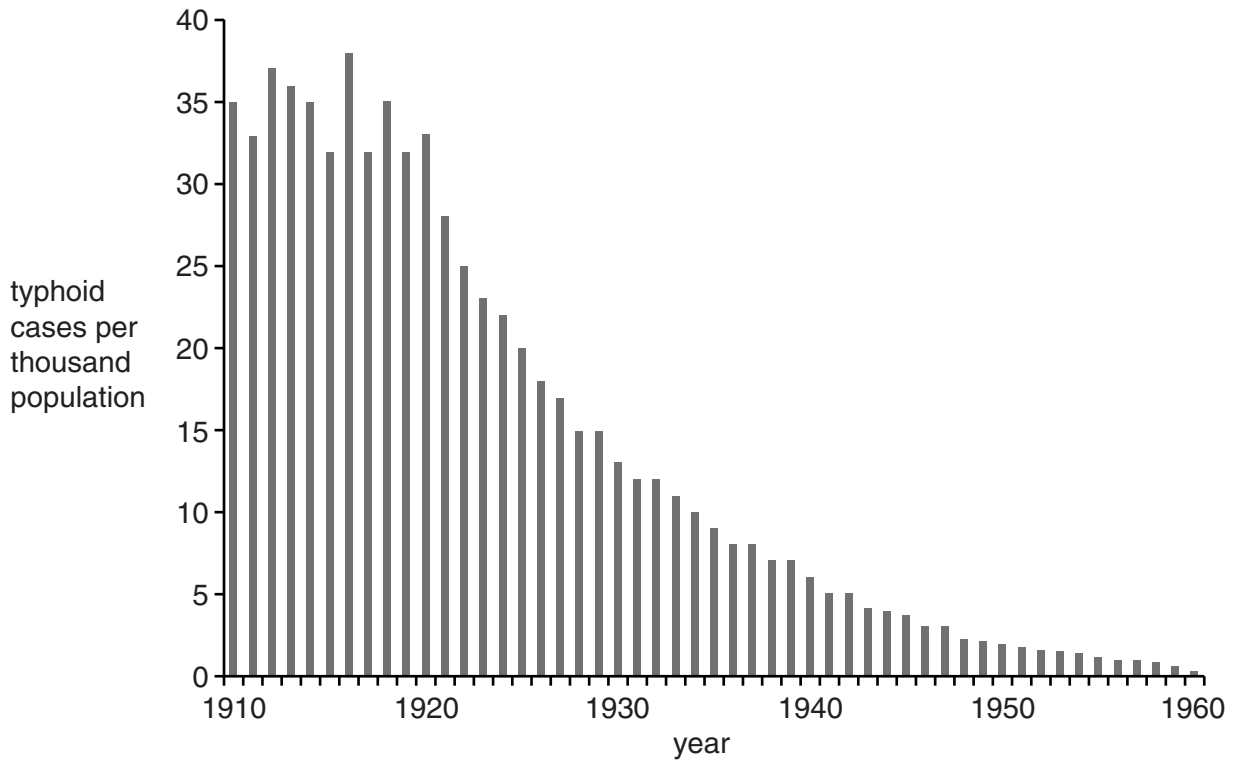
3 .....

[3]

[Total: 10]

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.



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**

**PLEASE DO NOT WRITE ON THIS PAGE**

**PLEASE DO NOT WRITE ON THIS PAGE**



**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

# 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	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	59 Co cobalt 27	65 Zn zinc 30	
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	103 Rh rhodium 45	112 Cd cadmium 48	
133 Cs caesium 55	137 Ba barium 56	139 La* lanthanum 57	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	192 Ir iridium 77	201 Hg mercury 80	
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[268] Mt meitnerium 109	207 Pb lead 82	
			[98] Tc technetium 43	55 Mn manganese 25	56 Fe iron 26	59 Ni nickel 28	63.5 Cu copper 29	
			101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	115 In indium 49	119 Sn tin 50	
			190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	204 Tl thallium 81	207 Pb lead 82	
			[277] Hs hasmium 108	[277] Hs hasmium 108	[271] Ds darmstadtium 110	[209] Po polonium 84	[222] Rn radon 86	
			[272] Rg roentgenium 111	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated			[210] At astatine 85

1  
H  
hydrogen  
1

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.