

Thursday 17 January 2013 – Afternoon

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A171/01 Modules C1 C2 C3 (Foundation 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. 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.

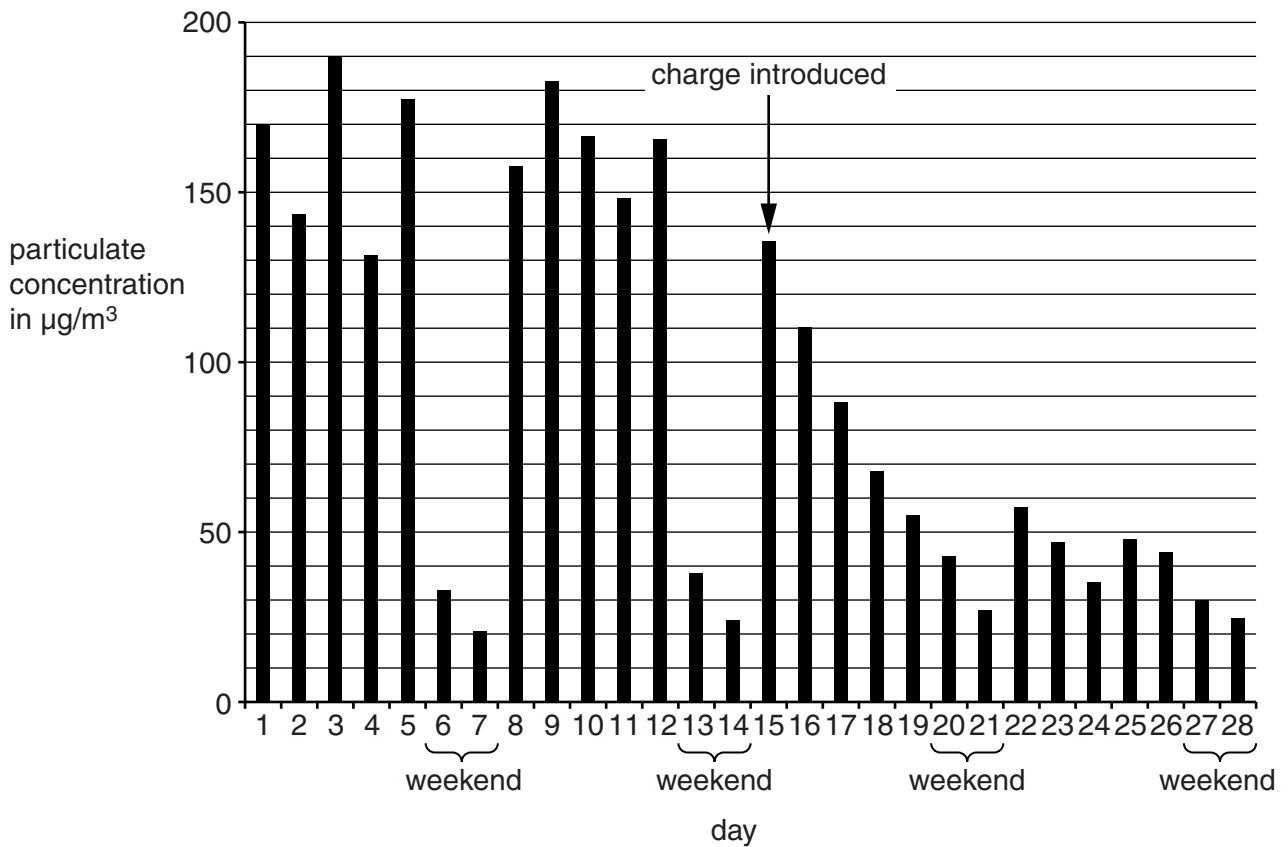
- 1 A town council decided to make drivers pay a charge for each vehicle entering the town on weekdays (Monday to Friday).

The council did this to reduce air pollution. Scientists were asked to see if this did reduce air pollution.

They made measurements for 14 days before the charge was introduced.

They continued to make measurements for 14 days after the charge was introduced.

The scientists recorded the average concentration of particulates in the air for each day.



- (a) (i) What was the highest particulate concentration measured during the 28 days?

highest particulate concentration = µg/m³ [1]

- (ii) The World Health Organisation limit for particulate concentration is 150 µg/m³.

On how many days was the particulate concentration higher than this?

number of days = [1]

(b) (i) Was the town council right to introduce the vehicle entry charge?

Use the graph to explain your answer.

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..... [3]

(ii) Suggest why the introduction of the vehicle entry charge caused a change in the particulate concentration in the town centre.

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..... [2]

(c) Complete these sentences about burning hydrocarbons.

Use words from the list.

- carbohydrate carbon dioxide carbon monoxide
- nitrogen oxygen water

During the **complete** combustion of a hydrocarbon the hydrogen burns to make and the carbon burns to make

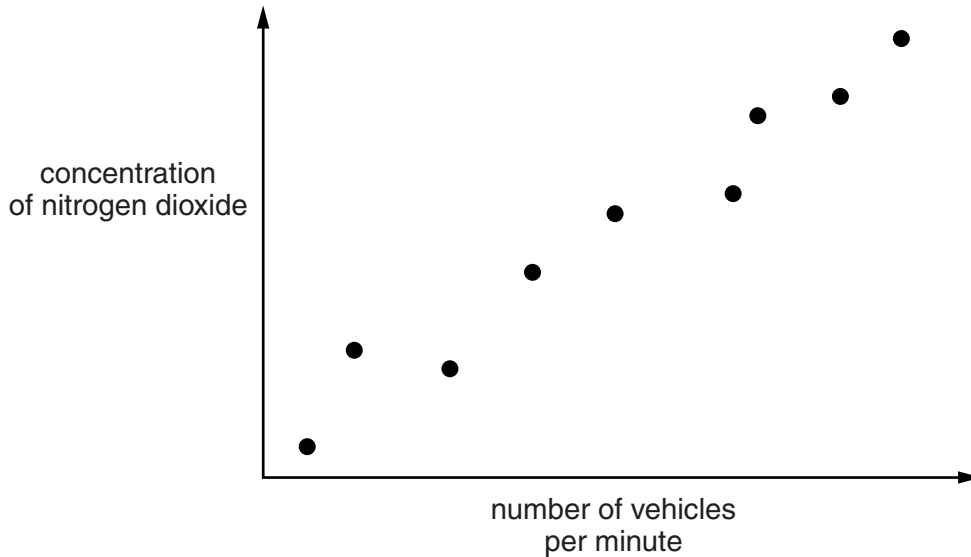
During **incomplete** combustion some of the carbon does not join with

.....

Instead it forms solid carbon particulates. [2]

[Total: 9]

2 Scientists measure the nitrogen dioxide concentration in the air next to a motorway. They sample the air at nine different times. At the same times they measure the number of vehicles per minute passing along the motorway. Their results are shown in the graph.



(a) The graph shows the relationship between nitrogen dioxide pollution and the number of vehicles per minute.

Use your knowledge of the reactions in a car engine to describe and explain this relationship.



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

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[6]

(b) At each time the scientists measure six samples of air.

They work out the mean value of these measurements.

The table shows the results from one set of six samples.

Sample number	1	2	3	4	5	6	mean
Nitrogen dioxide concentration in $\mu\text{g}/\text{m}^3$	123	122	120	121	124	122	122

(i) Why is it an advantage to take six samples rather than one?

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.....

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..... [2]

(ii) The true value for the nitrogen dioxide concentration lies within a range of values.

According to the results in the table, what is this range?

range = from to $\mu\text{g}/\text{m}^3$ [1]

(c) The scientists take measurements next to a different motorway.

Their results are different from those shown in the graph.

Suggest reasons for this difference.

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..... [3]

[Total: 12]

3 Crude oil is a mixture of hydrocarbons.

(a) Crude oil is refined to make chemicals that are used in different ways.

One way they are used is as raw materials, for example to make polymers.

Write down **two other** ways that chemicals from refined crude oil are used.

1

2

[2]

(b) Some hydrocarbons boil at higher temperatures than others.

Explain why.

Use ideas about the length of molecules and the forces between them.

.....

.....

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..... [2]

(c) Some of the chemicals from crude oil are polymerised to make polymers.

Which of these statements describe polymerisation?

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

Large molecules are broken down to make smaller ones.

Hydrocarbons are burned to release energy.

Many small monomer molecules join together.

Monomer molecules are separated.

Large molecules with long chains of atoms are made.

[2]

(d) Modern synthetic materials have replaced some materials that were used in the past.

Give one example of an object that is now made from a better synthetic material.

object

old material

new material

[2]

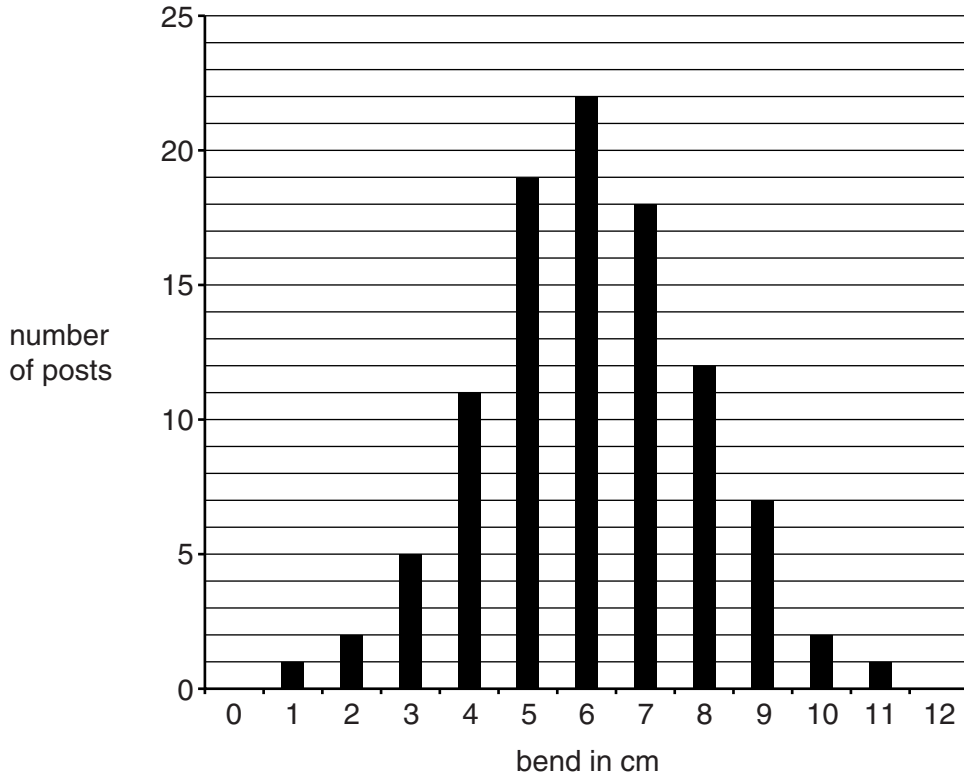
[Total: 8]

4 A company decides to make fence posts from a plastic.

The company makes and tests 100 fence posts with the same size and shape.

They measure how far each post bends under the same conditions.

The bar chart shows their results.



(a) (i) In the test, how many posts bent 9 cm or more?

..... [1]

(ii) The company wants to make 500 posts each day.

They will not sell posts that bend 9 cm or more.

How many posts will they reject each day?

Show your working.

number of posts rejected = [2]

(b) The polymer used to make the posts has a wide range of flexibility.

Which statements give an explanation for this?

Put ticks (✓) in the boxes next to the **two** best statements.

The polymer does not have any cross-linking.

Plasticizer has mixed unevenly in the polymer.

Only one type of monomer has been used to make the polymer.

Too much plasticizer has been added to the polymer.

Different batches of the polymer have different chain lengths.

All of the polymer molecules are very long.

[2]

Question 4 continues on the next page

- (c) The company decides that the plastic they have is too flexible and has too large a range of flexibility.

Technicians test small pieces of three other plastics.

All the samples used have exactly the same size.

They measure how far each sample bends under the same conditions.

Their results are shown in the table.

Sample number	Distance sample bends in mm						mean
	1	2	3	4	5	6	
Plastic A	35	33	35	34	34	33	34
Plastic B	14	13	14	15	13	15	14
Plastic C	10	18	12	14	17	13	14

Describe the advantages and disadvantages of each plastic for making fence posts.

Which plastic would you choose and why?



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

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[Total: 11]

5 (a) The Life Cycle Assessment of a product can be divided into four stages.

These stages are shown below, but are in the wrong order.

- A using the product
- B making the product from the material
- C disposing of the product
- D making the material from raw materials

Write the letters **A**, **B**, **C** and **D** for the four processes in the correct order in the boxes.

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[2]

(b) Scientists compare the environmental impact of three types of disposable grocery bag.

They do this by carrying out a Life Cycle Assessment (LCA) for each type of bag.

They compare bags made of paper, biodegradable plastic and polythene.

The results for each whole LCA are shown in the table.

	Totals for 1000 bags for the whole LCA		
	paper	biodegradable plastic	polythene
Energy use (MJ)	2620	2070	763
Fossil fuel use (kg)	23.2	41.5	14.9
Municipal solid waste (kg)	33.9	19.2	7.0
Greenhouse gas emissions (kg CO₂)	80	180	40
Fresh water use (litres)	4520	4580	260

(i) Which type of bag uses the **most** energy?

..... [1]

(ii) Which type of bag gives the **least** greenhouse gas emissions?

..... [1]

(iii) A government decides to ban the use of disposable bags made from polythene.

Explain why this data might persuade the government to change this decision.

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..... [2]

(iv) There are other reasons for banning disposable bags made from polythene.

Which two statements, when taken together, give another reason?

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

- Polythene is a polymer.
- Polythene bags may cause litter.
- Polythene is made by joining ethene molecules.
- Polythene bags are expensive.
- Polythene is transparent.
- Polythene takes a long time to decompose.

[2]

(v) Plasticizers are added to polymers to make them more flexible.

Explain why the use of some plasticizers can have a bad environmental impact.

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..... [2]

[Total: 10]

6 (a) Chlorine is added to water before it is supplied to homes and businesses.

Describe and explain the advantages and disadvantages of adding chlorine to water supplies.



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

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..... [6]

Question 6 continues on the next page

(b) Chlorine is made by the electrolysis of sodium chloride solution.

Sodium hydroxide is also made in the electrolysis.

Chlorine and sodium hydroxide must be kept separate during the process.

Two industrial methods can be used for the electrolysis of sodium chloride solution.

Method 1: The mercury cell

- The cell uses mercury.
- The mercury keeps the chlorine and sodium hydroxide separate.
- Mercury is very toxic.
- Some of the mercury is lost from the cell into water supplies.
- The sodium hydroxide made is a concentrated solution.

Method 2: The membrane cell

- Chlorine and sodium hydroxide are kept separate by a membrane.
- No mercury is used.
- Some chlorine leaks into the sodium hydroxide made.
- The sodium hydroxide made is dilute and has to be concentrated by evaporation.

State and explain one disadvantage of each method.

mercury cell

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membrane cell

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[4]

[Total: 10]

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	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Key relative atomic mass atomic symbol name atomic (proton) number </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						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 Ni nickel 28	59 Co cobalt 27	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	106 Pd palladium 46	103 Rh rhodium 45	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	195 Pt platinum 78	192 Ir iridium 77	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	[271] Ds darmstadtium 110	[268] Mt meitnerium 109	[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.