THIS IS A NEW SPECIFICATION

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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

A131470113

A171101

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.

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Answer **all** the questions.

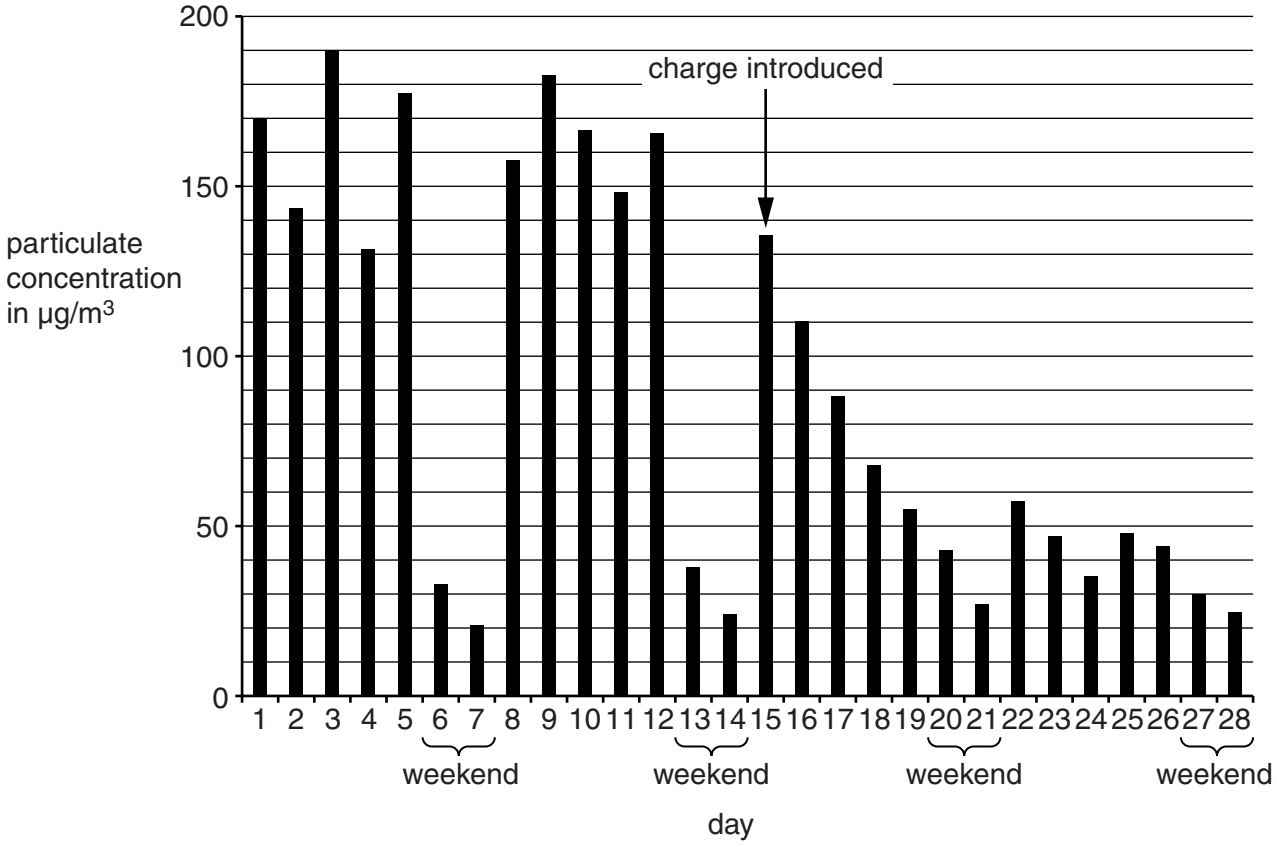
1 A town council decided to make drivers pay a charge for each vehicle entering the town on weekdays (Monday to Friday).

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/m^3 **[1]**

(ii) The World Health Organisation limit for particulate concentration is 150 µg/m^3.

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

number of days = ... **[1]**

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(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]

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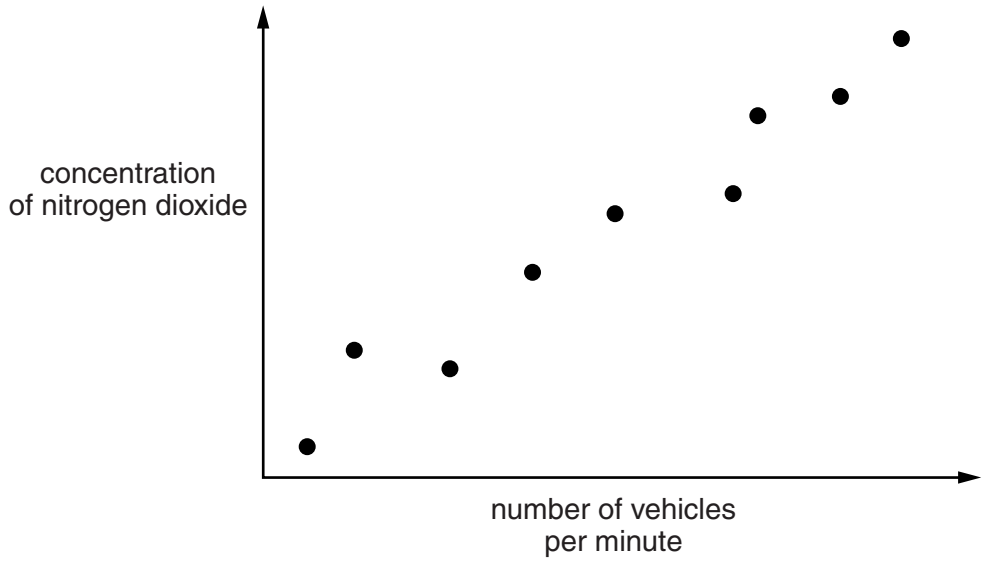
2 Scientists measure the nitrogen dioxide concentration in the air next to a motorway.

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]**

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(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 μg/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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..... **[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 ..... μg/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]

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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.

.....

.....

.....

..... **[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]

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(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]

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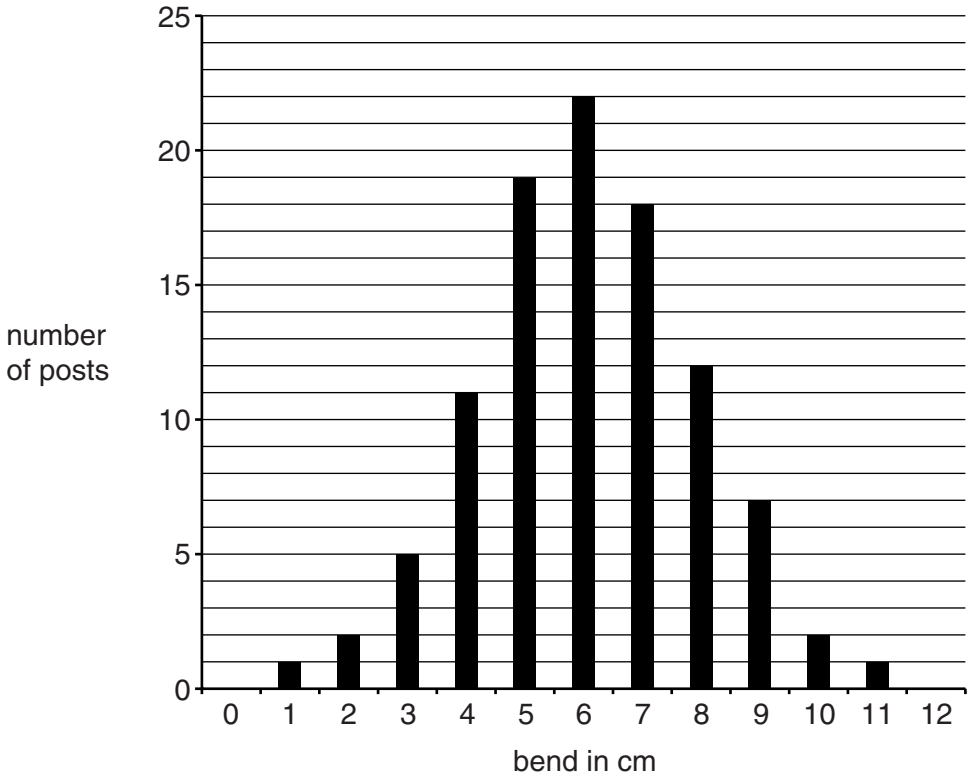
4 A company decides to make fence posts from a plastic.

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]**

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(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

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(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.

	Distance sample bends in mm						
Sample number	1	2	3	4	5	6	mean
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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..... **[6]**

[Total: 11]

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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.

[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 CO_2)	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]**

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(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]

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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

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(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 .....

.....

.....

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
							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.