

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.

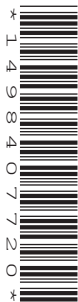
OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour

MODIFIED LANGUAGE




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.

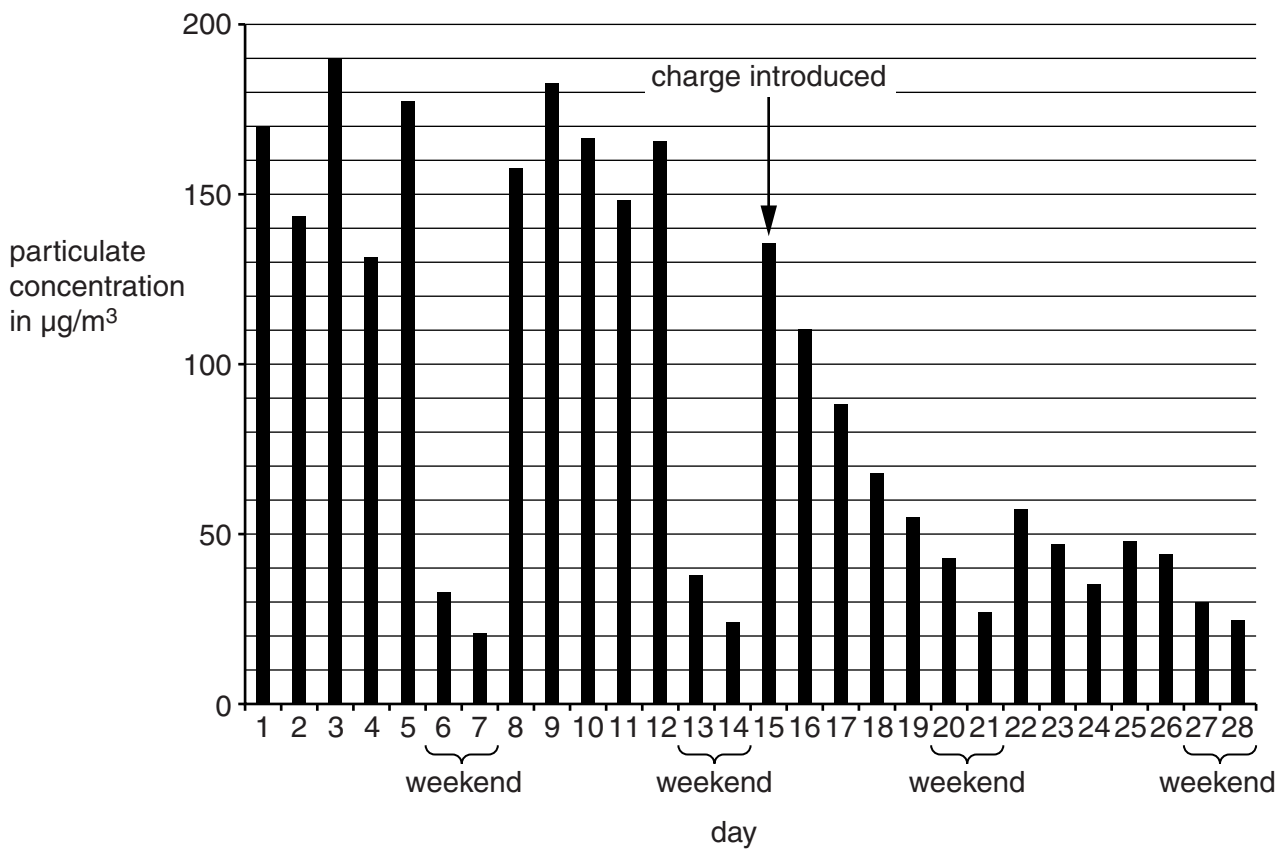
- 1 A town council decided to make drivers pay a fee for each vehicle entering the town on weekdays (Monday to Friday).

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

They made measurements in the town centre for 14 days before the fee was introduced.

They continued to make measurements in the town centre for 14 days after the fee 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 fee?

Use the graph to explain your answer.

.....

.....

.....

.....

..... [3]

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

.....

.....

.....

..... [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]

At the same times they measure the number of vehicles per minute passing along the motorway.

A scatter plot illustrating the relationship between the number of vehicles per minute (x-axis) and the concentration of nitrogen dioxide (y-axis). The x-axis is labeled 'number of vehicles per minute' and the y-axis is labeled 'concentration of nitrogen dioxide'. There are 10 data points plotted, showing a positive correlation between the two variables.

number of vehicles per minute	concentration of nitrogen dioxide
1	1
2	3
3	2
4	4
5	5
6	6
7	7
8	8
9	9
10	10

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



..... [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?

.....

 [2]

- (ii) The true value for the nitrogen dioxide concentration lies in 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.

.....

 [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 chemicals from refined crude oil are used.

1

2 [2]

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

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]

- (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 new synthetic material.

object

old material

new material

[2]

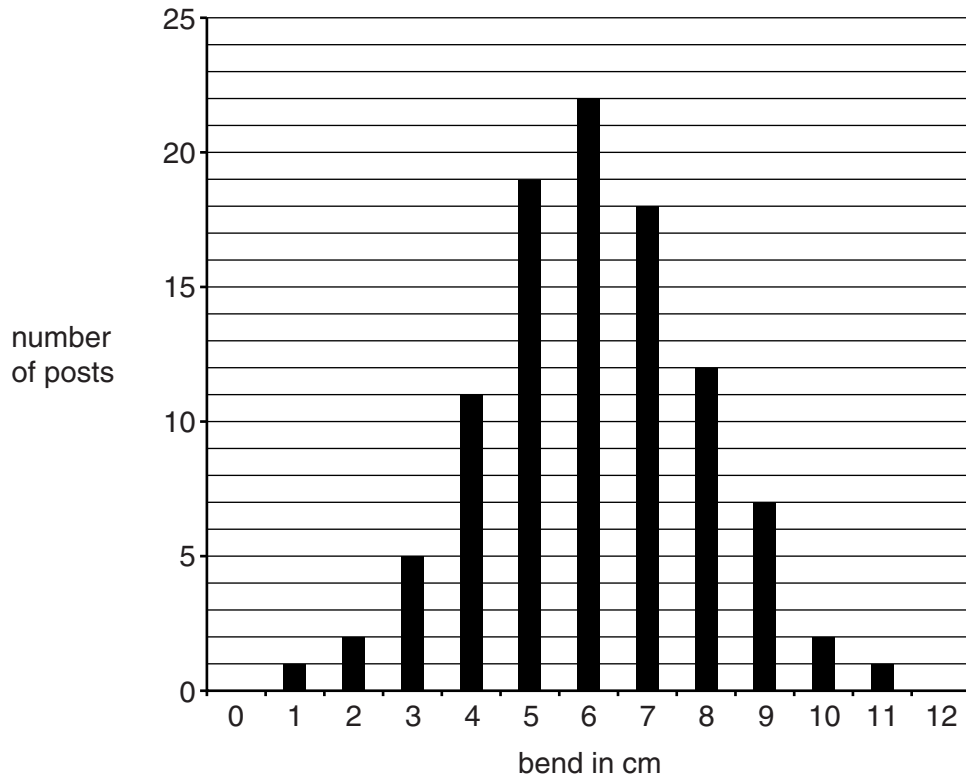
[Total: 8]

- 4 A company makes 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) Posts that bend 9 cm or more cannot be sold. They will be rejected. The company makes 500 posts.

On average, how many posts will they reject?

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

Their results are shown in the table.

Which plastic would you choose and why?



[6]

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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 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.

.....

.....

.....

..... [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.

.....

.....

.....

.....

..... [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.

..... [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

.....

.....

membrane cell

.....

.....

[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	Key relative atomic mass atomic symbol name atomic (proton) number					4 He helium 2
23 Na sodium 11	24 Mg magnesium 12	11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
39 K potassium 19	40 Ca calcium 20	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
85 Rb rubidium 37	88 Sr strontium 38	65 Zn zinc 30	63.5 Cu copper 29	59 Ni nickel 28	56 Fe iron 26	59 Co cobalt 27	84 Kr krypton 36
133 Cs caesium 55	137 Ba barium 56	112 Cd cadmium 48	108 Ag silver 47	106 Pd palladium 46	101 Ru ruthenium 44	103 Rh rhodium 45	131 Xe xenon 54
[223] Fr francium 87	[226] Ra radium 88	201 Hg mercury 80	197 Au gold 79	195 Pt platinum 78	190 Os osmium 76	192 Ir iridium 77	[222] Rn radon 86
Elements with atomic numbers 112-116 have been reported but not fully authenticated							
[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							

* 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.