

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE**

A171/02

**TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

Modules C1 C2 C3 (Higher Tier)

THURSDAY 17 JANUARY 2013:

Afternoon

DURATION: 1 hour

plus your additional time allowance

MODIFIED ENLARGED 24pt

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**Candidates answer on the Question Paper.
A calculator may be used for this paper.**

OCR SUPPLIED MATERIALS:

Periodic Table

Insert A

OTHER MATERIALS REQUIRED:

Pencil


Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- **Write your name, centre number and candidate number in the boxes on the first page. 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).**

INFORMATION FOR CANDIDATES

-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- An enlarged copy of the Periodic Table is inserted.
- 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.

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). (Insert A).**

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.

[3]

[2]

(b) No particulates are made during the complete combustion of hydrocarbons.

Incomplete combustion of hydrocarbons makes particulates.

Which statements, when put together, explain this difference?

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

When a hydrocarbon burns with a good supply of oxygen, carbon reacts to make carbon dioxide. ☐

When a hydrocarbon burns in a good supply of oxygen, only the hydrogen burns. ☐

In a limited supply of oxygen both hydrogen and carbon burn. ☐

The hydrogen in the hydrocarbon reacts more readily with oxygen than the carbon does. ☐

Carbon is unreactive and so does not combine with oxygen in air. ☐

In a limited supply of oxygen some of the carbon in a hydrocarbon does not burn. ☐

[2]

(c) Air pollutants may cause harm to people directly or indirectly.

When particulates are breathed in they may cause harm to the lungs DIRECTLY.

Name a pollutant that causes harm to people INDIRECTLY and explain how it does this.

pollutant _____

explanation_____

_____ **[2]**

(d) To reduce air pollution in this town the council introduced a charge for each vehicle entering the town centre.

Suggest TWO other things that the council could do to reduce air pollution in the town centre.

[2]

(e) Some cars use propane, C_3H_8 , as a fuel.

Complete the table to show the number of molecules involved in the complete combustion of one molecule of propane.

[TOTAL: 13]

NAME	propane	oxygen	→	carbon dioxide	water
FORMULA	C ₃ H ₈	O ₂		CO ₂	H ₂ O
NUMBER OF MOLECULES	1				

[2]

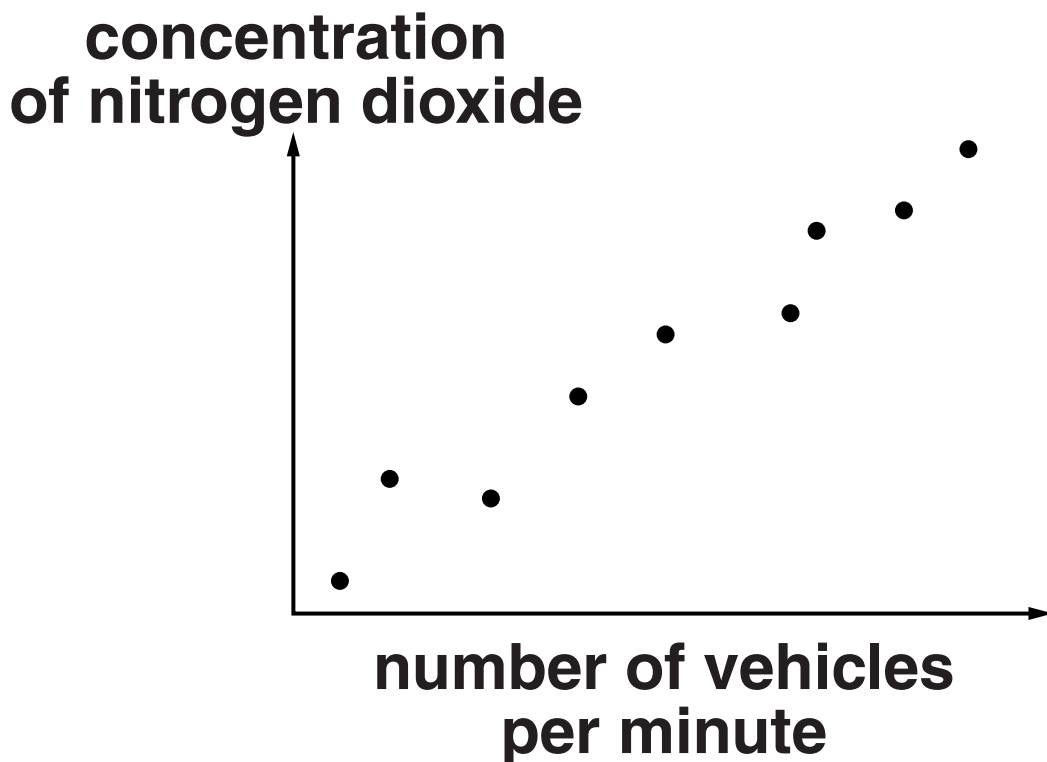
2 Scientists measure the nitrogen dioxide concentration in the air next to a motorway.

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.

[6]

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

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

SAMPLE NUMBER	1	2	3	4	5	6
NITROGEN DIOXIDE CONCENTRATION IN $\mu\text{g}/\text{m}^3$	123	132	120	121	124	122

The scientists work out the best estimate of the nitrogen dioxide concentration.

They include all of the data to calculate this best estimate.

(i) Why did the scientists include all of the data when calculating the best estimate?

[2]

(ii) Calculate the best estimate for the nitrogen dioxide concentration.

best estimate = _____ $\mu\text{g}/\text{m}^3$ [2]

- (iii) The scientists take similar measurements next to a different motorway.**

These results are shown in the table.

SAMPLE NUMBER	1	2	3	4	5	6
NITROGEN DIOXIDE CONCENTRATION IN $\mu\text{g}/\text{m}^3$	133	134	130	131	134	131

The nitrogen dioxide concentration measured next to this motorway is different from that measured next to the first motorway.

Use your answer to (b)(ii) to explain how the data show this.

[1]

[TOTAL: 11]

3 Crude oil is a mixture of hydrocarbons.

(a) (i) 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]

(ii) During the refining process crude oil is heated.

The hydrocarbons are vapourised and then condensed into fractions.

Each fraction contains hydrocarbons of similar chain length.

Which of these statements explains why this process separates the hydrocarbons into fractions?

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

The energy needed to break molecules away from each other decreases as they get bigger.

☐

The longer the hydrocarbon chains, the larger the forces between them.

☐

All hydrocarbons boil at the same temperature.

☐

Small molecules are held together by larger forces than large molecules.

☐

Large molecules need more energy to vapourise than small molecules.

☐

Small molecules boil at higher temperatures than large molecules.

☐

[2]

(b) Ethene, C_2H_4 , is obtained from crude oil.

Ethene reacts with water (steam) to make ethanol, C_2H_5OH .

Complete the table to show THE NUMBER OF ATOMS of each element when ONE molecule of ethene reacts.

	carbon	hydrogen	oxygen
ethene			
water			
ethanol			

[3]

[TOTAL: 7]

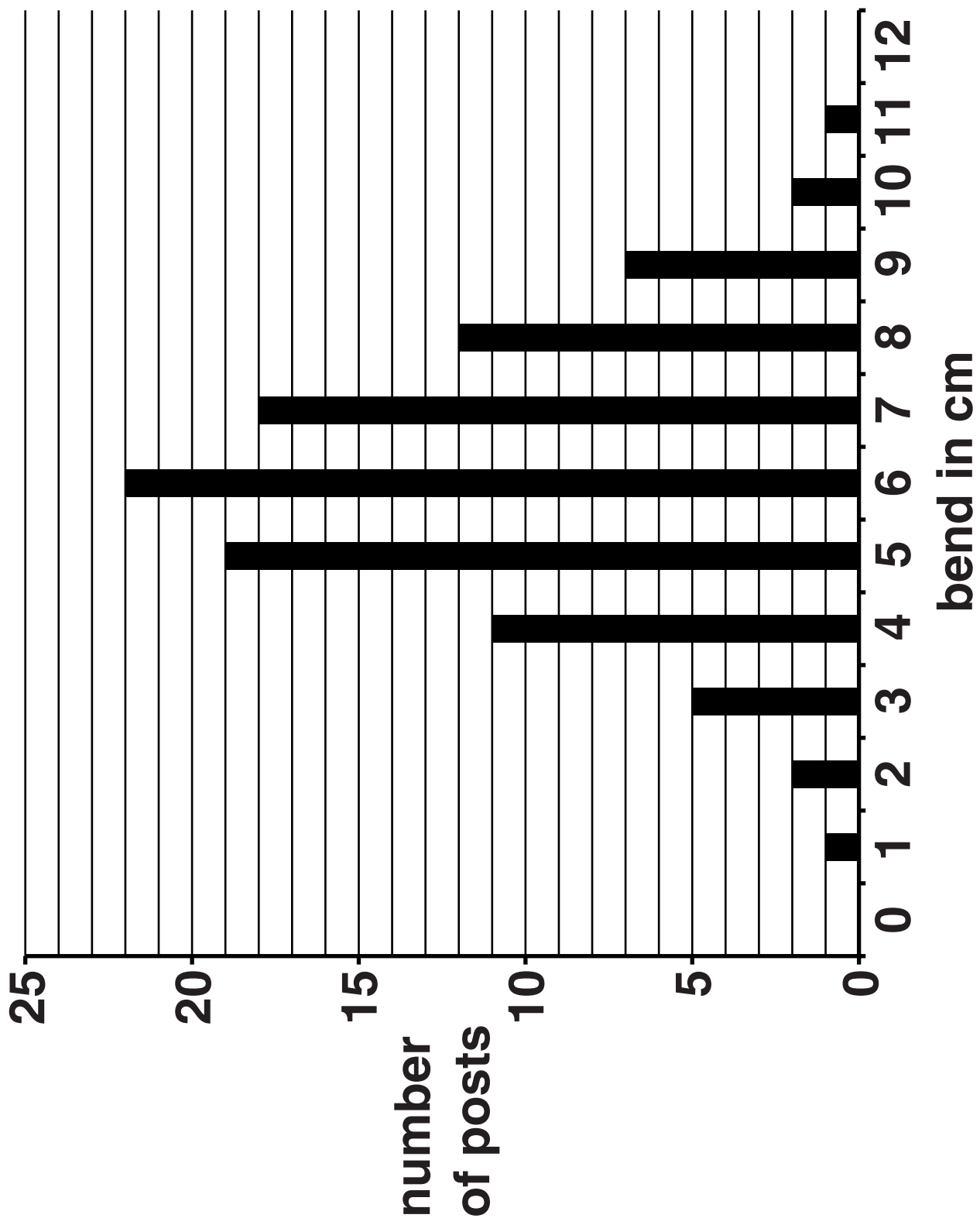
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4 A company decides to make fence posts from a plastic.

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) The same size force is used for each measurement.

Why is this essential?

Put ticks (✓) in the boxes next to the TWO best answers.

Factors that are not kept constant may affect the outcome. ☐

So that the fence post does not bend too far. ☐

So that the size of the force does not have to be noted down each time. ☐

To compare the flexibility of different fence posts. ☐

To make sure the fence post does not break. ☐

[2]

(b) The company decides to test each post they make for quality control.

They will not sell posts that bend 3 cm or less, or those that bend 9 cm or more.

The company makes 2500 posts each week.

How many posts will they reject each week?

Show your working.

**number of posts
rejected = _____ [2]**

(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	2	4	3	2	4	3	3
PLASTIC C	14	13	14	15	13	15	14

Use your knowledge of the structure of polymers to suggest why these three plastics gave different results in the tests.



[6]

[TOTAL: 10]

5 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 (30% recycled fibre)	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

(a) Which of the following factors should NOT be included in a comparison of the environmental impact of these three types of disposable grocery bag?

Put ticks (✓) in the boxes next to the TWO statements that should not be included.

The energy input for making the bags from the fibres or polymers. ☐

The environmental impact of disposing of the bags. ☐

Whether customers are charged for bags. ☐

The environmental impact of making the fibres or polymers from raw materials. ☐

Which bags customers prefer to use. ☐

The energy input as the bags are being disposed. ☐

[2]

- (b) (i) A government decides to ban the use of disposable bags made from polythene.**

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

[2]

(ii) There are reasons other than the data from Life Cycle Assessments that might influence the government's decision to ban disposable bags made from polythene.

Suggest and explain TWO of these reasons.

[2]

[TOTAL: 6]

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- 6 (a) Cholera is a disease caused by drinking contaminated water.**

During a cholera outbreak in Exeter in 1832 there were 402 deaths.

There were more outbreaks of the disease in 1848 and 1867.

There have been no cases of cholera in the city since chlorine was added to the water.

Describe and explain how the use of chlorine has helped to stop people in cities, such as Exeter, being affected by cholera.

[2]

(b) Chlorine is used to make pesticides.

These are sprayed onto crops to reduce damage caused by insect pests.

Some of these pesticides are harmful to human health and the environment.

Suggest how the use of chemicals such as pesticides may cause environmental or health problems.



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

[6]

(c) Two people talk about the pesticide DDT.

Joe says ‘DDT is used in some countries to kill mosquitoes that carry the disease malaria.’

Sally says ‘DDT is banned in many countries. It was found to prevent the normal breeding of some birds.’

Should the use of DDT be banned in all countries?

Justify your answer.

[3]

(d) Sodium hydroxide and sodium carbonate both neutralise acids to make salts.

Name the salts made when the following neutralisation reactions take place.

ACID	ALKALI	SALT
sulfuric acid	sodium hydroxide	
nitric acid	sodium carbonate	

[2]

[TOTAL: 13]

END OF QUESTION PAPER

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