

Thursday 17 January 2013 – Afternoon

**GCSE TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A171/02 Modules C1 C2 C3 (Higher Tier)

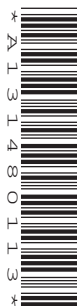
Candidates answer on the Question Paper.
A calculator may be used for this paper.

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.

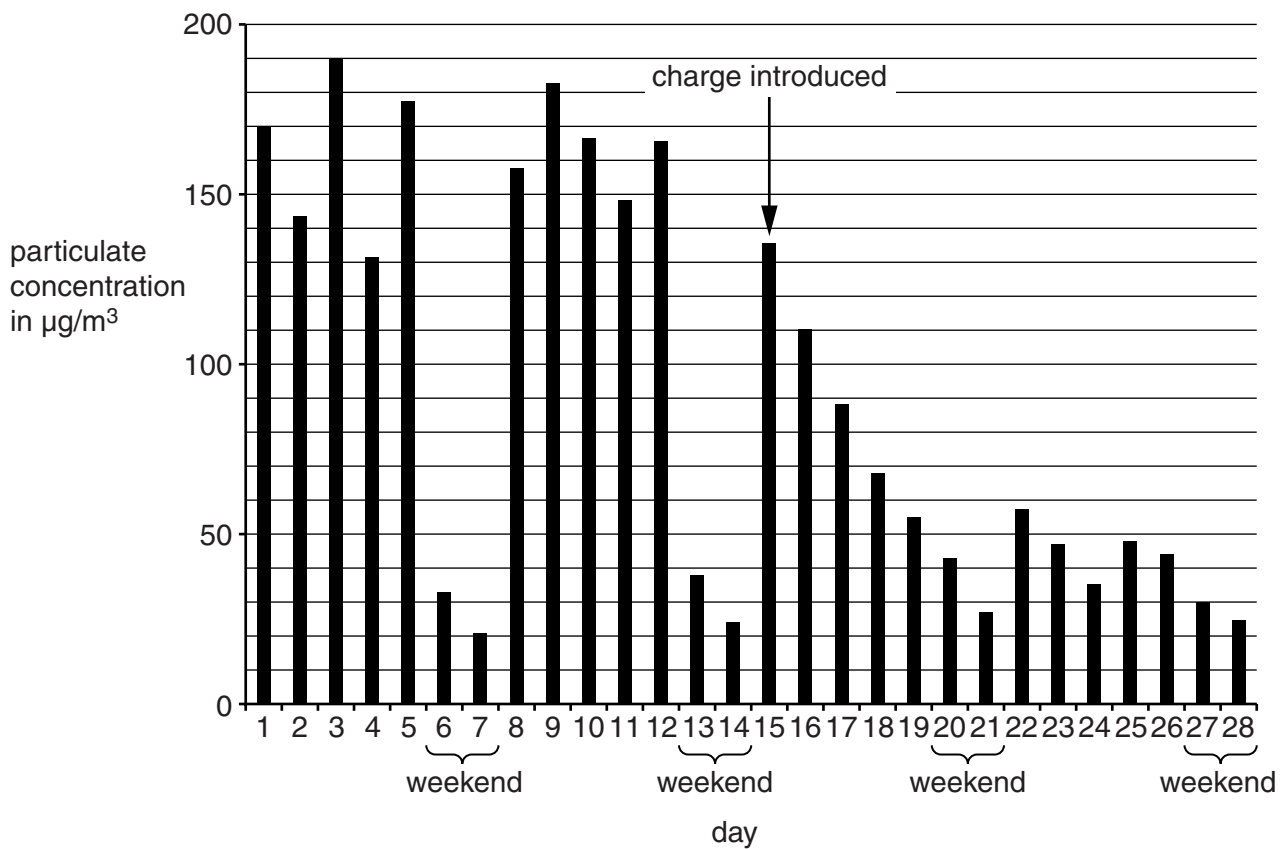
- 1 A town council decided to make drivers pay a charge for each vehicle entering the town on weekdays (Monday to Friday).

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 conclusions can be drawn from the data shown in the bar chart?

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..... [3]

- (ii) Suggest an explanation for the pattern shown by the data from day 15 to day 21.

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..... [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.

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..... [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.

Name	propane	oxygen	→	carbon dioxide	water
Formula	C_3H_8	O_2		CO_2	H_2O
Number of molecules	1				

[2]

[Total: 13]

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.

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, $\text{C}_2\text{H}_5\text{OH}$.

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]

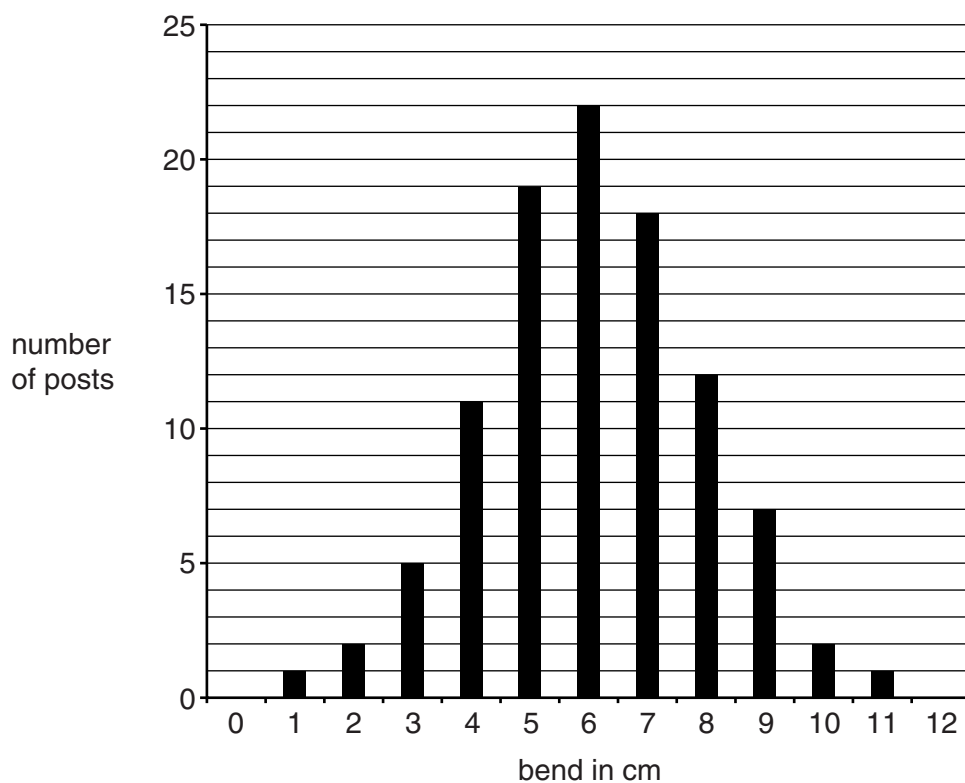
[Total: 7]

- 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]

All the samples used have exactly the same size.

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

	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



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

..... [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 CO₂)	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.

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..... [2]

[Total: 6]

- 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.

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..... [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.

.....

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..... [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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The Periodic Table of the Elements

16

1	2	Key					0
		relative atomic mass atomic symbol name atomic (proton) number					4 He helium 2
7 Li lithium 3	9 Be beryllium 4						19 F fluorine 9
23 Na sodium 11	24 Mg magnesium 12						16 O oxygen 8
							14 N nitrogen 7
							12 C carbon 6
							11 B boron 5
							10 Ne neon 10
							17 Cl chlorine 17
							18 Ar argon 18
							35.5 S sulfur 16
							32 P phosphorus 15
							31 Si silicon 14
							28 Al aluminium 13
							27 Mg magnesium 12
							20 Ca calcium 20
							19 K potassium 19
							88 Sr strontium 38
							87 Rb rubidium 37
							131 Xe xenon 54
							127 I iodine 53
							128 Te tellurium 52
							122 Sb antimony 51
							119 Sn tin 50
							115 In indium 49
							112 Cd cadmium 48
							108 Ag silver 47
							106 Pd palladium 46
							103 Rh rhodium 45
							101 Ru ruthenium 44
							98 Tc technetium 43
							96 Mo molybdenum 42
							93 Nb niobium 41
							91 Zr zirconium 40
							89 Y yttrium 39
							84 Kr krypton 36
							80 Br bromine 35
							79 Se selenium 34
							75 As arsenic 33
							73 Ge germanium 32
							70 Ga gallium 31
							65 Zn zinc 30
							63.5 Cu copper 29
							59 Ni nickel 28
							59 Co cobalt 27
							56 Fe iron 26
							55 Mn manganese 25
							52 Cr chromium 24
							51 V vanadium 23
							48 Ti titanium 22
							45 Sc scandium 21
							40 Ca calcium 20
							39 K potassium 19
							38 Sr strontium 38
							37 Rb rubidium 37
							36 Kr krypton 36
							35 Br bromine 35
							34 Se selenium 34
							33 As arsenic 33
							32 Ge germanium 32
							31 Ga gallium 31
							30 Zn zinc 30
							29 Cu copper 29
							28 Ni nickel 28
							27 Co cobalt 27
							26 Fe iron 26
							25 Mn manganese 25
							24 Cr chromium 24
							23 V vanadium 23
							22 Ti titanium 22
							21 Sc scandium 21
							20 Ca calcium 20
							19 K potassium 19
							18 Ar argon 18
							17 Cl chlorine 17
							16 S sulfur 16
							15 P phosphorus 15
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							9 F fluorine 9
							8 O oxygen 8
							7 N nitrogen 7
							6 C carbon 6
							5 B boron 5
							4 He helium 2
							3 Li lithium 3
							2 Be beryllium 4
							1 H hydrogen 1
							0 He helium 2
							1 H hydrogen 1
							2 He helium 2
							3 Li lithium 3
							4 Be beryllium 4
							5 B boron 5
							6 C carbon 6
							7 N nitrogen 7
							8 O oxygen 8
							9 F fluorine 9
							10 Ne neon 10
							11 Na sodium 11
							12 Mg magnesium 12
							13 Al aluminium 13
							14 Si silicon 14
							15 P phosphorus 15
							16 S sulfur 16
							17 Cl chlorine 17
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							22 Ti titanium 22
							23 V vanadium 23
							24 Cr chromium 24
							25 Mn manganese 25
							26 Fe iron 26
							27 Co cobalt 27
							28 Ni nickel 28
							29 Cu copper 29
							30 Zn zinc 30
							31 Ga gallium 31
							32 Ge germanium 32
							33 As arsenic 33
							34 Se selenium 34
							35 Br bromine 35
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							39 Y yttrium 39
							40 Zr zirconium 40
							41 Nb niobium 41
							42 Mo molybdenum 42
							43 Tc technetium 43
							44 Ru ruthenium 44
							45 Rh rhodium 45
							46 Pd palladium 46
							47 Ag silver 47
							48 Cd cadmium 48
							49 In indium 49
							50 Sn tin 50
							51 Sb antimony 51
							52 Te tellurium 52
							53 I iodine 53
							54 Xe xenon 54
							55 Cs caesium 55
							56 Ba barium 56
							57 La* lanthanum 57
							58 Ce* cerium 58
							59 Pr* praseodymium 59
							60 Nd* neodymium 60
							61 Pm* promethium 61
							62 Sm* samarium 62
							63 Eu* europium 63
							64 Gd* gadolinium 64
							65 Tb* terbium 65
							66 Dy* dysprosium 66
							67 Ho* holmium 67
							68 Er* erbium 68
							69 Tm* thulium 69
							70 Yb* ytterbium 70
							71 Lu* lutetium 71
							72 Hf hafnium 72
							73 Ta tantalum 73
							74 W tungsten 74
							75 Re rhenium 75
							76 Os osmium 76
							77 Ir iridium 77
							78 Pt platinum 78
							79 Au gold 79
							80 Hg mercury 80
							81 Tl thallium 81
							82 Pb lead 82
							83 Bi bismuth 83
							84 Po polonium 84
							85 At astatine 85
							86 Rn radon 86
							87 Fr francium 87
							88 Ra radium 88
							89 Ac* actinium 89
							90 Th* thorium 90
							91 Pa* protactinium 91
							92 U* uranium 92
							93 Np* neptunium 93
							94 Pu* plutonium 94
							95 Am* americium 95
							96 Cm* curium 96
							97 Bk* berkelium 97
							98 Cf* californium 98
							99 Es* einsteinium 99
							100 Fm* fermium 100
							101 Md* mendelevium 101
							102 No* nobelium 102
							103 Lr* lawrencium 103
							104 Rf rutherfordium 104
							105 Db dubnium 105
							106 Sg seaborgium 106
							107 Bh bohrium 107
							108 Hs hassium 108
							109 Mt meitnerium 109
							110 Ds darmstadtium 110
							111 Rg roentgenium 111
							112 Cn copernicium 112
							113 Nh nihonium 113
							114 Fl flerovium 114
							115 Mc moscovium 115
							116 Lv livermorium 116
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