

THIS IS A NEW SPECIFICATION

**H****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<br>forename |  | Candidate<br>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.

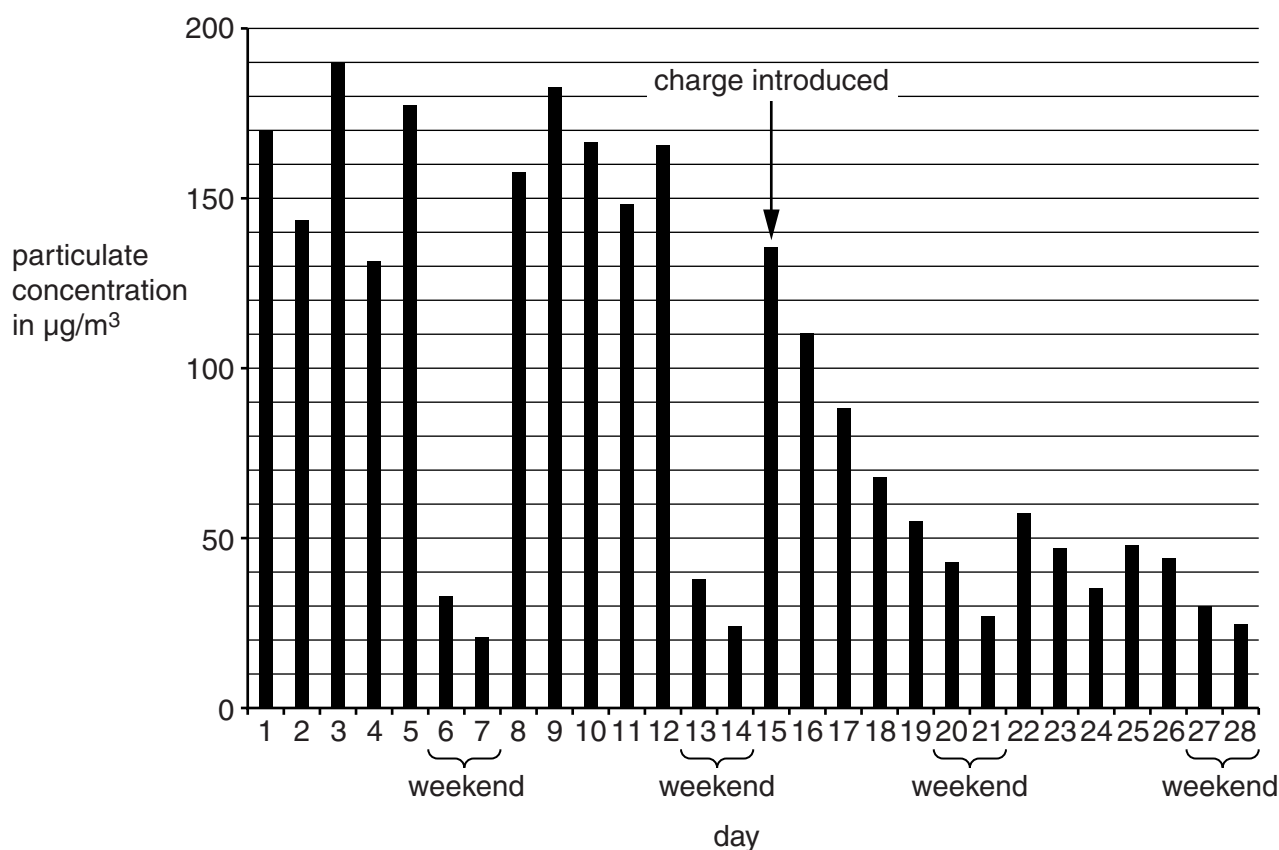
- 1 A town council decided to make drivers pay a charge for each vehicle entering the town on weekdays (Monday to Friday).

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]

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]

4

- (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.

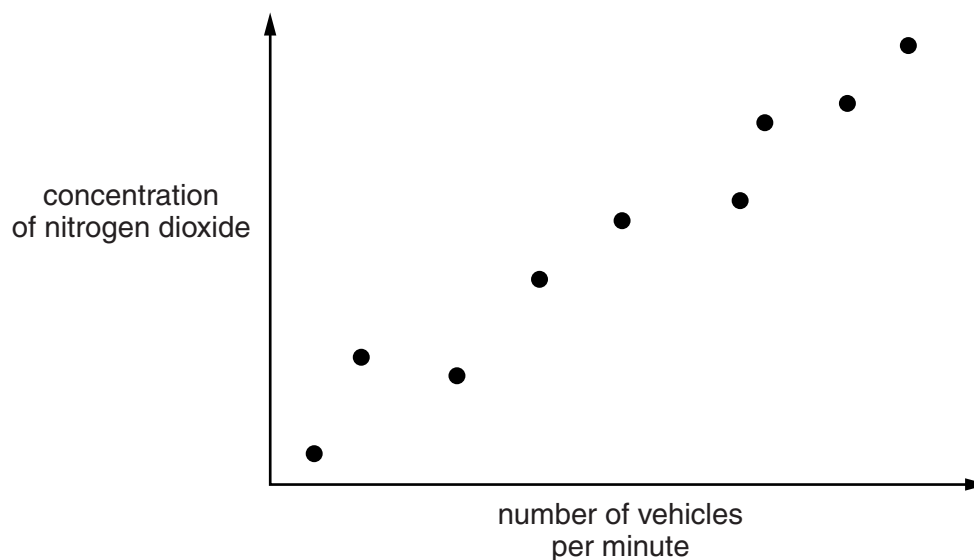
Complete the table to show the number of molecules involved in the complete combustion of one molecule of propane.

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

[2]

[Total: 13]

- Their results are shown in the graph.



- 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

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]

8

(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]



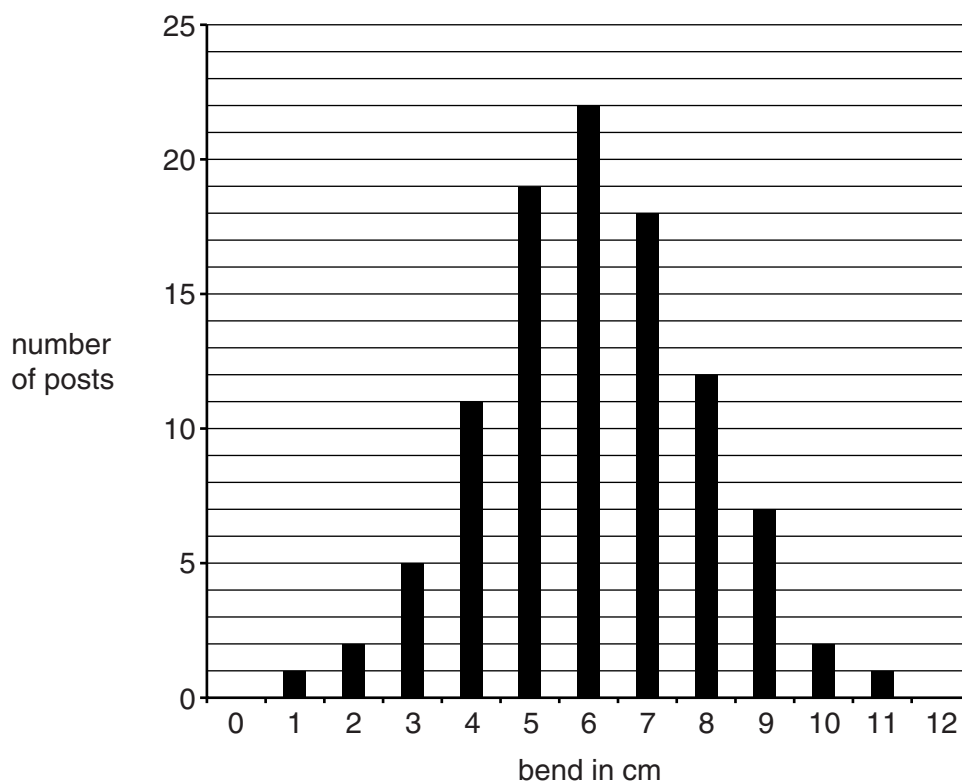
9

- 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]

10

(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]



- 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<br>(30% recycled fibre)          | biodegradable<br>plastic | polythene |
| <b>Energy use (MJ)</b>                              | 2620                                   | 2070                     | 763       |
| <b>Fossil fuel use (kg)</b>                         | 23.2                                   | 41.5                     | 14.9      |
| <b>Municipal solid waste (kg)</b>                   | 33.9                                   | 19.2                     | 7.0       |
| <b>Greenhouse gas emissions (kg CO<sub>2</sub>)</b> | 80                                     | 180                      | 40        |
| <b>Fresh water use (litres)</b>                     | 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]

13

- (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.

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..... [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.

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..... [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]

15

- (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

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|                               |                             |                                                                         |                                     |                               |                                  |                                |                               |                                  |                                    |                                   |                                                                                     |                             |                             |                              |                               |                               |                            |
|-------------------------------|-----------------------------|-------------------------------------------------------------------------|-------------------------------------|-------------------------------|----------------------------------|--------------------------------|-------------------------------|----------------------------------|------------------------------------|-----------------------------------|-------------------------------------------------------------------------------------|-----------------------------|-----------------------------|------------------------------|-------------------------------|-------------------------------|----------------------------|
| 1                             | 2                           | Key                                                                     |                                     |                               |                                  |                                | 3                             | 4                                | 5                                  | 6                                 | 7                                                                                   | 0                           |                             |                              |                               |                               |                            |
|                               |                             | relative atomic mass<br>atomic symbol<br>name<br>atomic (proton) number |                                     |                               |                                  |                                |                               |                                  |                                    |                                   |                                                                                     |                             |                             |                              |                               |                               |                            |
| 7<br>Li<br>lithium<br>3       | 9<br>Be<br>beryllium<br>4   |                                                                         |                                     |                               |                                  |                                |                               |                                  |                                    |                                   |                                                                                     | 11<br>B<br>boron<br>5       | 12<br>C<br>carbon<br>6      | 14<br>N<br>nitrogen<br>7     | 16<br>O<br>oxygen<br>8        | 19<br>F<br>fluorine<br>9      | 20<br>Ne<br>neon<br>10     |
| 23<br>Na<br>sodium<br>11      | 24<br>Mg<br>magnesium<br>12 |                                                                         |                                     |                               |                                  |                                |                               |                                  |                                    |                                   |                                                                                     | 27<br>Al<br>aluminium<br>13 | 28<br>Si<br>silicon<br>14   | 31<br>P<br>phosphorus<br>15  | 32<br>S<br>sulfur<br>16       | 35.5<br>Cl<br>chlorine<br>17  | 40<br>Ar<br>argon<br>18    |
| 39<br>K<br>potassium<br>19    | 40<br>Ca<br>calcium<br>20   | 45<br>Sc<br>scandium<br>21                                              | 48<br>Ti<br>titanium<br>22          | 51<br>V<br>vanadium<br>23     | 52<br>Cr<br>chromium<br>24       | 55<br>Mn<br>manganese<br>25    | 56<br>Fe<br>iron<br>26        | 59<br>Co<br>cobalt<br>27         | 59<br>Ni<br>nickel<br>28           | 63.5<br>Cu<br>copper<br>29        | 65<br>Zn<br>zinc<br>30                                                              | 73<br>Ge<br>germanium<br>32 | 75<br>As<br>arsenic<br>33   | 79<br>Se<br>selenium<br>34   | 80<br>Br<br>bromine<br>35     | 84<br>Kr<br>krypton<br>36     |                            |
| 85<br>Rb<br>rubidium<br>37    | 88<br>Sr<br>strontium<br>38 | 89<br>Y<br>yttrium<br>39                                                | 91<br>Zr<br>zirconium<br>40         | 93<br>Nb<br>niobium<br>41     | 96<br>Mo<br>molybdenum<br>42     | [98]<br>Tc<br>technetium<br>43 | 101<br>Ru<br>ruthenium<br>44  | 103<br>Rh<br>rhodium<br>45       | 106<br>Pd<br>palladium<br>46       | 108<br>Ag<br>silver<br>47         | 112<br>Cd<br>cadmium<br>48                                                          | 119<br>Sn<br>tin<br>50      | 122<br>Sb<br>antimony<br>51 | 128<br>Te<br>tellurium<br>52 | 127<br>I<br>iodine<br>53      | 131<br>Xe<br>xenon<br>54      |                            |
| 133<br>Cs<br>caesium<br>55    | 137<br>Ba<br>barium<br>56   | 139<br>La*<br>lanthanum<br>57                                           | 178<br>Hf<br>hafnium<br>72          | 181<br>Ta<br>tantalum<br>73   | 184<br>W<br>tungsten<br>74       | 186<br>Re<br>rhenium<br>75     | 190<br>Os<br>osmium<br>76     | 192<br>Ir<br>iridium<br>77       | 195<br>Pt<br>platinum<br>78        | 197<br>Au<br>gold<br>79           | 201<br>Hg<br>mercury<br>80                                                          | 204<br>Tl<br>thallium<br>81 | 207<br>Pb<br>lead<br>82     | 209<br>Bi<br>bismuth<br>83   | [209]<br>Po<br>polonium<br>84 | [210]<br>At<br>astatine<br>85 | [222]<br>Rn<br>radon<br>86 |
| [223]<br>Fr<br>francium<br>87 | [226]<br>Ra<br>radium<br>88 | [227]<br>Ac*<br>actinium<br>89                                          | [261]<br>Rf<br>rutherfordium<br>104 | [262]<br>Db<br>dubnium<br>105 | [266]<br>Sg<br>seaborgium<br>106 | [264]<br>Bh<br>bohrium<br>107  | [277]<br>Hs<br>hassium<br>108 | [268]<br>Mt<br>meitnerium<br>109 | [271]<br>Ds<br>darmstadtium<br>110 | [272]<br>Rg<br>roentgenium<br>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.