OCR
Oxford Cambridge and RSA

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Thursday 19 May 2016 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A/SCIENCE 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

A171/02

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

- The quality of written communication is assessed in questions marked with a pencil (✎).
- 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 **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** Welding joins metals by heating them to high temperatures so that they melt.
Ethyne is a gas used in welding. It is burned in oxygen.

Suggest why ethyne is burned in oxygen rather than air.

.....**[1]**

(b) This is a diagram of ethyne.

● is a carbon atom

○ is a hydrogen atom

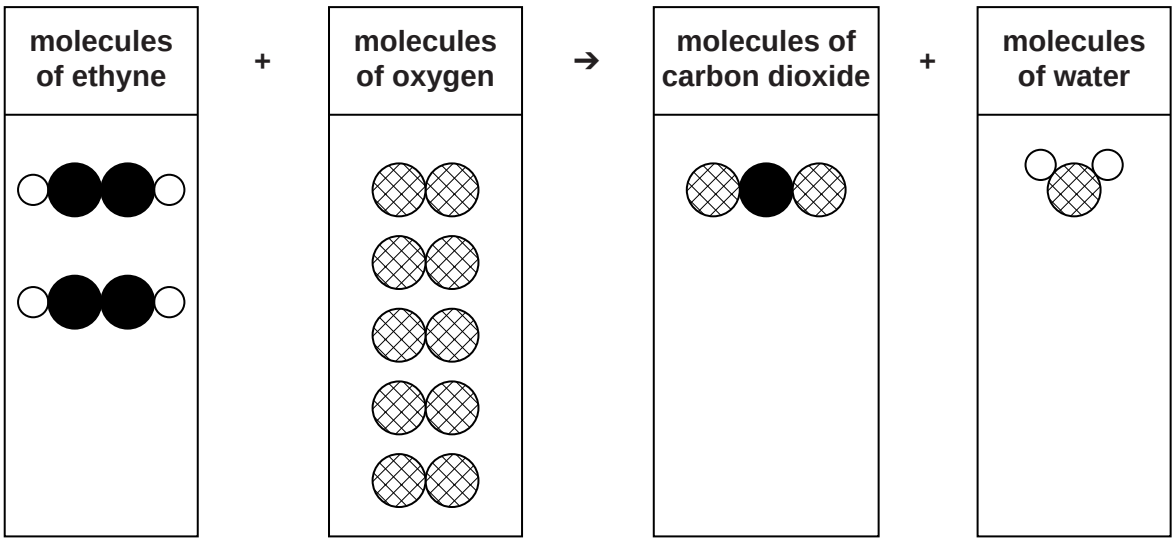
What type of compound is ethyne?

…… **[1]**

(c) Ethyne reacts with oxygen to make carbon dioxide and water.
The boxes show the four types of molecule in this reaction.

2 molecules of ethyne react with 5 molecules of oxygen.

Complete the diagram to show the number of molecules of carbon dioxide and water made in this reaction.



[2]

[Total: 4]

2 **(a)** Carbon monoxide and particulate carbon are air pollutants.
They are sometimes formed when fuels burn.

Which **two** sentences explain why carbon monoxide and particulate carbon form?

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

Some carbon atoms in the fuel react with oxygen in the air.	☐
There is plenty of oxygen for complete combustion.	☐
Carbon dioxide is not made when fuels burn completely.	☐
Every carbon atom in the fuel reacts with oxygen in the air.	☐
There is not enough oxygen for complete combustion.	☐
There is too much nitrogen for complete combustion.	☐

[2]

(b) A catalytic converter removes carbon monoxide and nitrogen monoxide from the exhaust gases of cars.

Complete the sentences about the chemical reaction in a catalytic converter.
Use the names of the reactants and products.

In a catalytic converter ..... is oxidised to

..... .

At the same time ..... is reduced to

..... . **[2]**

(c) Diesel cars may be banned in some large cities.
Here is some data on the exhaust gases of petrol and diesel cars.
The cars are the same except for the fuel they use.

	Pollutant (grams per km travelled)			Fuel used (litres per 100 km)
	Carbon monoxide	**Carbon particulates**	**Nitrogen monoxide**	
Petrol car	12.0	none	6.0	5.5
Diesel car	0.5	0.5	9.0	4.5

Use your knowledge of these pollutants to discuss the **advantages** and **disadvantages** of diesel cars over petrol cars. Suggest reasons why diesel cars may be banned from large cities.

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

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..... **[6]**

[Total: 10]

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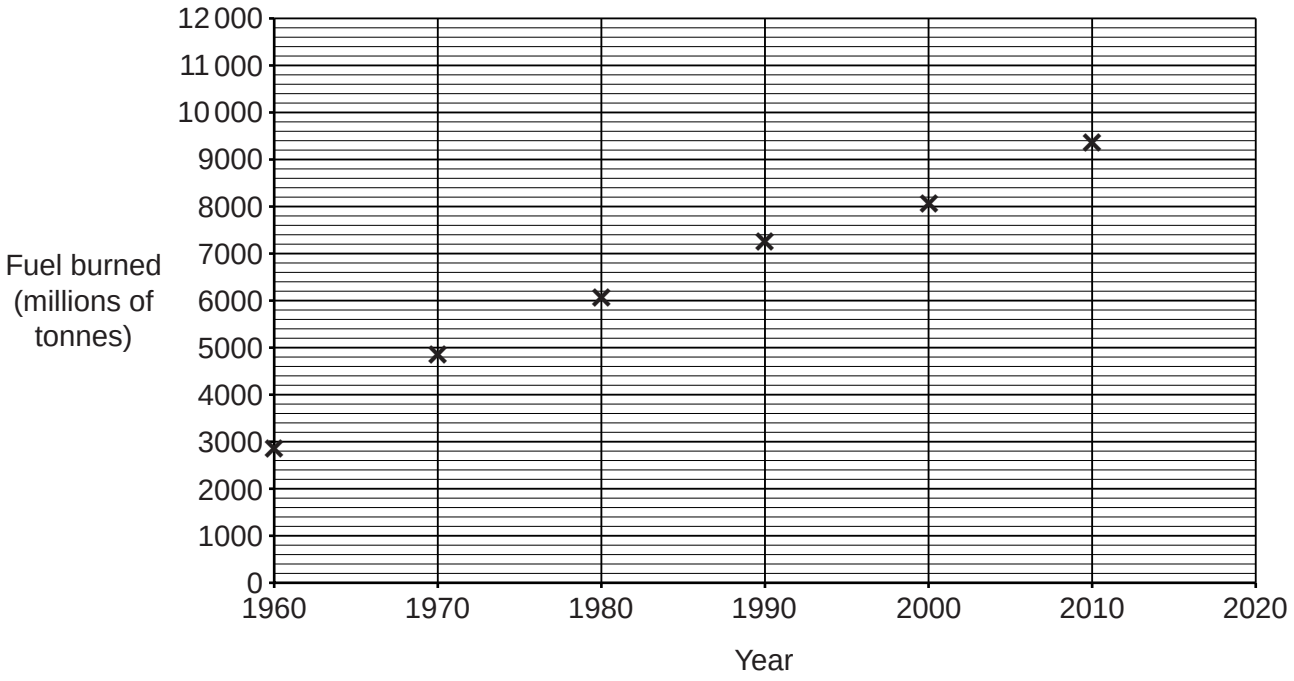
Turn over for the next question

3 John looks at a graph that shows the amount of fossil fuels burned in the world from 1960 to 2010.



(a) (i) Estimate the amount of fossil fuels that will be burned in 2020.

..... millions of tonnes **[1]**

(ii) John says that it is very difficult to estimate the amount of fossil fuel we will use in 100 years' time.

Suggest reasons John could give to justify this statement.

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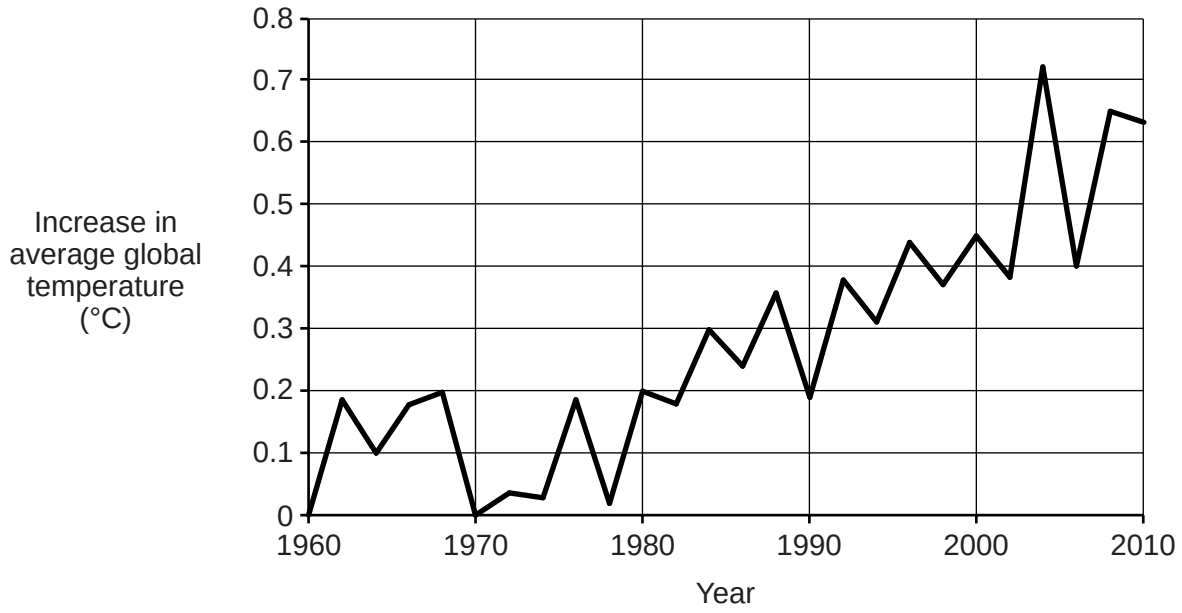
..... **[2]**

(b) John looks at the changes in average global temperature from 1960 to 2010.



Some scientists think there is a link between the trends shown in this graph and the graph on page 6.

Describe the link between the trends shown in the graphs.

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..... **[2]**

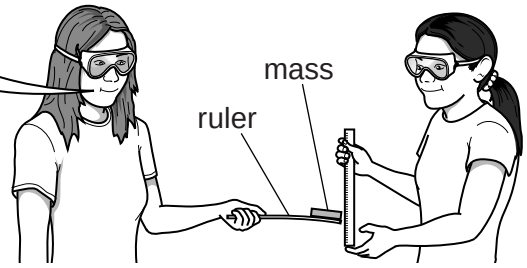
[Total: 5]

4 Some students investigate the stiffness of plastic rulers.

This is how three students plan their investigation.

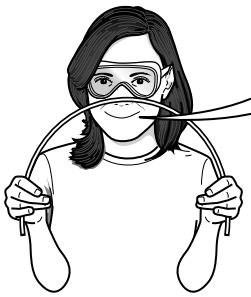
Jane

I will hold the ruler at one end and put a mass on the other end. I will measure how much it bends and get my friend to repeat the test.



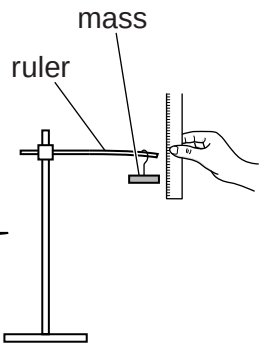
Katya

I will measure how far I can bend the ruler before it breaks. I will bend and break the rulers myself so that the test is fair.



Matt

I will use rulers that are the same length. I will hang the same mass to the end of each ruler and measure the distance it bends. I will do each test four times and work out the mean.



(a) Which plan is best? Explain why this plan is better than the other two plans.

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

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..... **[6]**

(b) Some students investigate the stiffness of ruler **A**.
Here are their measurements.

Test number	**1**	**2**	**3**	**4**	**5**
Bend (mm)	23	26	13	19	24

(i) These measurements include an outlier.

Which measurement is the outlier?

..... **[1]**

(ii) What could the students do to decide whether or not to include the outlier when calculating the best estimate of the true value from their measurements?

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.....

..... **[1]**

(iii) **Include** the outlier and work out the best estimate of the true value of their measurements.

Show your working.

[2]

(iv) The students think a second ruler, **B**, is made from a different plastic.
The students repeat the investigation with ruler **B**.

They write down the range and the best estimate of these measurements.

Range (mm)	Best estimate (mm)
5 – 10	8

Do these results support the idea that ruler **A** and ruler **B** are made from different plastics?
Use the data to explain your answer.

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..... **[2]**

[Total: 12]

5 Crude oil is separated into different fractions.
Petrol and fuel oil are fractions from crude oil.

Here are the boiling ranges of these fractions.

Fraction	Boiling range (°C)
Petrol	30 – 80
Fuel oil	300 – 340

How do the sizes of molecules in petrol and fuel oil differ? Explain why the boiling range for petrol is different from the boiling range of fuel oil.

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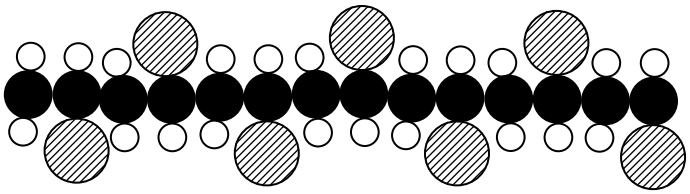
[Total: 4]

6 **(a)** The diagram shows part of a molecule of PVC.



(i) Name the missing element.

● is a carbon atom

○ is a hydrogen atom

is a ..... atom.

[1]

(ii) **Seven** monomer molecules have been joined together in this diagram.

Draw a diagram to show one monomer of PVC.

[1]

(b) **(i)** Plasticizers are small molecules. They are added to PVC to make it more flexible.

Explain how adding plasticizers makes PVC more flexible.

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..... **[3]**

(ii) In some parts of the world there is a ban on the use of plasticized PVC to wrap food.

Explain why some scientists think that plasticized PVC is not safe when it is in contact with food.

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..... **[2]**

[Total: 7]

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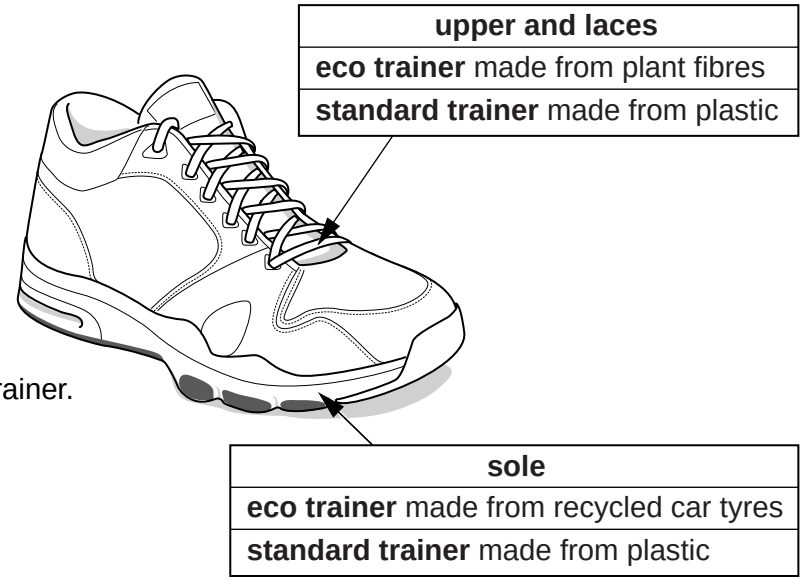
Turn over for the next question

7 A company makes a **standard** trainer using plastics made from crude oil.

They make a new **eco trainer** from plant fibres and recycled car tyres.

They expect a Life Cycle Assessment (LCA) to show that the eco trainers do less harm to the environment than standard trainers.

Here is data on the LCA of each trainer.



	Eco trainers		Standard trainers	
	Energy (MJ)	**Greenhouse gases made (kg CO_2)**	**Energy (MJ)**	**Greenhouse gases made (kg CO_2)**
Making materials for the trainers	1.6	0.1	6.0	4.2
Making the trainers from the materials	1.4	1.0	4.2	3.7
Disposing of the trainers	0.8	0.6	0.8	0.6

17

Suggest reasons why the company expected the LCA would show eco trainers do less harm to the environment than standard trainers. Does the data show the company was right? What additional information is needed to complete the LCA?

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

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..... **[6]**

[Total: 6]

8 **(a)** Salt is found underneath the ground in some parts of the UK.
It can be mined using solution mining.

Here are some statements about solution mining of salt.

Not all of the statements are correct, and they are in the wrong order.

A Water dissolves the salt.

B Water is pumped into the ground.

C Water is evaporated from the solution.

D Salt crystals are made.

E Water dissolves salt and clay.

F The solution is distilled.

G Pressure pushes the solution up to ground level.

(i) Choose the **correct steps** and then fill in the boxes to show the **correct order** for solution mining of salt.

One has been done for you.

				D

[3]

(ii) Salt is added to food to improve the taste and for one other reason.
What is that other reason?

..... **[1]**

(b) (i) The electrolysis of brine makes chlorine and two other products.

Name the **two** other products.

1 .....

2 ..... **[2]**

Methods for the production of chlorine by electrolysis of brine have changed over the past 50 years.

Look at this data about the production of chlorine during this time.

	1965	**1990**	**2015**
Chlorine made in the UK (tonnes / year)	0.25×10^6	0.75×10^6	……..
Electricity used to make 1 tonne chlorine (MJ)	12 400	……..	9000
Total electricity used for electrolysis of brine (MJ)	3100×10^6	7500×10^6	$14\,400 \times 10^6$
Toxic liquids and solids produced	small amounts	trace	none

(ii) Complete the table. **[2]**

(iii) Use the data in the table to discuss how the production of chlorine has changed over the past 50 years.

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..... **[4]**

[Total: 12]

END OF QUESTION PAPER

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.