OCR
Oxford Cambridge and RSA

F

Wednesday 22 June 2016 – Morning

GCSE GATEWAY SCIENCE
FURTHER ADDITIONAL SCIENCE B

B762/01 Further Additional Science modules B6, C6, P6 (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 30 minutes

* B 7 6 2 0 1 *

* 4 4 0 0 3 4 4 4 6 6 *

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- A list of equations can be found on page 2.
- The Periodic Table can be found 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 **85**.
- This document consists of **36** pages. Any blank pages are indicated.

EQUATIONS

$$\text{energy} = \text{mass} \times \begin{matrix}\text{specific}\\ \text{heat}\\ \text{capacity}\end{matrix} \times \begin{matrix}\text{temperature}\\ \text{change}\end{matrix}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

$$\text{efficiency} = \frac{\text{useful energy output } (\times 100\%)}{\text{total energy input}}$$

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

$$\text{power} = \text{voltage} \times \text{current}$$

$$\text{energy supplied} = \text{power} \times \text{time}$$

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{distance} = \text{average speed} \times \text{time}$$

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

$$\text{power} = \text{force} \times \text{speed}$$

$$KE = \frac{1}{2}mv^2$$

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

$$GPE = mgh$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\begin{matrix}\text{voltage across}\\ \text{primary coil}\end{matrix}}{\begin{matrix}\text{voltage across}\\ \text{secondary coil}\end{matrix}} = \frac{\begin{matrix}\text{number of}\\ \text{primary turns}\end{matrix}}{\begin{matrix}\text{number of}\\ \text{secondary turns}\end{matrix}}$$

$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

$$V_pI_p = V_sI_s$$

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Question 1 begins on page 4

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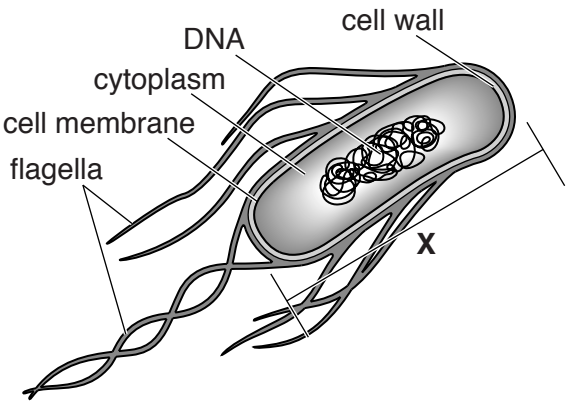
Answer **all** the questions.

SECTION A – Module B6

1 Scientists have genetically engineered bacteria to produce human growth hormone.

The bacterium that they used is called *E. coli*.

This is what it looks like using a microscope.



(a) *E. coli* is a bacterium.

(i) **X** on the diagram shows the length of *E. coli*.

Put a (ring) around the length that *E. coli* is likely to be in real life.

0.003 mm **0.003 cm** **0.003 m** **0.003 km**

[1]

(ii) Put a tick (✓) in the box next to the way that *E. coli* reproduces.

by budding ☐

by sexual reproduction ☐

by splitting into two (binary fission) ☐ **[1]**

(b) Genetically engineered *E. coli* can produce a lot of human growth hormone very quickly.

Write about how scientists can make this happen.

In your answer include:

- what has to be inserted into the *E. coli* cells
- where the *E. coli* cells are then grown.

.....

.....

.....

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

[Total: 5]

2 Lake Michigan is a large lake in North America.

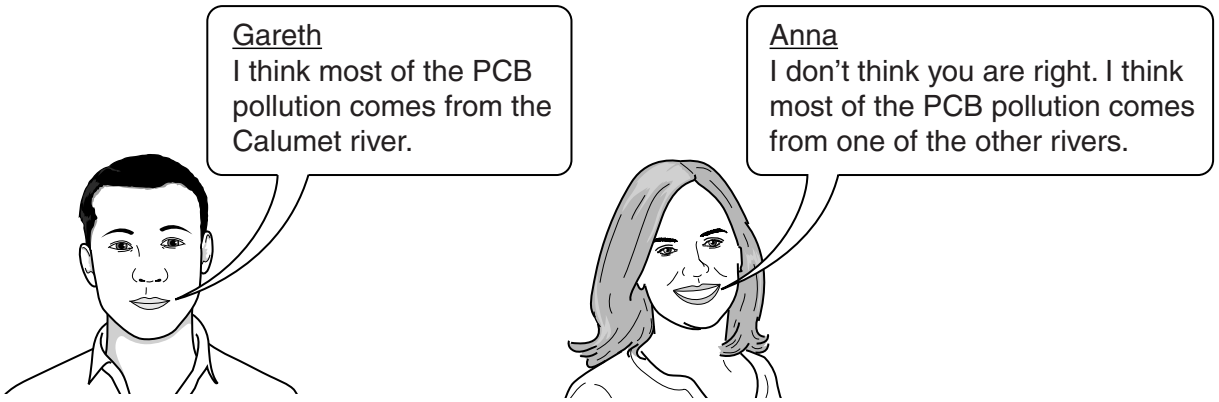
A number of rivers flow into the lake.

(a) The table shows the volume of water flowing down four of these rivers.

It also shows the concentration of chemicals called PCBs in the water in each river.

Name of river	Volume of water flowing in m^3 per second	Concentration of PCBs in micrograms per m^3
Calumet	12	58.9
Fox	86	52.0
Grand	187	1.5
St Joseph	203	1.3

Gareth and Anna are talking about PCB pollution in the lake.



Use the data in the table to explain why Anna is correct.

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

(b) Read this article about Lake Michigan.

Smelly lake!

In the summer people have noticed that the lake is starting to smell.

This is due to phytoplankton increasing in numbers.
This happens in the summer.
Bacteria then rot the phytoplankton when they die.
This gives off a mixture of gases.

One resident said:
'*The gas given off smells horrible but if we could trap it we could use it as a fuel*'.

(i) Which word is used to describe the rotting of the phytoplankton?

Put a (ring) around the answer in this list.

decomposition **immobilisation** **infection** **reproduction**

[1]

(ii) When the bacteria rot the phytoplankton, a mixture of gases is given off.

Write down the name of **one** of these gases.

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

(iii) Suggest why the smell is worse in the summer.

.....

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

(iv) A similar mixture of gases is sometimes given off from rubbish buried in landfill sites.

Why may this be dangerous?

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

[Total: 8]

3 Many people wear jeans.

They are usually coloured blue by a dye.

Many people like their jeans to look a little faded.

So makers wash the jeans in a washing machine with heavy stones.

This removes some of the colour.

A new way of doing this is to wash the jeans with an enzyme called laccase.

This fades the blue dye.

(a) Draw straight lines to join each **feature** of the enzyme to a possible **advantage**.

feature	**advantage**
The enzyme only needs temperatures of less than 40 °C to work.	The waste water does not have to be filtered.
The enzyme only breaks down the dye and does not damage the cloth fibres.	Less energy is used in the washing process.
The enzymes are soluble but the stones make lots of small particles.	The material of the jeans is not weakened.

[1]

(b) The problem with the new process is that the enzyme is quite expensive.

The jean makers want to immobilise the enzyme to save money.

Write **one** way the enzyme can be immobilised.

.....

.....

Explain why immobilising the enzyme could save money.

.....

.....

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

[Total: 4]

4 In 1800, there were two nearby hospitals in Austria where women gave birth.

Bacterial infection was a common cause of death in women after childbirth.

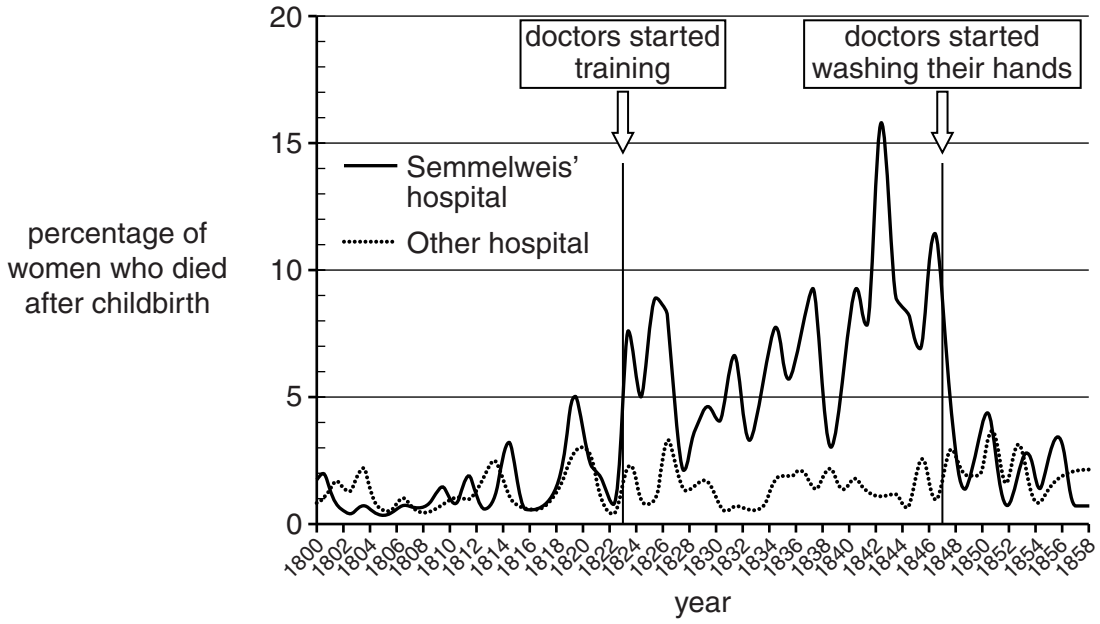
Ignaz Semmelweis was a doctor who worked in one of the hospitals.

In 1823, the hospital that Semmelweis worked in also started to train doctors.

These doctors dissected dead bodies as well as treating pregnant women.

In 1847, Semmelweis suggested that the doctors washed their hands after dissecting the dead bodies.

The graph shows the percentage of women who died in each of the hospitals.



(a) Compare the percentage of women who died in each hospital.

Suggest why the percentage of deaths changed in Semmelweis' hospital.

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

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

(b) The timeline shows some famous scientists who made important discoveries about diseases.

Semmelweis knew that diseases could be passed from person to person.

However, he did **not** realise what caused them.

Use the timeline to explain why he did **not** know what caused diseases.

.....

.....

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

[Total: 8]

SECTION B – Module C6

5 The formula for sodium carbonate is Na_2CO_3.

(a) Sodium carbonate is a **compound**.

Explain how you can tell.

.....

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

(b) Finish the sentences about sodium carbonate.

The number of **different elements** in sodium carbonate is ..... .

The total number of **atoms** in the formula Na_2CO_3 is ..... .

[2]

[Total: 4]

6 This question is about ethanol.

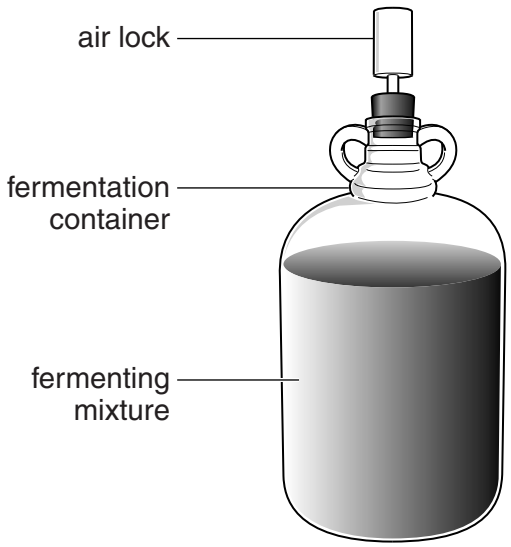
(a) Ethanol has the formula C_2H_5OH.

Ethanol is **not** a hydrocarbon.

Explain why.

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

(b) Ethanol is made by the fermentation of sugar.



Write down **two** conditions needed for fermentation.

.....

.....

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

[Total: 3]

7 This question is about tap water in four different cities.

Look at the table.

It shows the total mass of calcium ions and magnesium ions dissolved in 1 dm^3 of tap water.

City	Total mass of calcium and magnesium ions dissolved in 1 dm^3 of tap water in mg	
	Before boiling	**After boiling**
Birmingham	23	20
Bristol	97	41
London	103	68
Manchester	25	19

(a) Which city has the **softest** tap water?

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

(b) Nick says that tap water from Birmingham produces the most limescale when it is boiled.

Is he correct? Use the data to explain your answer.

.....

.....

.....

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

[Total: 4]

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Question 8 begins on page 16

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8 This question is about electrolysis.

(a) Molten magnesium chloride is electrolysed to make magnesium and chlorine.

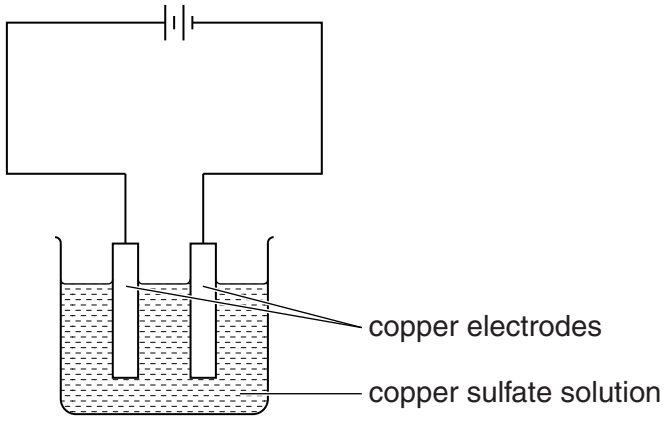
Complete the table about the electrolysis of some molten compounds.

Molten compound	Products of electrolysis
magnesium chloride	magnesium and chlorine
sodium chloride	..... and .....
magnesium bromide	..... and .....

[2]

(b) Louise is a research chemist.

She studies the purification of copper by electrolysis.



She measures the mass of copper made in 10 minutes.

She does the experiment five times.

Look at her results.

Experiment number	Mass of copper made in 10 minutes in g
1	5.1
2	4.9
3	5.0
4	5.2
5	4.8

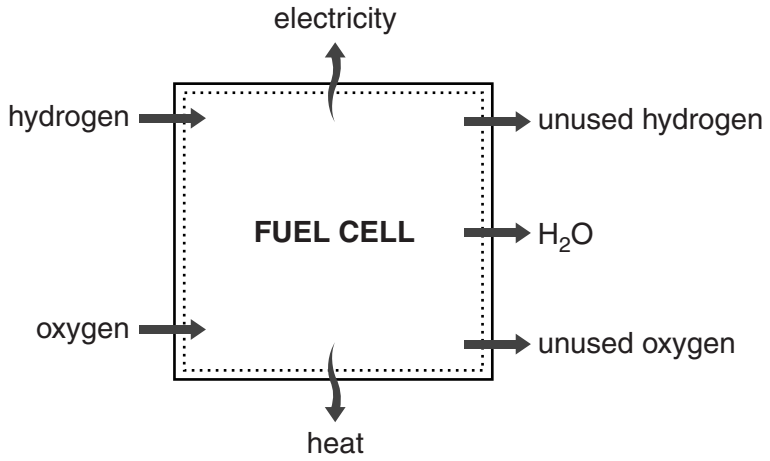
Calculate the mean (average) mass of copper produced in 10 minutes.

Use your answer to work out how fast the copper is produced in g per minute.

answer ..... g per minute **[2]**

[Total: 4]

9 Fuel cells are used in spacecraft.



In this fuel cell, hydrogen reacts with oxygen to make water.

(a) (i) Write down the name of the fuel used in this fuel cell.

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

(ii) Write the **word** equation for the reaction in this fuel cell.

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

(b) This fuel cell is used in a spacecraft.

Write down **two** advantages of using fuel cells in a spacecraft.

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

[Total: 4]

10 This bridge is made of iron.

It is important to stop the bridge rusting.

Two methods of stopping rusting are **painting** and **galvanising**.

Write about how painting and galvanising prevent rusting.

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

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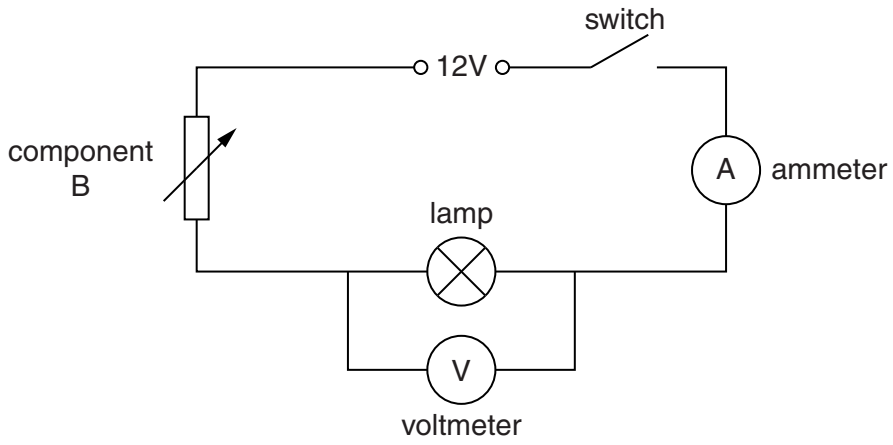
..... **[6]**

[Total: 6]

SECTION C – Module P6

11 Alice connects an electric circuit.

Look at her circuit diagram.



Alice switches the lamp on.

She measures the voltage across the lamp and the current in the circuit.

(a) Use ideas about particles to describe the current in the wires of the circuit.

.....

.....

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

(b) When Alice adjusts component **B** the brightness of the lamp changes.

What is the name of component **B**?

Choose from: **capacitor** **diode** **relay** **transformer** **variable resistor**

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

(c) Alice takes more readings of current and voltage.

She puts her results in a table and calculates the resistance.

Look at her results.

Voltage across the lamp in volts	Current in the lamp in	Resistance of the lamp in ohms
2	0.4	5.0
4	0.7	5.7
6	1.0	6.0
8	1.3	6.2
10	1.6	6.3
12	1.8	6.7

(i) The unit for current is missing from the table.

What is the unit for current?

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

(ii) Show how she calculates the resistance when the voltage across the lamp is 2 volts.

.....

.....

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

(iii) Look at Alice's results.

Describe how the **resistance** of the lamp changes as the current changes **and** suggest why the resistance changes.

.....

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

[Total: 8]

12 Mysha has two sensors.

- LDR
- thermistor

The resistance of a thermistor changes as the temperature changes.

(a) What changes the resistance of the **LDR**?

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

(b) The thermistor carries more current as it gets **hotter**. This current can be used to turn on an LED.

Mysha builds a circuit. It contains a thermistor and an LED. The LED lights up when the thermistor is hotter.

She wants the LED to light up when the thermistor is **colder**.

Mysha chooses a logic gate to do this.

(i) Name the logic gate she chooses and suggest what she might use this circuit for.

.....

.....

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

(ii) Complete the truth table to describe how this logic gate works.

Input	Output

[1]

(c) The LED is a light emitting **diode**.

Mysha puts the LED in the circuit the wrong way round.

Why will the circuit not work?

.....

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

(d) Mysha decides to replace the LED with a mains light bulb.

She now needs to use a relay.

Describe what a relay does.

.....

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

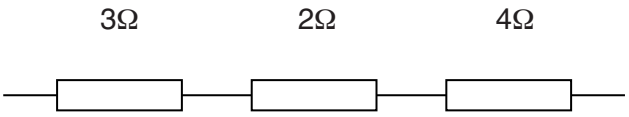
[Total: 7]

13 Resistors can be placed in series to produce a total resistance for a circuit.

Each of the resistor combinations **A**, **B**, **C** and **D** contain three resistors.

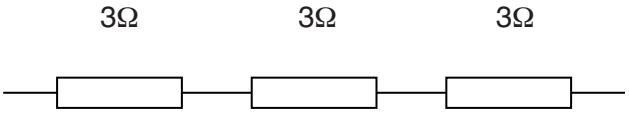
Look at the diagrams.

A



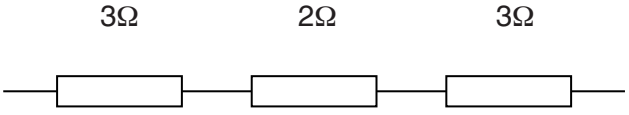
total resistance = 9Ω

B



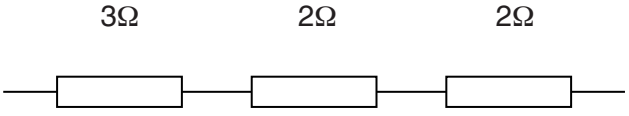
total resistance = ... Ω

C



total resistance = ... Ω

D



total resistance = ... Ω

Calculate the missing values to answer the following questions.

(a) Which circuit has the lowest total resistance?

Choose from **A**, **B**, **C** or **D**.

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

(b) Which two circuits have the same total resistance?

Choose from **A**, **B**, **C** or **D**.

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

[Total: 2]

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Question 14 begins on page 26

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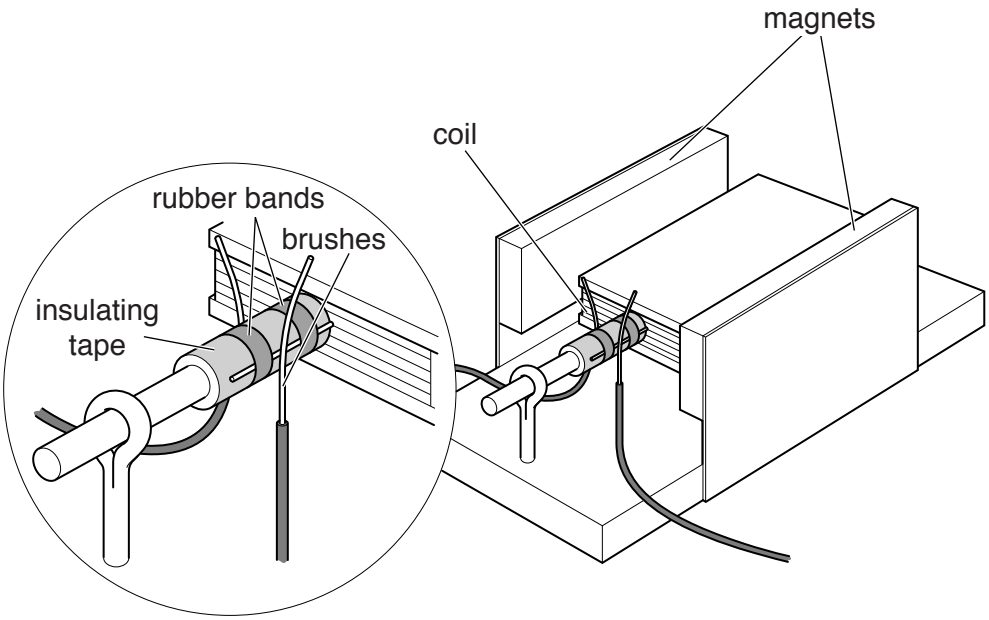
14 Look at the diagram of a model electric motor.



(a) Matt builds the motor and he passes current through the coil.

The coil starts to move.

Explain why the coil starts to move.

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.....

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

(b) Matt wants to double the speed of his electric motor.

He does two things:

- He changes the number of turns on the coil from 8 to 16.
- He changes the current.

The motor's speed does **not** double but remains **unchanged**.

Explain why the motor speed stays the same and suggest what he did to the current.

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

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

[Total: 8]

SECTION D

15 Fossil fuels such as oil are running out.

Scientists are trying to make biofuels from plants instead of using fossil fuels.

Two of these biofuels are **biodiesel** and **bioethanol**.

(a) The table shows the relative amounts of energy used for three different regions in 2010.

Region	Population in millions	Total energy use	Energy from biodiesel	Energy from bioethanol
Europe	510	1759	8.6	2.2
North America	294	2216	1.9	26.3
South America	309	570	3.6	12.3

(i) Which region has the highest total energy use in 2010?

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

(ii) In Europe, 510 million people use 1759 units of energy.
How many units of energy will one million people use?

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

(iii) Garry and Susie are talking about the data in the table.

They have different opinions.

Use data from the table to support each of their opinions.

Garry .....

.....

.....

Susie .....

.....

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

(b) Burning biofuels and fossil fuels releases carbon dioxide into the air.

However, biofuels will cause carbon dioxide levels in the air to rise less.

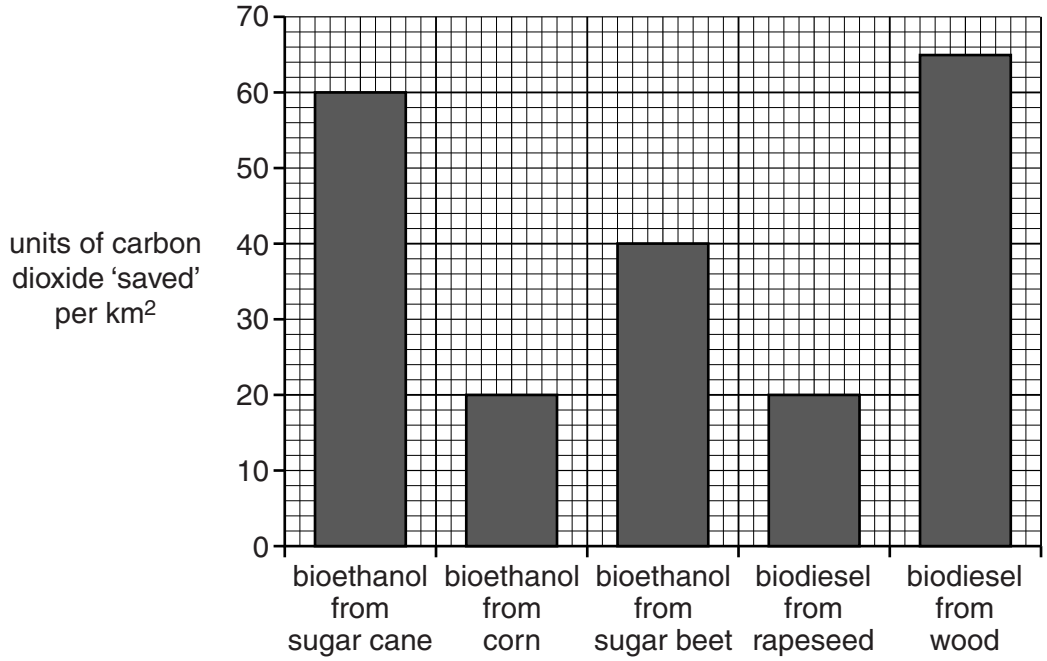
This is because the carbon dioxide released is taken up by the new plants used to make biofuels.

This is the carbon dioxide 'saved'.

Graph 1 shows the carbon dioxide 'saved' over 30 years by using biofuels made from different plants.

The data are for one km^2 of land.

Graph 1



Sugar cane was grown in a field for 30 years.

This field has an area of **10 km^2**.

What is the carbon dioxide 'saved' using the bioethanol from this sugar cane?

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

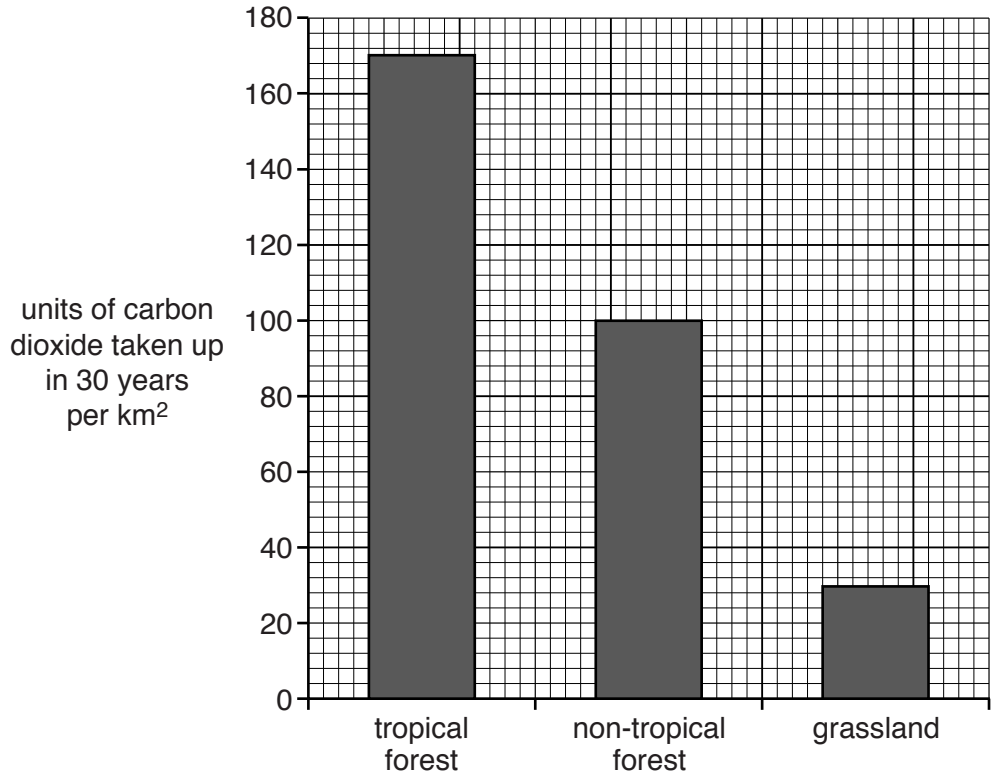
(c) Some scientists think that it may be better not to grow plants used to make biofuels.

They suggest allowing other plants to grow on the land.

These plants may take up more carbon dioxide from the air than the carbon dioxide 'saved' due to using biofuels.

Graph 2 shows how much carbon dioxide could be taken up in 30 years if other plants grew rather than the biofuel crop.

Graph 2



(i) The land in a one km^2 field can be used in two ways:

- growing sugar beet for 30 years to make bioethanol
- leaving the field for 30 years as grassland.

Use data from Graphs 1 and 2 to decide which is better for limiting the carbon dioxide levels in the atmosphere. Explain your answer.

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.....

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

(ii) Large areas of tropical forest are cut down to make room for cattle farming.

Why are scientists concerned about this?

Use data from Graph 2 to explain your answer.

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

[Total: 10]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

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.