OCR
Oxford Cambridge and RSA

H

Wednesday 22 June 2016 – Morning

GCSE GATEWAY SCIENCE
FURTHER ADDITIONAL SCIENCE B

B762/02 Further Additional Science modules B6, C6, P6 (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 30 minutes

B762/02

4400611547

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 **32** 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

PLEASE DO NOT WRITE ON THIS PAGE

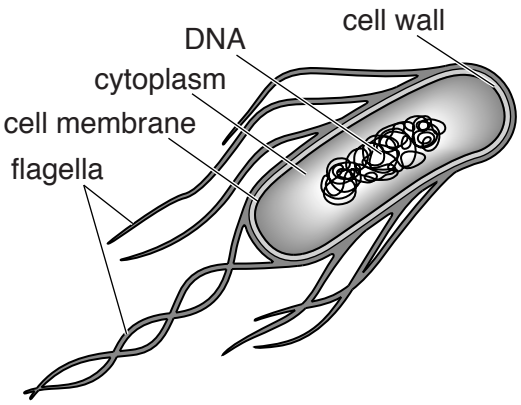
Answer **all** the questions.

SECTION A – Module B6

1 Scientists have genetically engineered bacteria to produce human insulin.

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

This is what it looks like using a microscope.



(a) (i) Which part of *E. coli* allows it to move?

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

(ii) Different enzymes are used to genetically engineer *E. coli* bacteria.

Draw lines to join each **process** to the **type of enzyme** responsible.

process	type of enzyme
makes 'sticky ends'	ligase enzymes
joins DNA strands together	restriction enzymes
cuts the insulin gene out of human DNA	

[2]

(b) To make genetically engineered insulin, bacteria are grown in fermenters.

The bacteria make and store insulin in their cells.

One fermenter can produce **10 kg** of insulin per batch. A batch is made in **2 days**.

(i) The insulin can be used to treat people with diabetes.

A typical person with diabetes needs **0.0025 g** of insulin **a day**.

How many people can be regularly supplied with insulin from one fermenter?

answer = ... people **[2]**

(ii) Before genetic engineering was developed, insulin was extracted from pigs.

The pancreas from a dead pig can supply **0.05 g** of insulin.

The production of genetically engineered insulin was an important breakthrough.

Use calculations and your answer to **(i)** to explain why.

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

(c) Some drug companies use yeast to produce insulin rather than *E. coli.*

The yeast cells make and release insulin into the liquid that they are feeding on.

Suggest why this is an advantage to the drug companies.

.....

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

[Total: 8]

2 Lake Michigan is a large lake in North America.

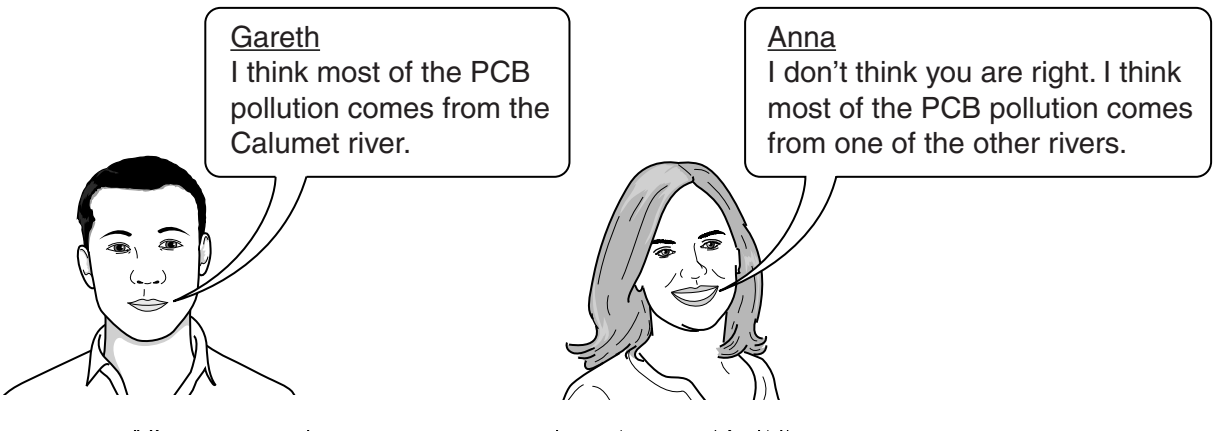
A number of rivers flow into the lake.

(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 a different type of pollution in Lake Michigan.

Smelly lake!

In the summer, people have noticed that the lake is starting to smell.
This is due to algae increasing in numbers.
Bacteria then rot algae 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) Scientists are linking the increase in algae to a different type of pollution to PCBs.

Write down a pollutant that can cause the growth of algae.

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

(ii) The gas given off is a type of biogas.

Explain why the percentage of methane in biogas is important when the biogas is burned as fuel.

.....

.....

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

(iii) The government is trying to reduce the pollution in the lake.

The effects of PCB pollution take longer to clear than the pollution affecting the algae.

Explain why.

.....

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

[Total: 8]

3 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.

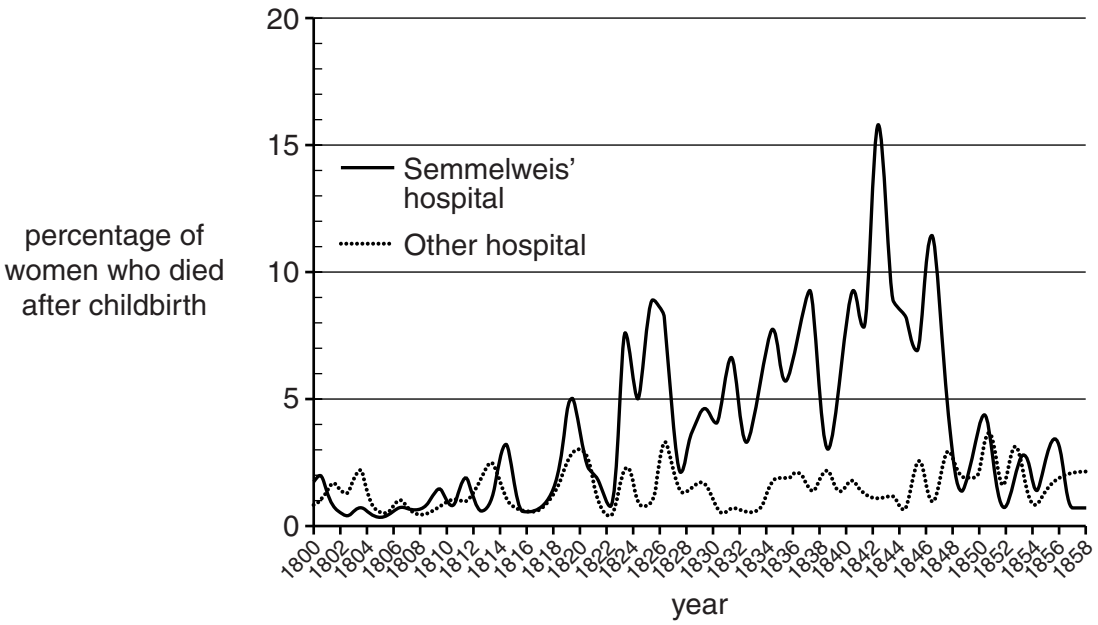
Ignaz Semmelweis was a doctor who worked in one of the hospitals.

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) Explain the patterns of death rates in the two hospitals.

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

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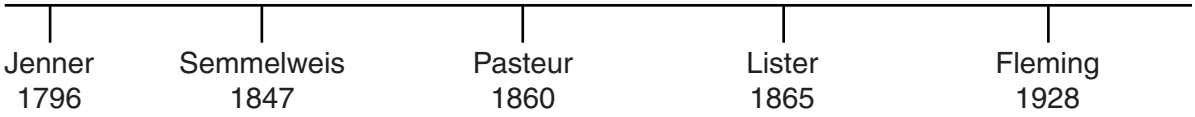
..... **[6]**

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



(i) 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.

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

(ii) Fleming's discovery made the infection seen by Semmelweis much more treatable.

Which of these actions would be most effective in giving long-term protection from bacterial infections?

Put a tick (✓) in the box next to the best answer.

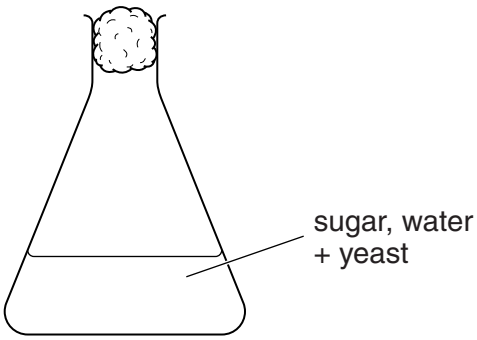
Make antibiotics readily available at chemists so infections can be treated as soon as they appear.	☐
Always complete the dose of any antibiotic that is prescribed.	☐
Regularly spray hospitals and public areas with antibiotics.	☐
Regularly give doctors antibiotics to prevent them spreading infection.	☐

[1]

[Total: 9]

SECTION B – Module C6

4 Ethanol is made by fermentation.



(a) Ethanol produced by fermentation is a **renewable** fuel.

Explain why.

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

(b) In fermentation the temperature must not go above 50 °C and air must be kept out of the apparatus.

Explain why.

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

[Total: 4]

5 CFCs **were** used in refrigerators and aerosols.

(a) Suggest a type of substance that could be used instead of CFC as a propellant in an aerosol.

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

(b) CFCs remove ozone from the upper atmosphere.

Explain why CFCs will continue to remove ozone even though they are not used in **new** fridges and aerosols.

.....

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

[Total: 3]

6 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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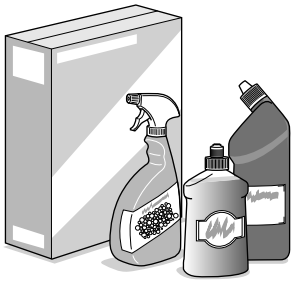
..... **[3]**

[Total: 4]

7 There is a wide variety of washing powders available.

Washing powder manufacturers often do surveys to find out what people think about their products.



Samples of different washing powders were sent to a small number of people.

They were asked to use the powder and then answer some questions.

They were asked to grade their answers from 1–10 (1 = poor, 10 = excellent).

Look at the table. It shows the mean (average) score for each question.

Question	**Washing powder A**	**Washing powder B**	**Washing powder C**	**Washing powder D**
How good was the powder at removing general dirt?	8.1	6.3	9.1	5.2
How good was the powder at removing food stains at low temperatures?	5.9	3.6	9.1	2.8
How soft did the garments feel after washing?	7.2	6.2	3.8	7.1
How economical was the powder to use?	6.8	5.0	7.0	7.9
Overall mean (average) score for each powder	7.0	5.3	7.3	5.8

(a) Which powder is most likely to contain an enzyme? Give a reason for your answer.

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

(b) The data collected suggests that washing powder **C** is the best.

Suggest **two** reasons why this conclusion may not be correct.

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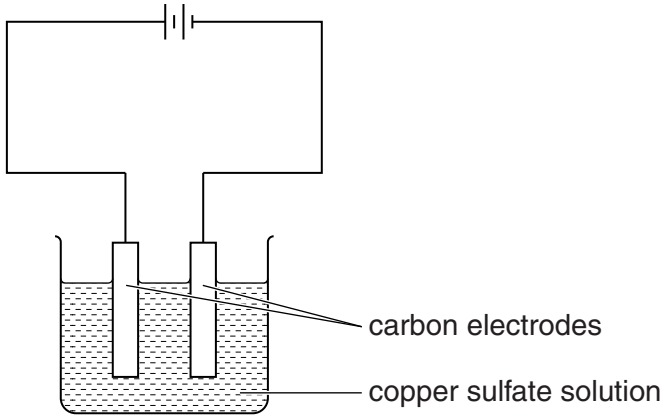
..... **[2]**

[Total: 4]

8 Copper sulfate solution is electrolysed.



Copper is made at the cathode and oxygen at the anode.

(a) Hydroxide ions, OH^-, react at the anode.

Oxygen gas, O_2, and water, H_2O, are made.

Write the **balanced symbol** equation for the reaction.

Use e^- to represent an electron.

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

(b) A current of **4A** is passed through copper sulfate solution for **1 minute**.

60 cm^3 of oxygen are made.

Calculate the volume of oxygen made if **8A** are passed through the solution for **1 hour**.

answer ..... cm^3 **[2]**

[Total: 4]

9 There are different ways of protecting iron from rusting.

Ethel wants to protect iron food cans from rusting.

She is considering galvanising and tin plating.

Explain how galvanising and tin plating prevent rusting.

Which would be more effective for protecting a food can from rusting?

Explain your answer.

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

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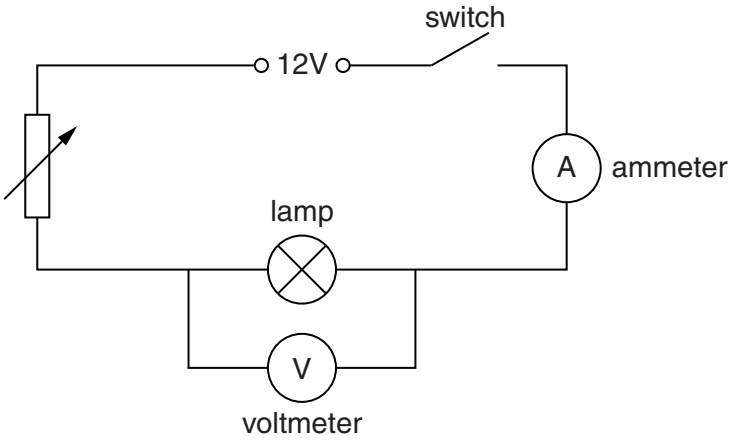
..... **[6]**

[Total: 6]

SECTION C – Module P6

10 Alice connects an electric circuit.

Look at her circuit diagram.



(a) The variable resistor contains a length of resistance wire.

Alice adjusts the variable resistor by increasing the length of the resistance wire.

How will this affect the lamp?

Explain your answer.

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

(b) Alice measures the voltage across the lamp and the current in the circuit.

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

Look at her results.

Voltage across the lamp in volts	Current in the lamp in amps	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

The resistance of the lamp changes.

Explain the trends shown in the table using kinetic theory.

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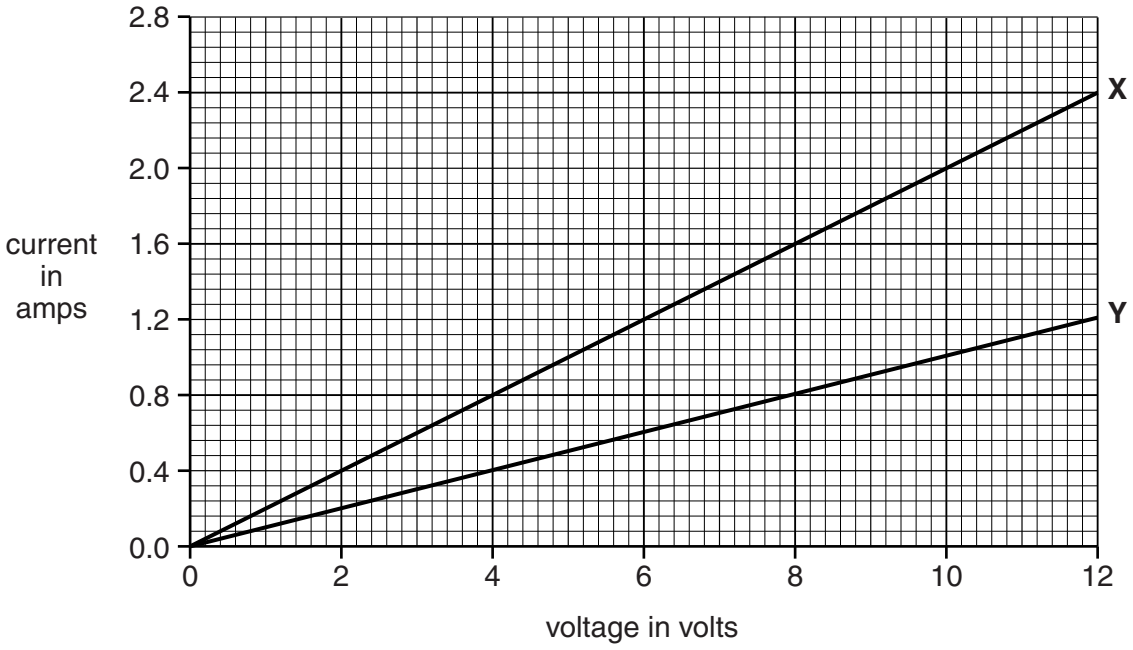
..... **[3]**

(c) Alice replaces the lamp with a resistor, **X**.

She measures the current in, and the voltage across, resistor **X**.

She repeats this with a different resistor, **Y**.

Look at the graph of her results for resistors **X** and **Y**.



(i) Alice thinks that these resistors are **ohmic** resistors.

Is she correct?

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Explain your answer.

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

(ii) How do the resistances of **X** and **Y** compare with each other?

Use the information in the graph to help your answer.

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

[Total: 8]

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Question 11 begins on page 20

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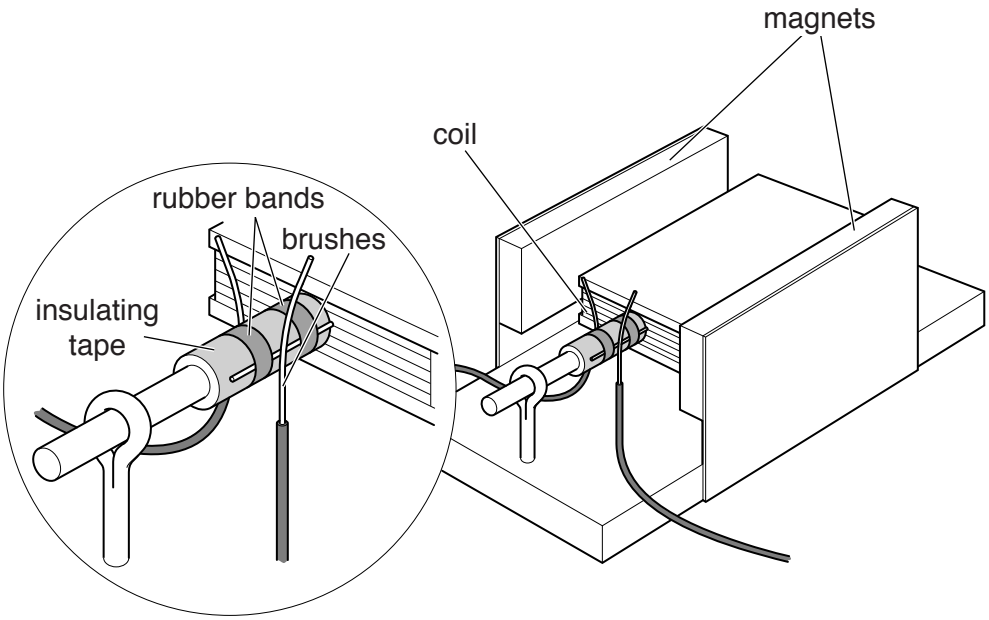
11 Look at the diagram of a model electric motor.



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

He adjusts the rubber bands and the brushes so they work like a **commutator**.

The coil starts to move and spin.

Explain how this arrangement keeps the coils spinning in one direction.

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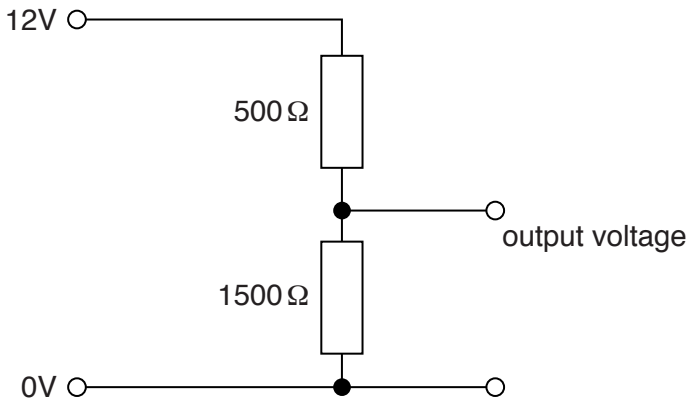
..... **[6]**

[Total: 8]

12 Mysha builds some electronic circuits.

She has a potential divider with two **fixed** resistors.

Look at the diagram.

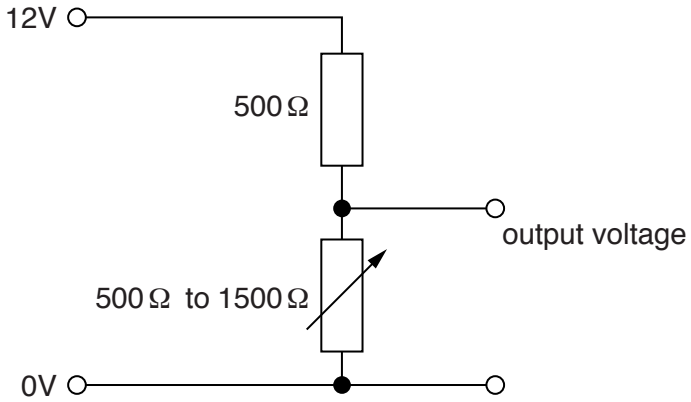


(a) She wants to improve the potential divider so it can produce a range of voltages.

She replaces one of the fixed resistors with a variable resistor.

This variable resistor can change from 500 Ω to 1500 Ω.

Look at the diagram.



Calculate the range of possible output voltages using this variable resistor.

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

(b) Mysha wants her potential divider to respond to changes in light levels.

Explain how she could modify her potential divider and explain how this new arrangement would work.

You may draw a diagram to help your answer.

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

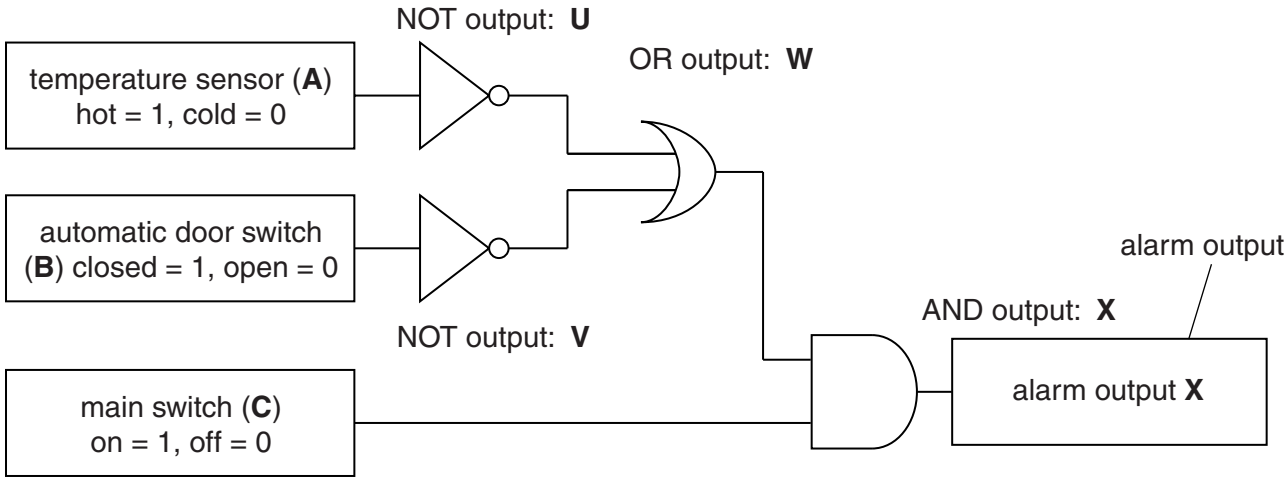
(c) Mysha has a greenhouse.

She often leaves the door open.

On cold days this can harm the plants.

She uses a system of logic gates to set off an alarm if the greenhouse gets too cold or the door is left open. The alarm will also only operate when a main switch is on.

Look at the diagram.



Complete the truth table to show how the alarm system works.

Inputs						Output
A	**B**	**C**	**U**	**V**	**W**	**X**
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

[3]

[Total: 9]

SECTION D

13 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) Sam says that in 2010 North America used more energy per million people than Europe.

Use the data to show that she is correct.

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

(ii) South America has fewer reserves of fossil fuel than North America or Europe.

Use data from the table to compare the **relative** use of biofuels in South America with the use in North America.

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..... **[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.

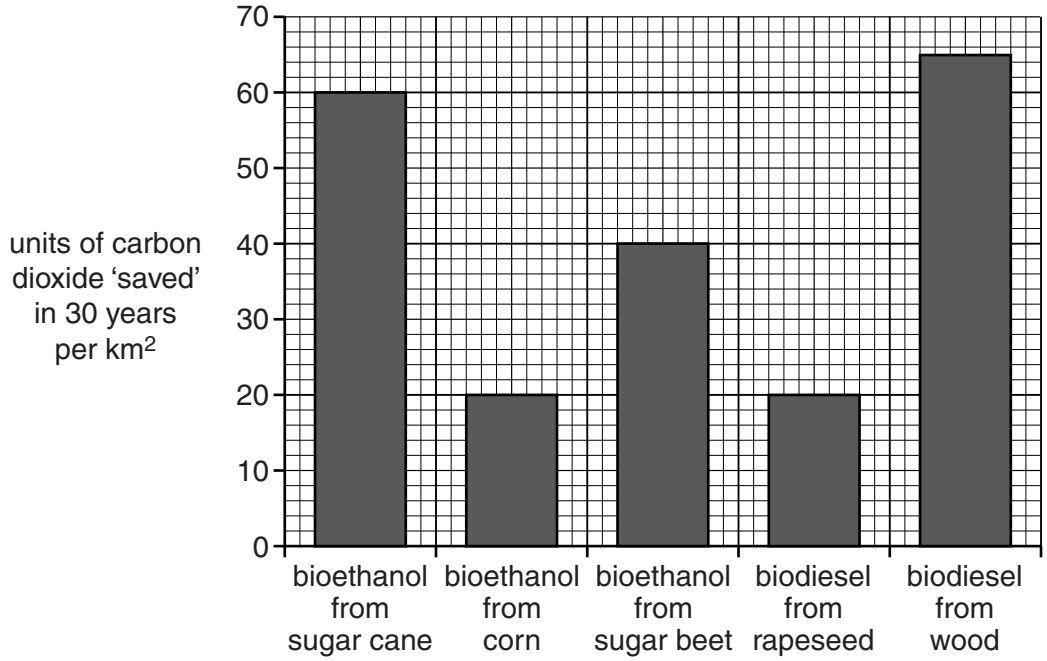
This is because the carbon dioxide released is taken up by the new plants used to make biofuels.

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



Areas of forest are cut down and burned.

This is to make land available to grow plants to make biofuels.

Burning a forest gives out 200 units of carbon dioxide per km^2.

Corn can be grown and made into bioethanol.
After many years, this will compensate for the **burning** of the forest.
Use the data provided to calculate how many years this would take.

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

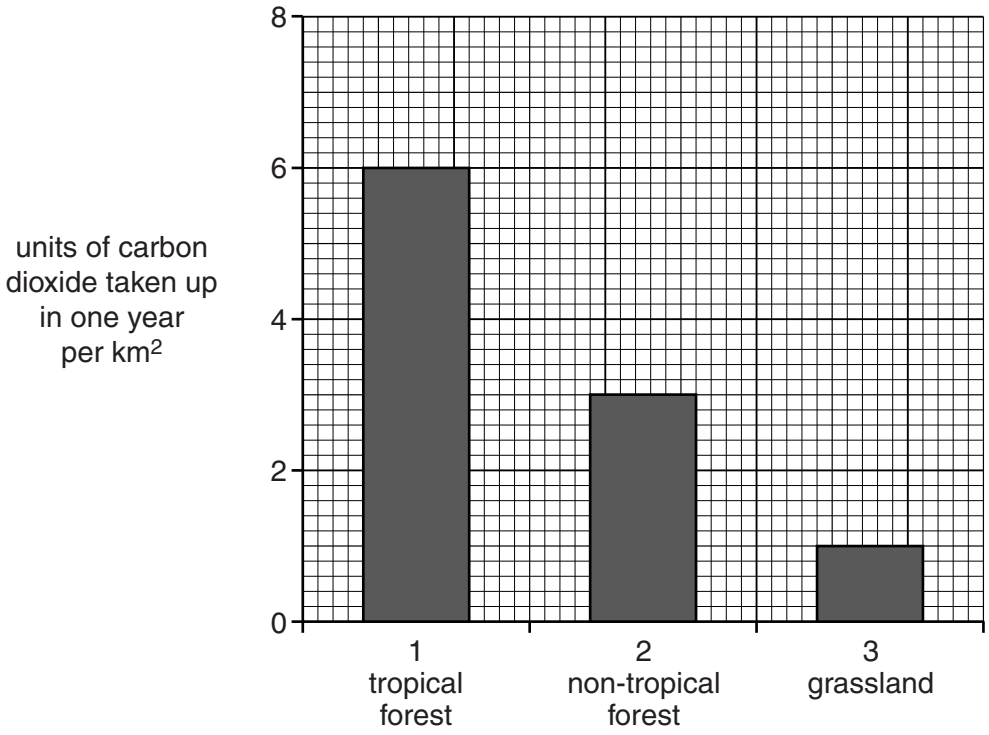
(c) Some scientists think that it may be better not to grow plants used to make biofuels.

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 **one year** 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 to make bioethanol
- leaving the field as grassland.

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

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

(ii) Some scientists now think that converting fields back to forests might be better for the environment than growing biofuels.

Does the data from Graphs 1 and 2 support the scientists' idea?

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.