OCR
Oxford Cambridge and RSA

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Wednesday 17 June 2015 – Morning

GCSE GATEWAY SCIENCE
PHYSICS B

B752/02   Physics modules P4, P5, P6 (Higher Tier)

Duration: 1 hour 30 minutes

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 (✐).
* A list of equations can be found on page 2.
* 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.

Turn over

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

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

distance = average speed × time

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

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

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

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

power = force × speed

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

momentum = mass × velocity

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

$$GPE = mgh$$

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

power loss = (current)^2 × resistance

$$V_pI_p = V_sI_s$$

3

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Question 1 begins on page 4

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4

Answer **all** the questions.

SECTION A – Module P4

1 Ksenia and Eva investigate five different variable resistors.

They set each variable resistor to the maximum resistance.

They keep the voltage the same and use this circuit to measure the current.
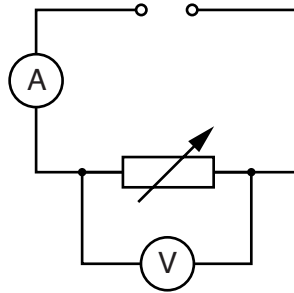
Look at their results.

Variable resistor	Reading on ammeter in amps
A	0.12
B	0.15
C	0.16
D	0.06
E	0.11

(a) (i) The maximum resistance for variable resistor **B** is 4.79 ohms.

Calculate the voltage to 2 significant figures.

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voltage .... volts **[2]**

  (ii) During the measurements the voltage was kept constant for all the variable resistors.

  Which variable resistor has the **highest** resistance?

  Choose from

| **A** | **B** | **C** | **D** | **E** |

  .... **[1]**

(b) Ksenia looks inside variable resistor **A**.

Look at the diagram.
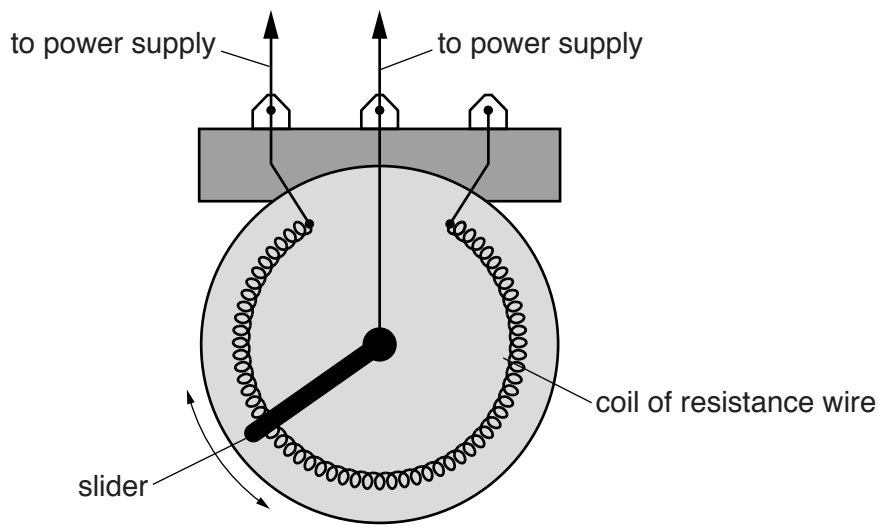
The slider moves around and keeps in contact with the coil of resistance wire.

Explain how this variable resistor can be moved to increase **and** decrease the current in a circuit.

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  .... **[2]**

Turn over

2 Ultrasound can be used on humans.

Becky has her body fat measured using ultrasound on her arm.

ultrasound
probe

display showing
ultrasound
reflections

strength of
reflection

A

B

C

0   5   10   15   20   25   30   35   40

distance into the arm in mm
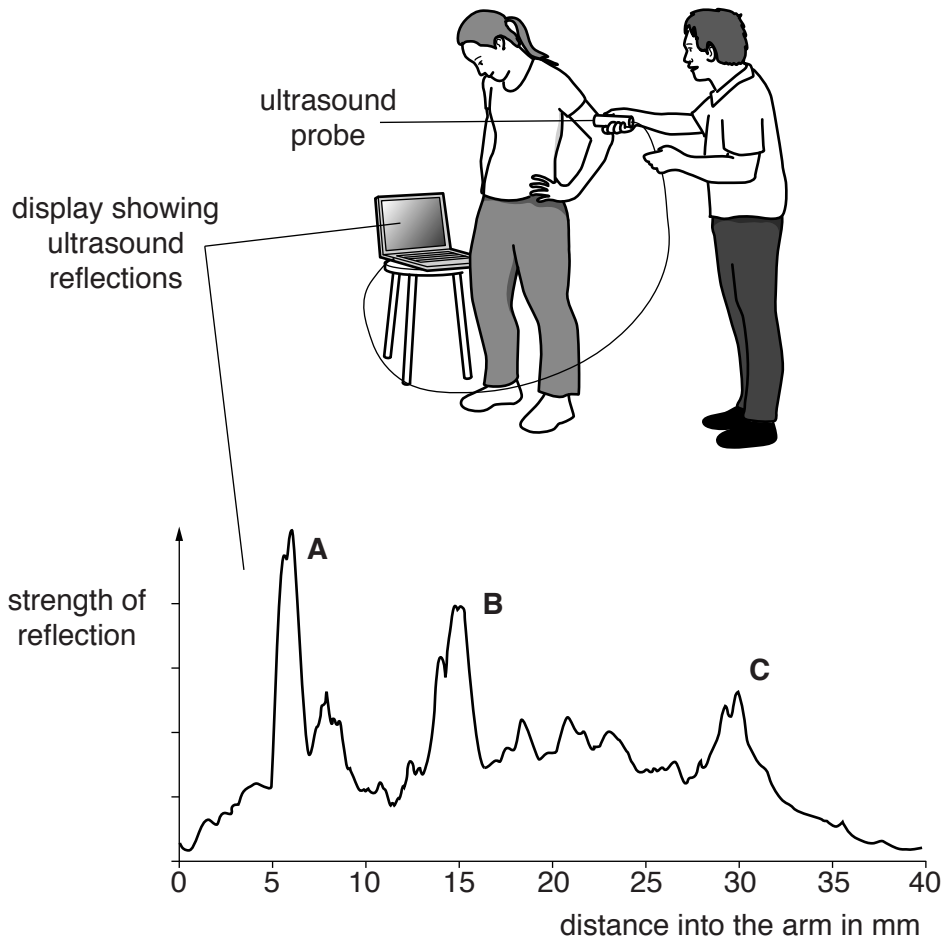
Ultrasound reflects strongly at different tissue layers inside the arm.

The body fat layer is just below the skin.

The different tissue layers in the arm are

*   fat-muscle layer

*   muscle-muscle layer

*   muscle-bone layer.

Why is ultrasound used rather than surgery or X-rays to measure body fat?

Explain what the display shows and how it can be used to find the thickness of body fat in Becky's arm.

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

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.... **[6]**

3 Scientists use several methods to find out when old plants lived.

(a) Here is information about two methods.

	Relative Dating	**Absolute Dating**
Method	Find out where plant fossils are in layers of rocks. Newer rocks are on top of older rocks. The method can be used in very old rocks.	This uses carbon dating. The amount of radioactive Carbon-14 can be measured in dead plants. This can be compared with the amount of Carbon-14 in living plants to find the age.
Problems	Cannot find the exact age of the plant fossils.	Cannot be used for very old dead plants as the amount of Carbon-14 is too low.

Describe why scientists might use both methods to find out when old plants lived.

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.... **[2]**

(b) Another method uses radioactive dating of rocks by calculating the ratio of two metals in the rocks.

One of the metals is uranium.

What is the name of the other metal?

Choose from

lead

potassium

rubidium

strontium

thorium

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

4 Radiation comes from the nucleus of an atom that is unstable.

(a) An alpha particle is a helium nucleus.

What is a beta particle?

Choose the **best** answer from

<div align="center">

an electron

a fast moving electron

a proton

a fast moving proton

</div>

.... **[1]**

(b) What happens to a nucleus when a beta particle is emitted?

Put ticks (✓) next to the **two** correct statements.

mass number is unchanged ☐

nucleus has one more neutron ☐

nucleus has one more proton ☐

atomic number decreases by one ☐

[1]

(c) Radioactive americium (Am) is used in smoke alarms.

(i) Complete the equation for alpha decay.

An alpha particle is a helium nucleus.

$$^{241}_{95}\text{Am} \rightarrow\ ^{......}_{......}\text{Np}\ +\ ^{......}_{......}\text{He}$$
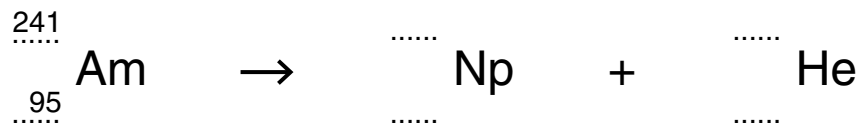
[2]

(ii) Here are two diagrams showing how a smoke detector works.
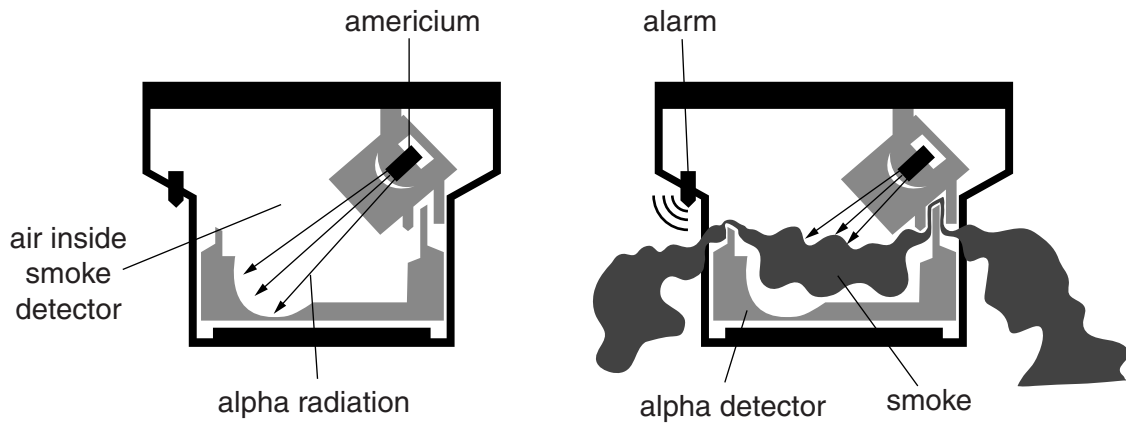
Use the diagrams to describe how a smoke detector works.

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.... **[2]**

5 Patrick walks on a nylon carpet.
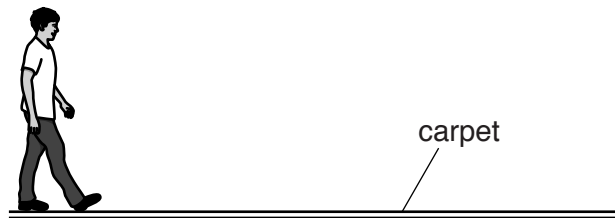
He becomes negatively charged.

(a) Describe how Patrick has become **negatively** charged.

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.... **[2]**

(b) His electrostatic voltage is measured when he walks on the carpet on different days.

electrostatic
voltage
in kV

distance walked on carpet in m
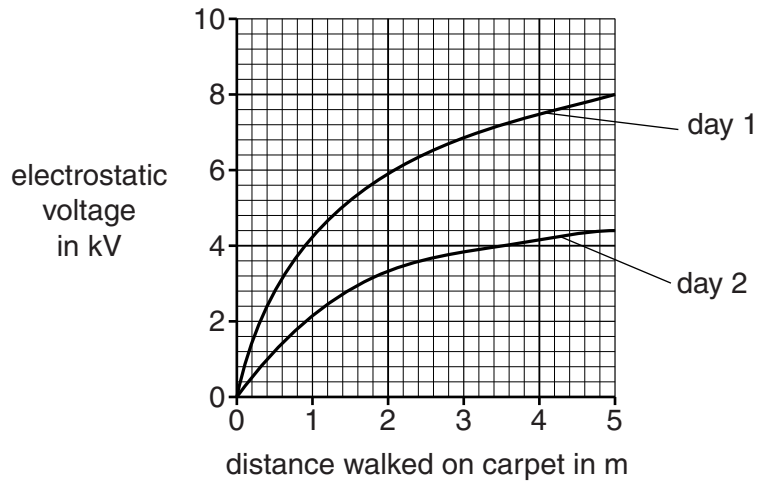
   (i) Use the graph to explain what happens on day **1**.

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   .... **[2]**

   (ii) Suggest what is different on day **2**.

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   .... **[1]**

Turn over

SECTION B – Module P5

6 Artificial satellites are put into space for scientific research.

The satellites are carried into space by rockets.

(a) A rocket accelerates steadily from rest and reaches 8000 m / s after travelling 1 680 000 m.
Calculate the time, in minutes, it takes the rocket to reach this speed.

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answer .... minutes **[3]**

(b) (i) The rocket is now in a stable orbit.
To keep the rocket in this orbit its speed needs to stay at 8000 m / s.
Suggest, by using ideas about gravitational and centripetal forces, why this speed needs
to be maintained to keep it in this stable orbit.

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.... **[3]**

(ii) The rocket re-enters the Earth's atmosphere safely.

In the final part of the descent its speed reduces steadily from 2000 m/s to 120 m/s just before touchdown. This takes place over a distance of 5×10^5 m.

Calculate the average **deceleration** over this distance.

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answer ....m/s^2 **[3]**

(c) The International Space Station (ISS) is an artificial satellite.
The astronauts on the ISS do scientific research.
These astronauts are from different countries that work in teams and publish their results.

(i) Suggest why using teams of scientists on the ISS may be beneficial.

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.... **[1]**

(ii) Suggest why it is important for the scientists on the ISS to publish their results.

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.... **[1]**

Turn over

7 This question is about using electromagnetic waves for communication.

   (a) Microwaves are used to communicate signals between Earth and satellites.
   Sometimes when these signals are received they can be weak or of poor quality.

   Suggest what engineers can do to the microwave dish on Earth to improve communication
   with a satellite. Explain why the improvements work.

   Suggestion 1 ....

   Explanation ....

   ....

   ....

   Suggestion 2 ....

   Explanation ....

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   [4]

(b) Electromagnetic waves are used for communication.
Look at the information about different waves.

Wave	Wavelength	Frequency
A	3.3 m	90 MHz
B	15 m	20 MHz
C	0.006 m	50 GHz

   (i) Which wave is reflected by the ionosphere?

   answer ....

   Explain why you chose this wave.

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   ....
   [2]

   (ii) Which wave can pass through the Earth's atmosphere but is reduced in strength because of absorption and scattering?

   answer ....

   Explain why you chose this wave.

   ....

   ....
   [2]

Turn over

8 Chantal does some experiments using light.

She shines a beam of white light through a prism.

Look at the diagram.

The white light disperses to produce a visible spectrum of colours.

Explain why the white light disperses and why the colours deviate by different amounts.

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

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.... **[6]**
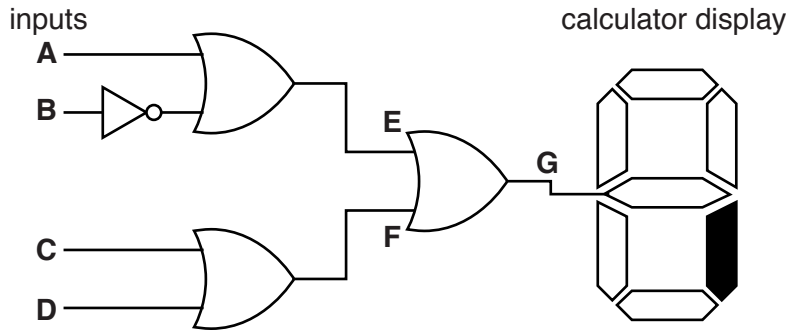
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SECTION C begins on page 18

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SECTION C – Module P6

9 Enzo connects logic gates together to make a logic system.

Look at the diagram.

He completes part of the truth table. The output from the logic system switches the shaded segment on the calculator display on and off.

A	B	C	D	E	F	G
0	0	0	0	1	0	1
0	0	0	1	1	1	1
0	0	1	0	1	1	1
0	0	1	1			
0	1	0	0			
0	1	1	0			
1	0	0	1			
1	0	1	1	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

The shaded segment is switched on for most numbers.

calculator display

```
1234567890
```

Complete Enzo's truth table and use it to describe how his logic system is used to display a segment of the numbers.

Explain your answer using numbers that have a 1 or 0 output at G.

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

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.... **[6]**

10 Transformers are used in many different appliances.

(a) Look at the simple diagram of a transformer.

.... core

.... coil

input

A

B

output

.... coil

this is a diagram of a
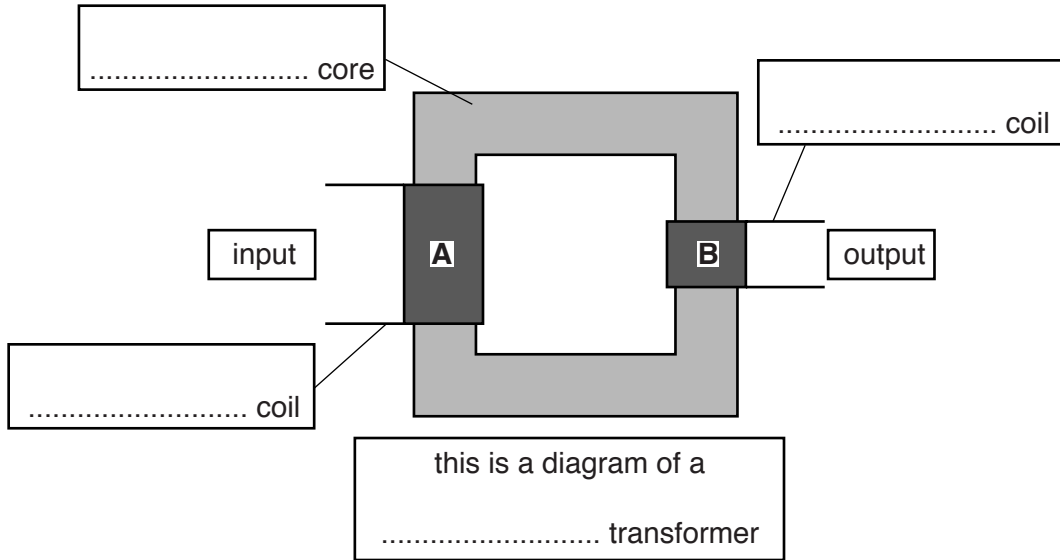
.... transformer

A has 4000 turns and **B** has 150 turns.

(i) Complete the **four** labels on the diagram. **[2]**

(ii) The input voltage is 10 000 V.

Calculate the output voltage.

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output voltage ....V **[2]**

(b) Transformers are devices that work with alternating current (AC).

Explain why transformers require AC.

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.... **[2]**

(c) **Isolating** transformers are an important technological advance.

How have these improved safety in the home?

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.... **[2]**

Question 11 begins on page 22

11 The NPN transistor is the basic building block of electronic components.
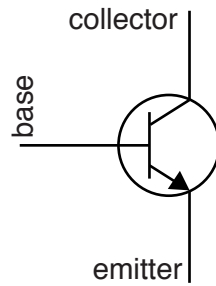
The currents flowing through the transistor terminals are I_c I_b and I_e.

Here are the currents of different transistors.

I_b in mA	I_c in mA	I_e in mA
2	80	....
4	100	....
8	120	....

(a) Calculate the **three** missing values for I_e and put your answers in the table.

[1]

(b) Look at the sizes of the currents I_b and I_c in the table.

  (i) Describe, in general, how I_b is different to I_c.

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  .... **[1]**

  (ii) Explain this difference.

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  .... **[2]**

Question 11(c) begins on page 24

Turn over

(c) Baxter is a new type of robot made by Rethink Robotics.
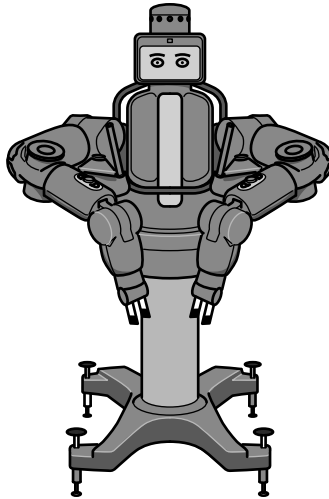
Baxter can carry out repetitive tasks in manufacturing.

It can work alongside humans.

Baxter is able to sense and react to its environment.
Its developers say it has 'common sense'.

Society needs to make choices about the acceptable uses of new technologies like Baxter.

Write about the advantages **and** disadvantages of Baxter.
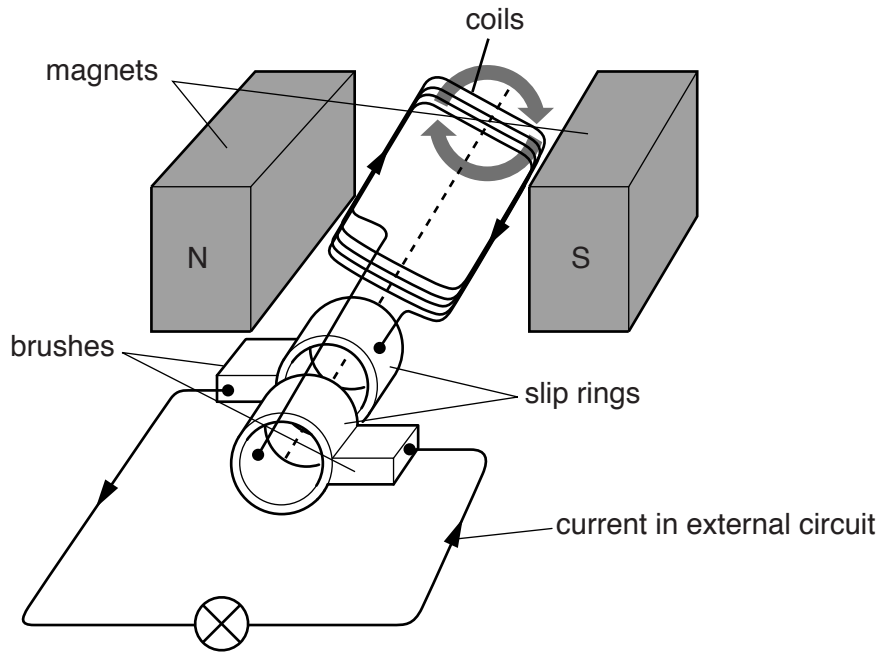
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.... **[3]**

12 AC generators are used to generate electricity.

Here is a diagram of a small AC generator.

(a) Explain how this AC generator works.

Use **all** the labels in the diagram in your explanation.

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.... **[2]**

(b) Look at the diagram.
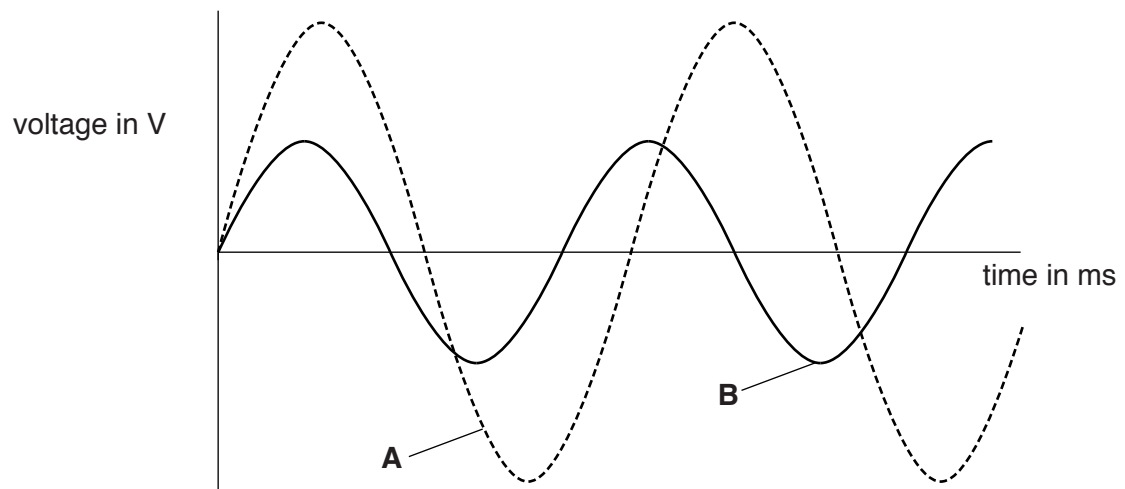
Graph **A** shows the output from this small AC generator.

The generator can also produce the output shown by graph **B**.

Suggest what changes are needed to produce the output shown by graph **B**.

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.... **[2]**

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SECTION D begins on page 28

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SECTION D

13 Rene researches the range of sounds that different people can hear.

(a) Rene's research shows that

'The average person has a hearing range from 20 Hz up to 20 000 Hz'.

Rene tests the hearing range of a group of people.
Look at the data she collects.

Person	Age	Lower frequency limit of hearing in Hz	Upper frequency limit of hearing in Hz	Frequency range of hearing in Hz
Jane	16	22	19 000	18 978
Alec	16	19	20 000	19 981
Dionne	16	24		
Niamh	16	16	21 000	20 984
Evangelos	16	15	20 000	19 985
average	16	19.2	19 800	19 780.8

(i) Rene's original research showed a lower frequency limit of human hearing of 20 Hz.
The data she collects shows an average lower frequency limit of 19.2 Hz.
Suggest reasons for this difference.

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.... **[3]**

(ii) Rene has not completed her table. She has lost some of her results.
Calculate the upper frequency limit of hearing for Dionne.

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....

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answer .... Hz   **[2]**

(b) Look at the data on hearing level loss at different ages.
It shows the hearing loss in dB for different ages at six different frequencies.
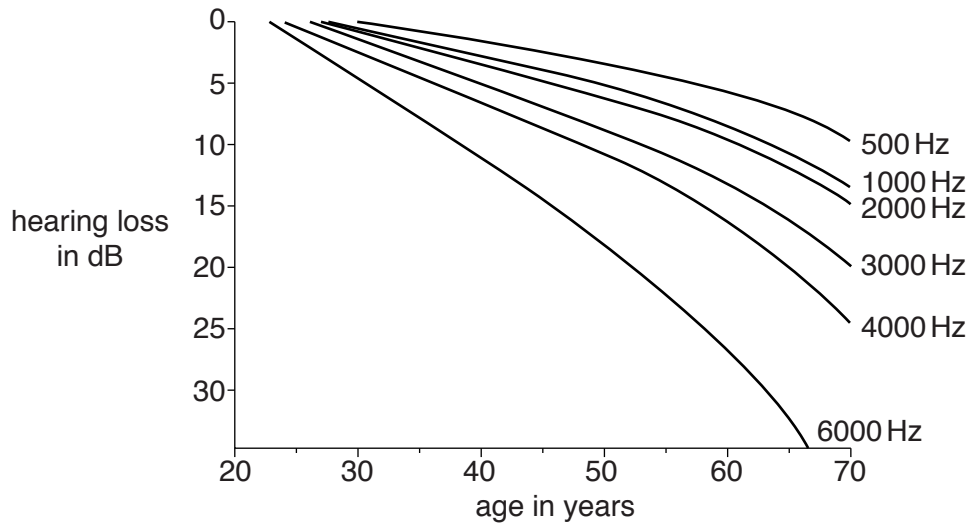
(i) Describe the trends shown by the graph.

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.... **[2]**

(ii) Scientists are developing hearing aids to help people hear high frequency sounds.
These hearing aids can detect sounds of frequency 6000 Hz and above and change them to sounds of half that frequency.

60 year olds can have difficulty hearing sounds above 6000 Hz.
Explain how these hearing aids can improve their hearing.
Use the data from the graph in your answer.

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.... **[3]**

END OF QUESTION PAPER

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