OCR
Oxford Cambridge and RSA

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Wednesday 22 June 2016 – Morning

GCSE GATEWAY SCIENCE
PHYSICS B

B752/02 Physics modules P4, P5, 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

B752/02

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. 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 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 **28** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

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

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module P4

1 Nuclear radiation is used in hospitals.

(a) Nuclear radiation from radioactive sources is used as a medical tracer.

Alpha emitters **cannot** be used as medical tracers.

Explain why.

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

(b) Medical tracers must **not** remain active in the body for long periods of time.

(i) Why is it dangerous for a tracer to remain active in the body for long periods of time?

.....

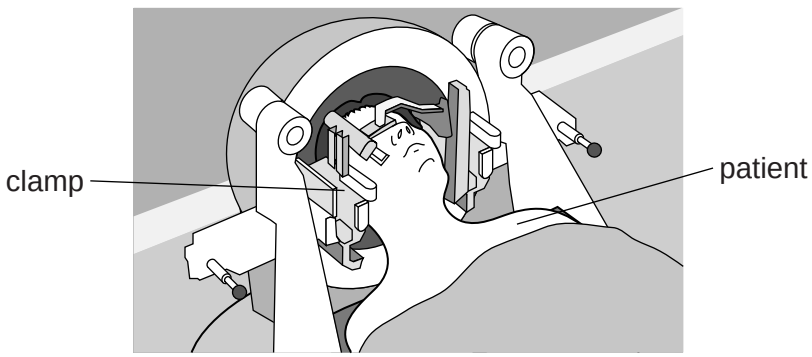
..... **[1]**

(ii) What property of the tracer affects the time it remains active in the body?

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

(c) Gamma knife treatment is used to treat brain cancer.

A gamma knife uses many gamma beams that can be accurately focused on one place.



The patient's head is clamped to keep their head fixed in one position.

Explain why this is important.

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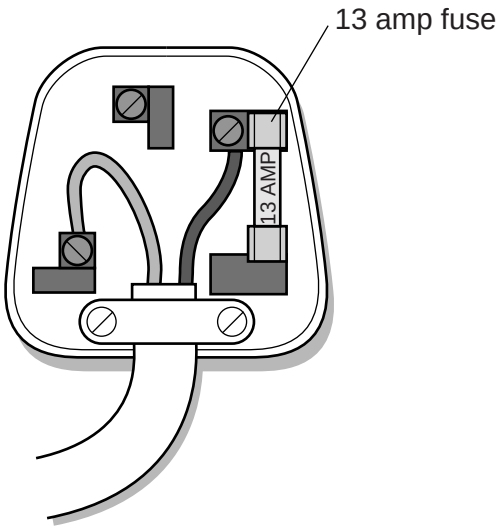
..... **[2]**

[Total: 5]

2 Carly has a hair dryer. The hair dryer has a plastic case as well as an insulated cable.

She attaches a plug to the hair dryer.

Look at the inside of the plug she uses.



Explain why the plug only needs two wires and a fuse.

Explain why this fuse needs to be 13 amp rather than a 3 amp.

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

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

[Total: 6]

3 This question is about static electricity.

(a) Bruno sometimes gets an electrostatic shock when he gets out of his car.

(i) As he gets out of the car he moves across the car seat.

Bruno becomes negatively charged.

Complete the sentence.

The car seat becomes ..... charged because it loses ..... .

[1]

(ii) Bruno sprays the car seat with an antistatic spray.

Explain how this helps to reduce static electricity.

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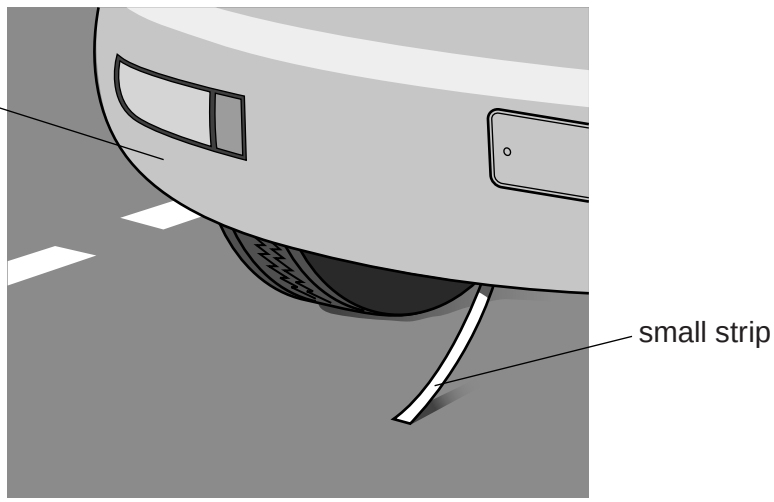
..... **[1]**

(iii) Bruno attaches a small strip to the back of his car.



This strip may reduce the chance of receiving an electrostatic shock but it is unreliable.

Explain why it is unreliable.

.....

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

(b) Designers are working on a pump that allows petrol to leave the pump quickly.

Static electricity can be dangerous when putting petrol in a car.

Suggest a **benefit** of this pump and a **risk** that needs to be considered by the designers.

.....

.....

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

[Total: 5]

4 Nuclear power stations are used to generate electricity.

(a) The statements in the table describe the different stages of the nuclear reaction that takes place in a nuclear reactor.

They are **not** shown in the correct order.

Statement	Statement letter
Energy and neutrons released	**A**
Nuclei are hit by neutrons	**B**
This process is called fission	**C**
Uranium-235 nuclei are in the fuel rods	**D**
Excited uranium-236 nuclei exist briefly	**E**
Uranium nuclei split	**F**

Use the letters **A**, **B**, **C**, **D**, **E** and **F** to put the statements in the correct order.

The first and last letters have been done for you.

D → ..... → ..... → ..... → ..... → **C**

[2]

(b) Nuclear scientists must make sure that nuclear reactions do not go out of control.

They can place control rods in the reactor.

Explain what the control rods do and why they cannot remain in the reactor all the time.

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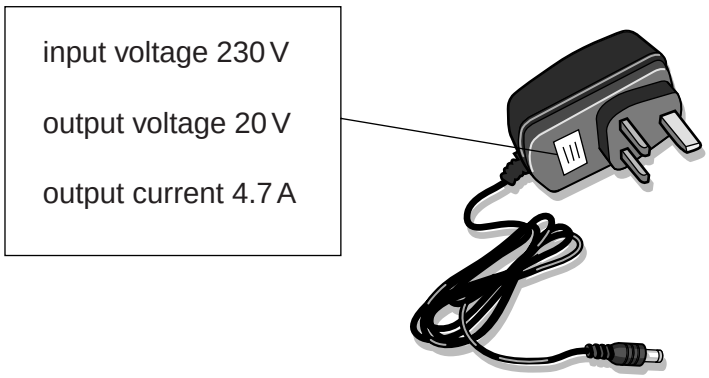
..... **[2]**

[Total: 4]

5 Victoria lives in the UK.

(a) She buys a new computer.

Look at the label on the adapter for the computer.



Calculate the **output power** of the adapter.

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Output power ..... W **[2]**

(b) Victoria notices that different countries have different **input voltages** for home appliances.

Look at the information she finds on the internet.

Country	Input voltage in V
Bermuda	120
Kenya	240
Japan	100
Mexico	127
UK	230

Victoria has a travel iron.

The input voltage to the iron varies for different countries.

The iron is designed to keep the current the same in each country.

(i) In which country does the iron have the most electrical power?

.....

Explain your answer.

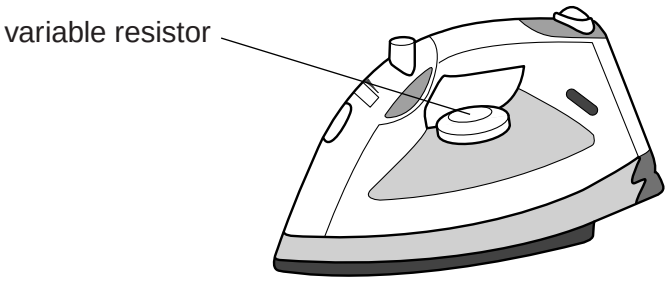
.....

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

(ii) Victoria's travel iron is not very good at getting creases out of clothes when she uses it in Japan.

She buys a different travel iron with a variable resistor.

Look at the picture of the different travel iron.



She uses the variable resistor in the iron to change the current.

She now finds that the new iron is more effective at getting rid of creases when she uses it in Japan.

Use the information in the question to explain why.

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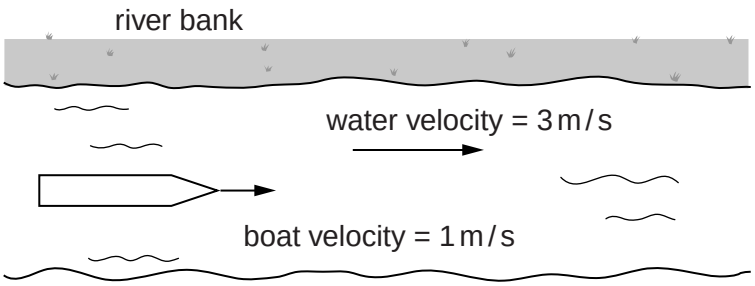
..... **[2]**

[Total: 5]

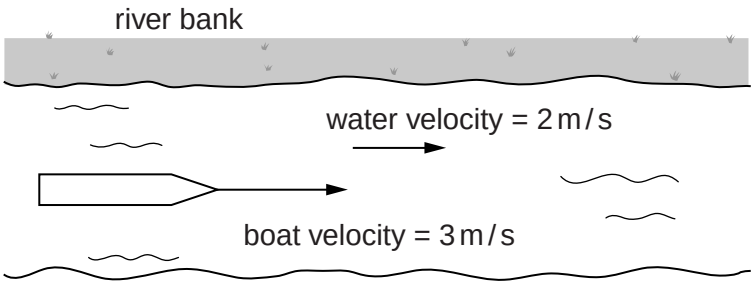
SECTION B – Module P5

6 Look at the diagrams, **V**, **W**, **X** and **Y**, each showing a rowing boat on different parts of a flowing river.

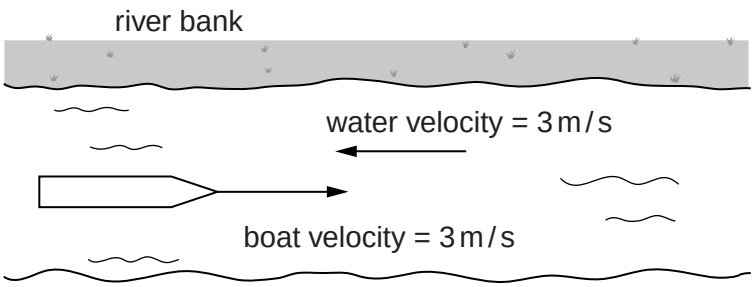
V



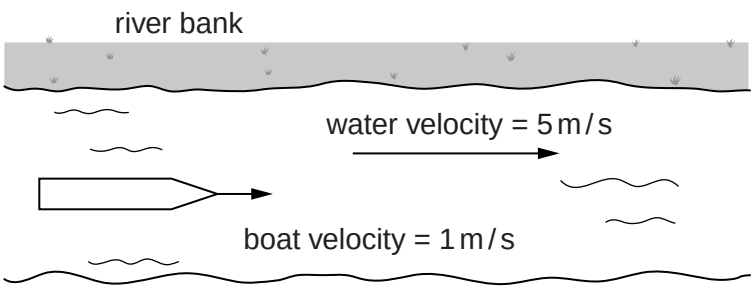
W



X



Y



(a) The diagrams show the **velocities** of the boat and the water flow.

(i) What is the **difference** between speed and velocity?

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

(ii) Which boat has the largest **resultant** velocity as seen from the river bank?

Choose from **V**, **W**, **X** or **Y**.

.....

Explain your answer.

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

(b) A horse and rider are training for a race in a field.

The horse accelerates steadily from 2 m/s to 6 m/s over a distance of 28 m.

initial velocity final velocity

Calculate the time taken for the horse to accelerate over this distance.

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answer ..... s **[2]**

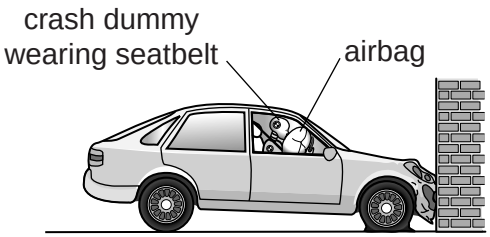
[Total: 5]

7 Scientists check the safety of cars by doing crash tests with crash dummies.

They use sensors to make measurements.

They put the sensors in the car and on the crash dummy.

Look at the diagram of a car crashing into a wall.



(a) When the car hits the wall, a sensor triggers the fast release of a large amount of gas into the airbag.

The gas particles cause the airbag to inflate.

Explain, using ideas about momentum, how the gas particles create enough force to increase the pressure in the airbag.

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

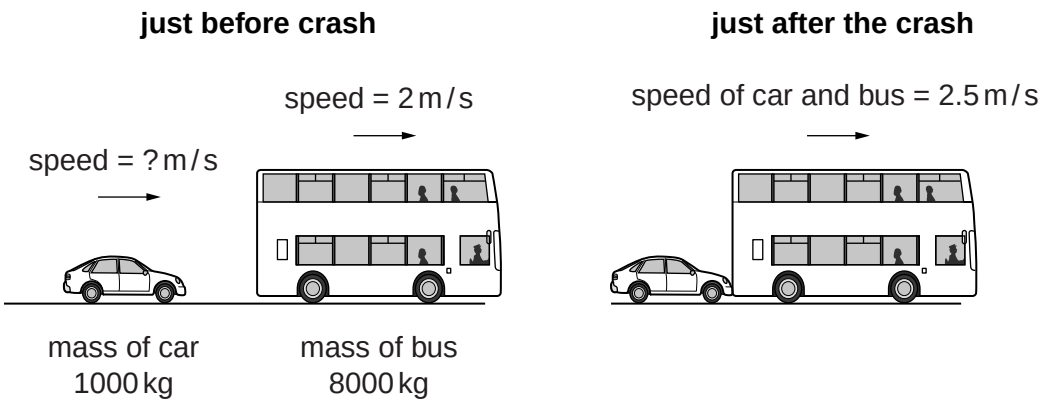
(b) A minor accident happens outside school. The police investigate the accident.

Here are the facts:

- **the speed limit outside school is 9 m / s (20 miles per hour)**
- **a car runs into the back of a bus**
- **the car and the bus move together at the same speed after the collision.**

The police need to find out if the car was breaking the speed limit.

Look at the information in the diagrams.



Use a calculation to find the speed of the car just before the accident.

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Car's speed before crash = ... m / s

Did the car break the speed limit? ..... .

[3]

[Total: 5]

8 Some waves in the electromagnetic spectrum are used for communication.

(a) Some radio stations use long wavelengths for broadcasting.

These radio waves have a very long range on Earth.

Explain why.

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

(b) Two radio waves may produce interference.

(i) What properties of waves are needed to produce interference?

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

(ii) Sometimes destructive interference between radio waves is only partial.

Suggest why **partial** destructive interference may occur and what effect this may have on the resulting radio waves.

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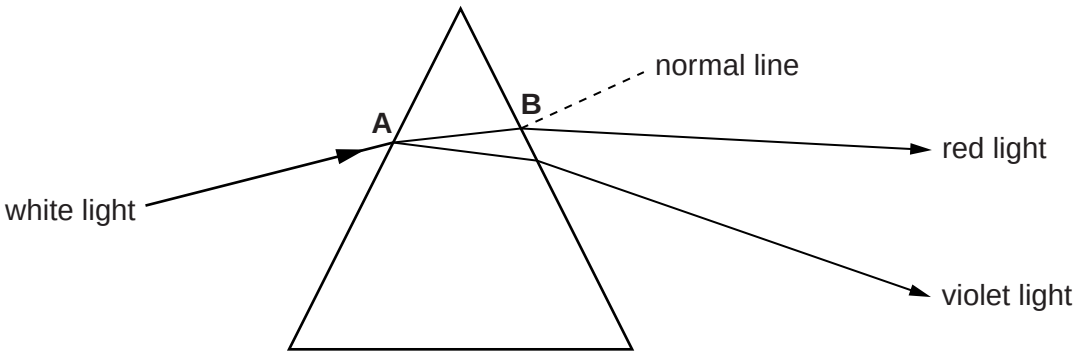
..... **[2]**

[Total: 5]

9 Look at the diagram. It shows white light entering a glass prism at **A**.



The red light refracts away from the normal at **B**.

(a) Use ideas about waves to explain why this happens.

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

(b) Violet light refracts **more** than red light.

Explain why.

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

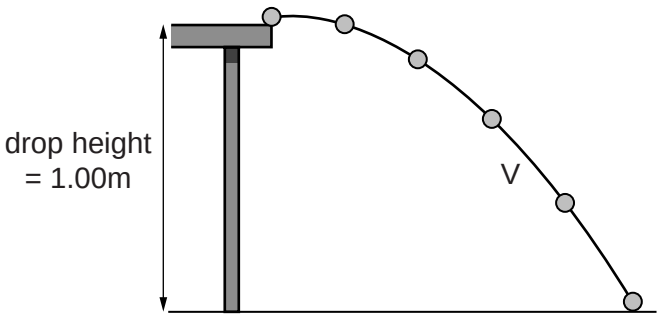
[Total: 4]

10 Gita rolls a marble at a velocity V off the edge of a desk.

She uses a camera to show the path of the marble.

Look at the diagram.

It shows the position of the marble at equal time intervals.



The acceleration due to gravity (g) is $10\,m/s^2$.

Describe and explain the horizontal and vertical accelerations of the marble and calculate the time taken for the marble to fall.

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

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

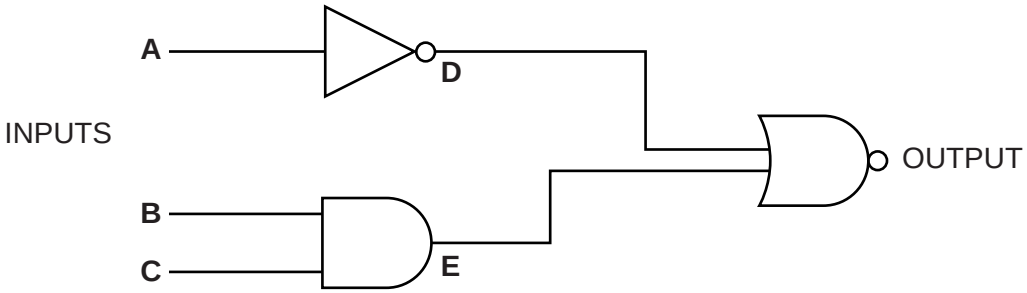
[Total: 6]

SECTION C – Module P6

11 This question is about logic gates.

(a) Liesl builds a circuit using three logic gates.

Complete the truth table for his circuit.



A	B	C	D	E	OUTPUT
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]

(b) Liesl decides to use the output of the logic gates to ring a bell.

He uses a relay between the output of the logic gate and the bell.

Explain why he needs to include a relay in his circuit.

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.....

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

[Total: 5]

12 The National Grid transfers power from power stations to homes and factories.

(a) The current in a circuit which is part of the National Grid is 100 A.

The resistance of this part of the circuit is 200 Ω.

Calculate the power loss in this part of the circuit in MW.

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answer ..... MW **[2]**

(b) The transmission voltages in the National Grid are very high.

Describe one **risk** and one **benefit** of using high voltages to transmit electricity.

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

(c) Transformers are used as part of the National Grid to change voltages.

Jack has completed his homework on transformers.

He asks John to check his homework.

John finds two mistakes in the **voltage columns**.

Row	Primary coils	Secondary coils	Input voltage in V	Output voltage in V	Step up / down
A	25	250	10	100	Step-up
B	2000	10000	40	200	Step-up
C	400	20	50	1000	Step-down
D	30	600	10	1000	Step-up

Identify which two rows in the table, **A**, **B**, **C** or **D** are incorrect and explain why.

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

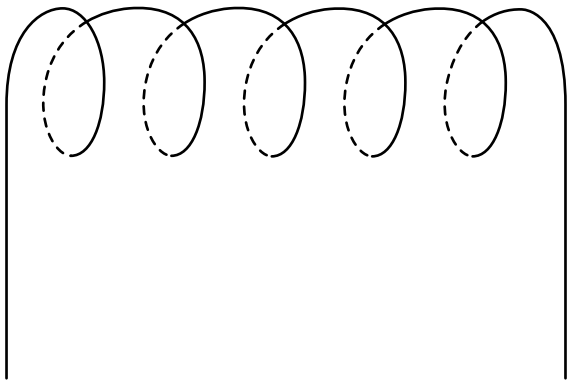
[Total: 6]

13 (a) (i) Mia investigates electricity and magnetism.

She connects a solenoid to a power supply.

The solenoid produces a magnetic field.

On the **diagram**, sketch the shape of the magnetic field produced.



[2]

(ii) Mia reverses the direction of the current through the solenoid.

Write down the effect this has on the magnetic field.

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

(b) Mia has a simple electric motor.

She can increase the speed of the motor by increasing the current.

Write down one other way she can change her motor to increase its speed.

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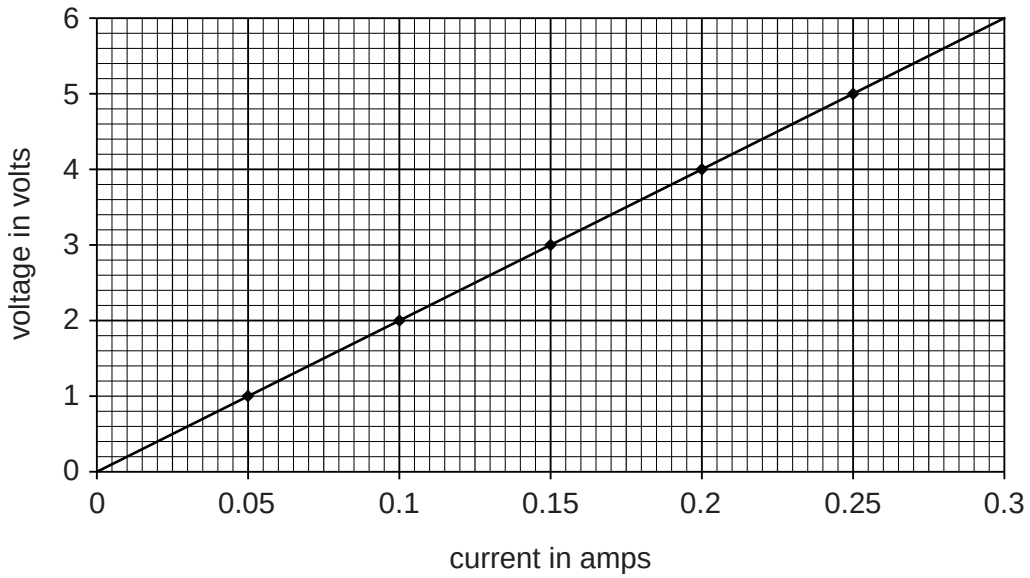
..... **[1]**

[Total: 4]

14 **(a)** Anna investigates how the current through a resistor changes with voltage.

She plots her results on a graph.



What is the resistance of the resistor that Anna used?

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answer ..... Ω **[2]**

(b) Anna replaces the resistor with one that has 3 times the resistance value.

Describe, and explain, how the gradient of the graph would change.

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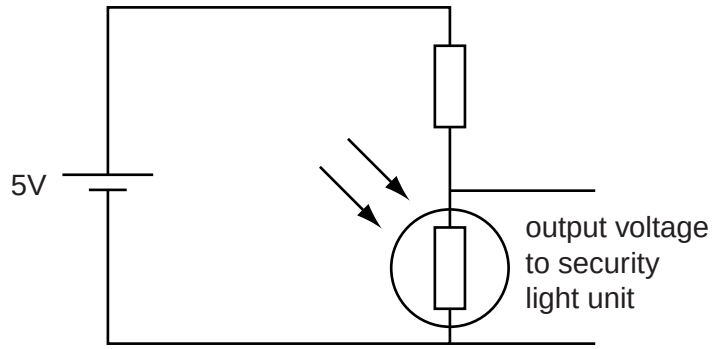
..... **[2]**

[Total: 4]

15 Felippe has a security light which turns on when it becomes dark.

An LDR can be used as part of a potential divider circuit to turn on the security light.

Look at the diagram.



Explain how the potential divider circuit and the LDR can be used to turn on the security light when it becomes dark.

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

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

[Total: 6]

SECTION D

16 We use electricity to provide energy in our everyday activities.

(a) Look at the table.

It shows the average electrical energy in kWh used per person each day in different countries.

Country	Average electrical energy used per person each day in kWh
Austria	4.3
Belgium	6.2
Denmark	5.2
Finland	9.7
France	5.8
Germany	4.3
Ireland	4.6
Luxembourg	4.4
Norway	20.5
Sweden	12.9
Switzerland	5.8
UK	5.0

(i) In the UK the Smith family use 7300 kWh of electrical energy in a year (365 days).

Use the figures in the table to calculate the number of people in the Smith family.

Show your working.

.....

.....

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

(ii) The average electrical energy use **per person** each day in the UK is less than that in Belgium.

However, as a country, Belgium uses less electrical energy than the UK.

Suggest a reason why.

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

(b) Energy can be lost through the walls of houses.

Different types of wall have different **U-values**.
This is a measure of how much energy is lost through the wall.

Jenny's house has a single brick wall which has a U-value of 2.0 W/m^2 °C.
This means that every 1 m^2 of the wall, with a temperature difference of 1 °C across it, will lose 2.0 J of energy every second.

The side wall of Jenny's house has an area of 50 m^2.
In the winter, the average temperature difference between the inside of the house and the outside is 12 °C.

(i) Calculate the energy lost through the wall each second for this temperature difference.

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.....

energy lost = ... unit = ... **[3]**

(ii) In a cold winter, the average temperature difference is greater than 12 °C.

How will this affect the energy lost each second through the wall?

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

(c) The front wall of Jenny's house is a double brick wall with insulating foam in the gap between the bricks.

This wall has a U-value of 0.5 W/m^2 °C.

When the outside temperature is 10 °C and the inside temperature is 22 °C the energy transfer rate through the wall is 240 W.

Calculate the area of the front wall.

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.....

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

[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.