OCR
Oxford Cambridge and RSA

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Wednesday 21 June 2017 – 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

* B 7 5 2 0 2 *

* 6 7 5 5 3 2 7 3 1 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 barcodes.

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

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

$$v = u + at$$

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

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

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

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

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

$$I_e = I_b + I_c$$

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

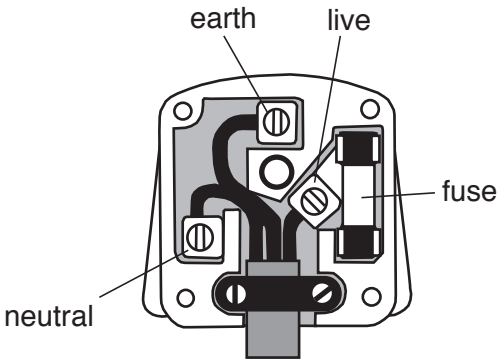
power loss = (current)^2 × resistance

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module P4

1 Look at the diagram of a plug for an appliance.



(a) Describe the functions of the live, neutral and earth wires.

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

(b) The plug has a fuse.

If the current is too large the fuse melts.

What is the safety reason for the fuse melting?

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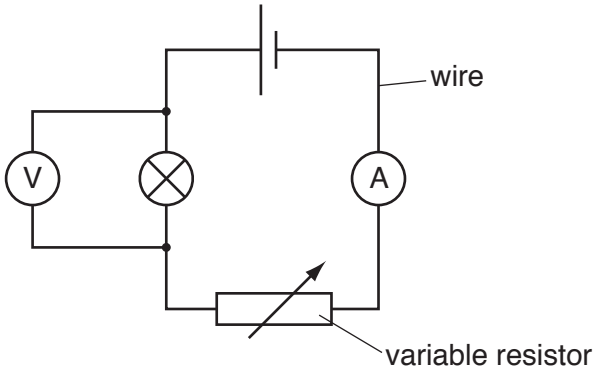
..... **[1]**

(c) Riya connects an electrical circuit.



The voltmeter reading is 3.0 V.

The ammeter reading is 1.5 A.

(i) Calculate the resistance of the lamp.

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answer ..... ohms **[2]**

(ii) Riya wants to decrease the total resistance of the circuit.

She **cannot** change the voltage.

Describe **two** changes she could make to this electrical circuit to decrease the total resistance.

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

2 **(a)** Radioisotopes can be used as tracers in industry.

(i) Explain why gamma sources are more useful as a tracer than alpha or beta sources.

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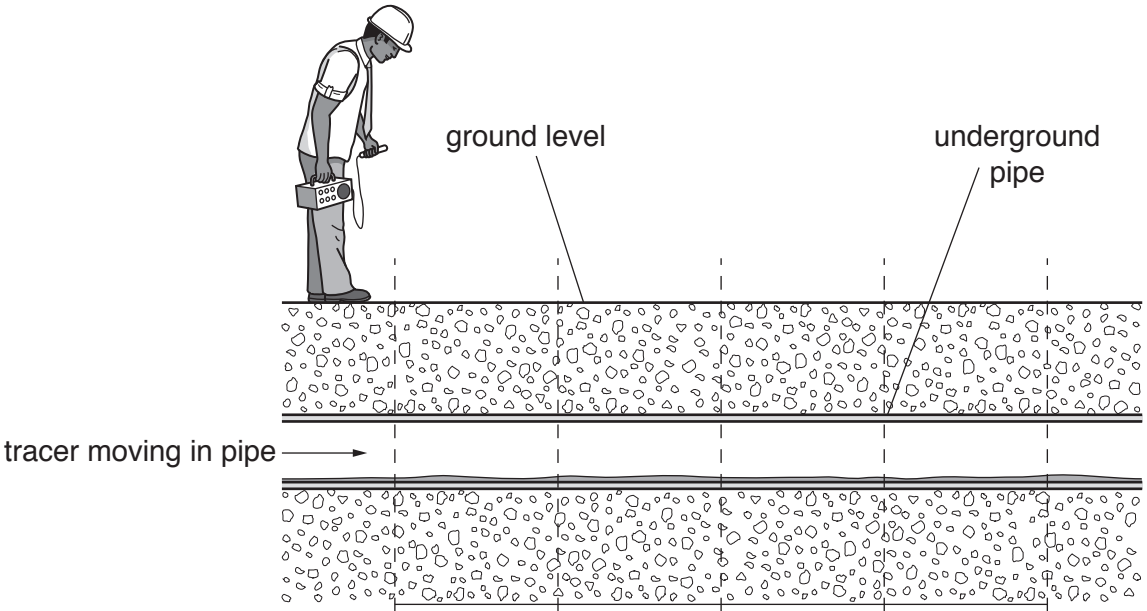
(ii) Tracers can be used to find a blockage in an underground pipe.



area A	area B	area C	area D
27	26		

The table shows the readings for the amount of radiation in each area.

There is a blockage between area **C** and area **D**.

Predict the readings for area **C** and area **D** and explain why you have predicted these readings.

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

(b) The amount of carbon in dead plants is used to find their age.

When they were alive they took in Carbon-14 (C-14) and Carbon-12 (C-12).

Scientists measure the amount of these two types of carbon.

Percentage of C-14 remaining	Percentage of C-12 remaining	Number of years dead (Age)
100	100	0
50	100	5 730
25	100	11 460
12.5	100	17 190

(i) Use the information in the table to explain what happens to the two types of carbon when the plant dies.

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(ii) Calculate the age of a dead plant with 6.25 percentage of C-14 remaining.

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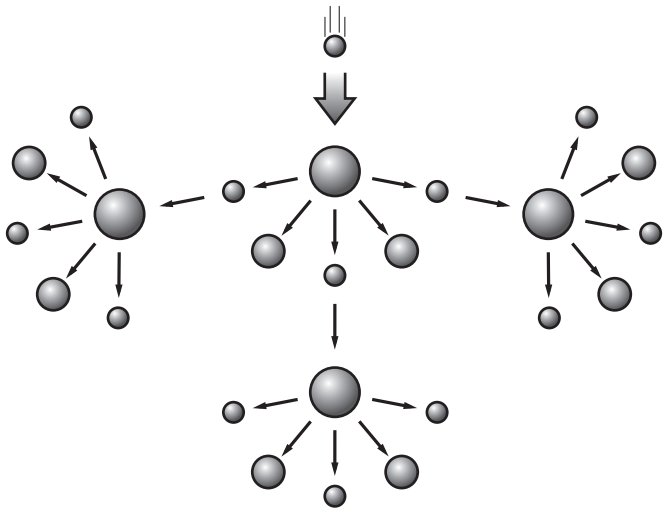
..... **[1]**

3 Carlos draws a diagram to show what happens in a chain reaction.



Label the diagram and use it to explain what happens in a chain reaction.

Describe the differences between a chain reaction in a nuclear reactor and in a nuclear bomb.

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

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

4 **(a)** Different hydrogen isotopes can undergo fusion.

Complete the **three** gaps in the nuclear equations.

$$^{1}_{1}H + {}^{2}_{1}H \rightarrow {}^{.....}_{2}He$$

$$^{2}_{.....}H + {}^{.....}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$$

[3]

(b) 'Cold fusion' is fusion at room temperature.

An Italian inventor claims he has achieved 'cold fusion'.

He has demonstrated his claims but has **not** shared any details or data.

(i) Explain why it is important to share details and data with other scientists.

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

(ii) Explain why 'cold fusion' is **not** accepted as a method of energy production.

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

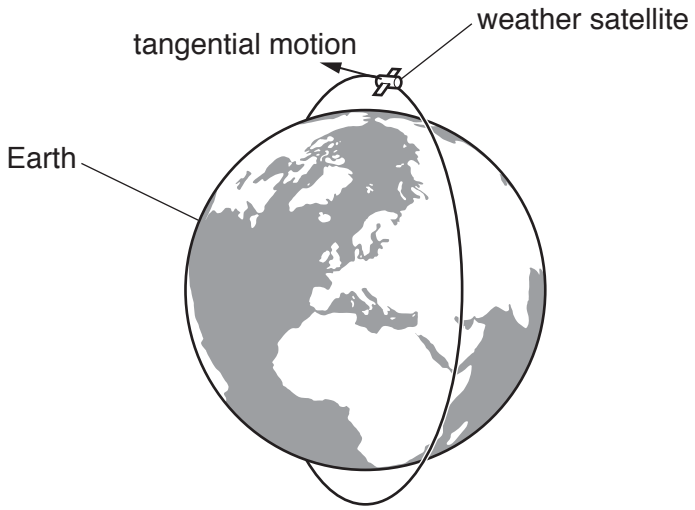
SECTION B – Module P5

5 Satellites are objects that orbit larger objects in space.

(a) Artificial satellites constantly accelerate towards the Earth.

Their tangential motion keeps them moving around the Earth.

Look at the diagram.



Explain what will happen if the tangential motion is too fast or too slow.

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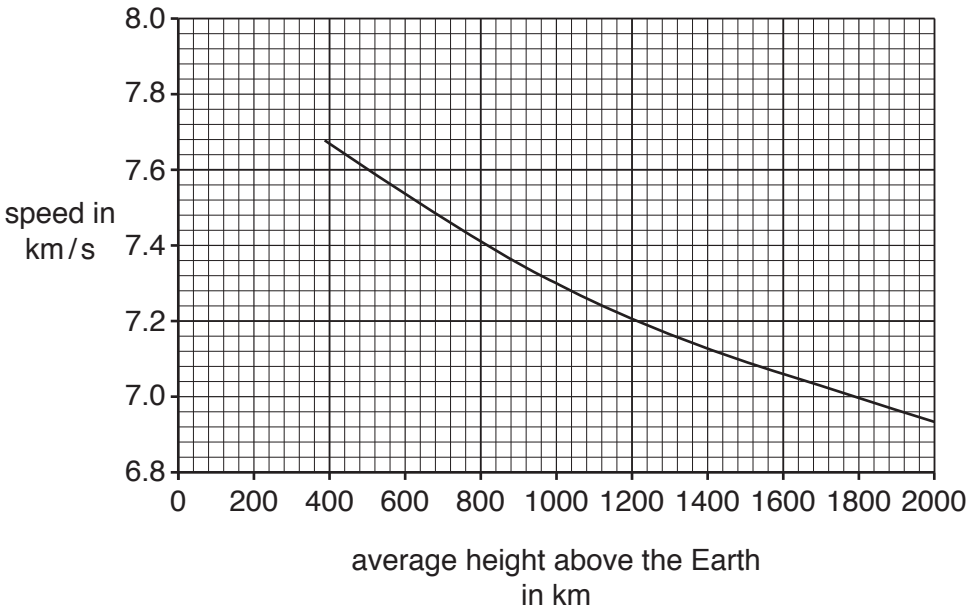
(b) Weather forecasting satellites are in a Low Earth Orbit (LEO).

The average height of a satellite above the Earth is linked to its speed.



(i) This artificial satellite is in orbit at an average height of 200 km above the Earth.

Use the graph to estimate its speed.

Speed ..... km/s **[1]**

(ii) Explain why artificial satellites have different speeds.

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(iii) Write down one **advantage** of a Low Earth Orbit (LEO) weather satellite.

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

(c) LEO satellites and geostationary satellites communicate with the Earth.

Look at the information about different waves.

Wave	Frequency in kHz	Wavelength in m	Property
A	more than 30 000 000	less than 0.01	scattered
B	less than 30 000	more than 10	reflected by ionosphere
C	30 000 to 30 000 000	0.01 to 10	pass through the atmosphere

Which wave is best for communicating with

- LEO satellites
- geostationary satellites?

Explain your answers.

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6 Velocity is a vector quantity.

It can be calculated by using equations or by drawing scale diagrams.

(a) Describe the difference between scalar and vector quantities.

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

(b) The diagram shows a car accelerating.

The car accelerates at $0.6\,m/s^2$ for 10 s.

The car has a final velocity of 11 m/s.

Calculate the starting velocity.

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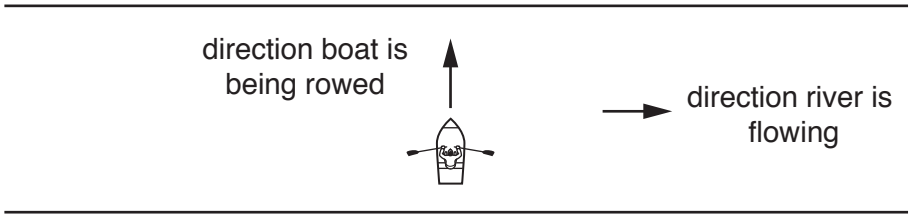
answer ..... m/s **[2]**

(c) A boat is rowed across a river at 4 m/s.

The river flows at 3 m/s.

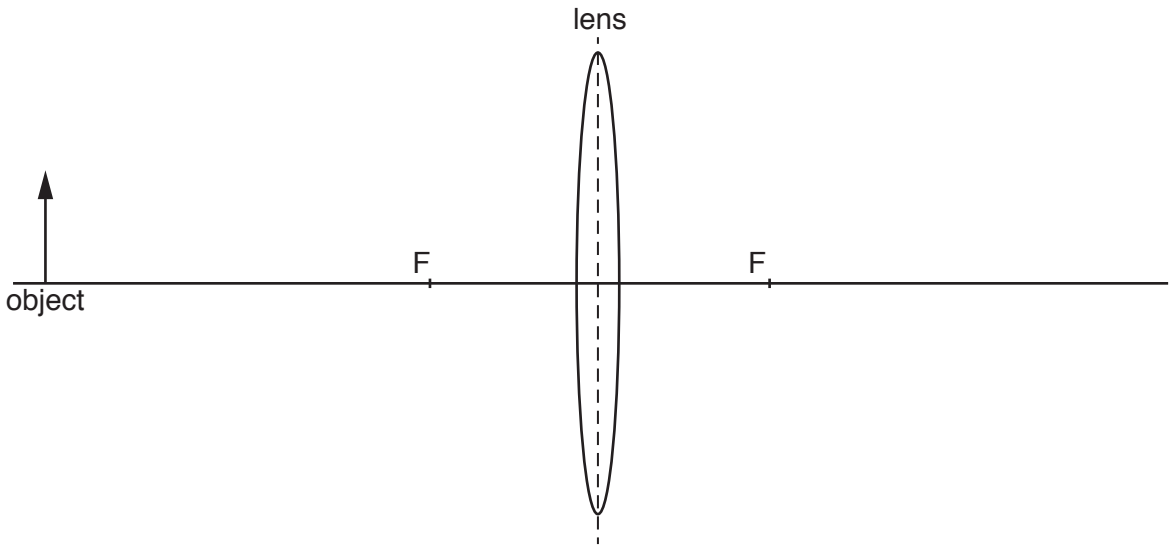


The velocities are at right angles to each other.

Use a scale diagram to find the **size** and **direction** of the resultant velocity.

[3]

7 Anya starts drawing a ray diagram for a convex lens.



The magnification of the lens is 0.5 and the object height is 1.5 cm.

Complete the ray diagram to show the size and position of the image. Calculate the size of the image and use your diagram to explain refraction by a convex lens.

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

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8 Models are useful in physics.

(a) There are two different models for the nature of light.

- Isaac Newton thought that light was made up of particles
- Christiaan Huygens thought light was made up of waves.

The particle model can be used to explain reflection.

Explain why the particle model **cannot** be used to explain interference.

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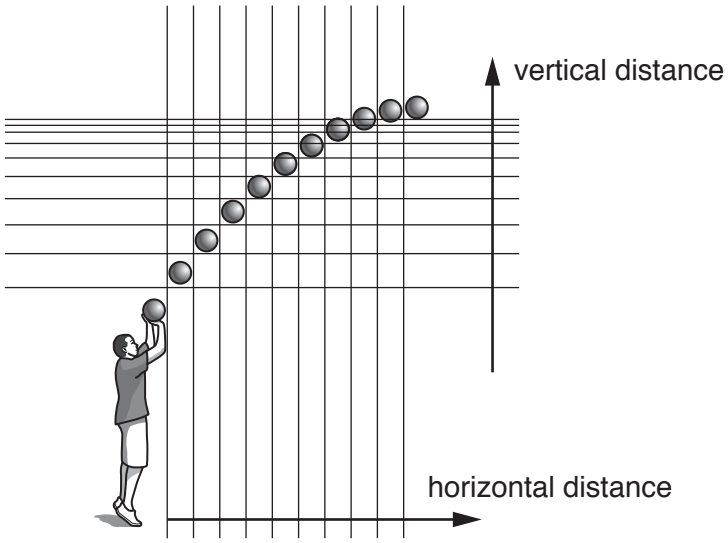
(b) Motion can also be shown with a model.

Eric throws **one** ball.

His friend takes photographs at equal intervals and puts them together.

Look at the picture of all the photographs.



The horizontal distance between each ball is the same.

The vertical distance between each ball is getting smaller.

Explain why these two distances are different.

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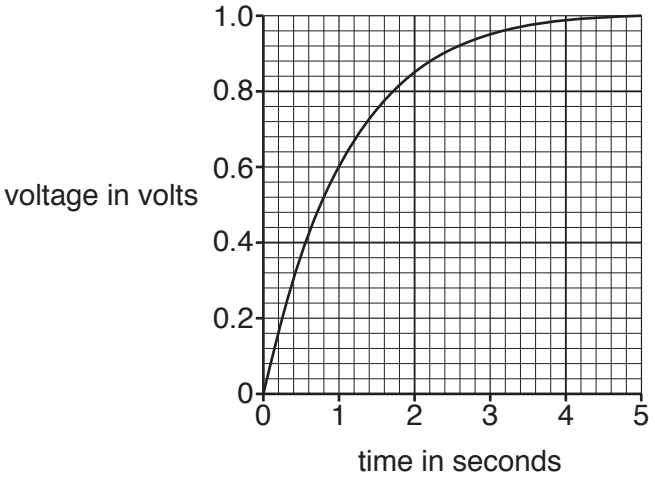
SECTION C – Module P6

9 Dev investigates using a capacitor in an electrical circuit.

(a) Dev connects the capacitor into a circuit.

He draws a graph of the voltage across the capacitor against time.



The capacitor is uncharged before he connects the electrical circuit.

(i) Compare the changes in voltage across the capacitor from 0 to 2.5 seconds **and** from 2.5 to 5 seconds.

Use information from the graph in your answer.

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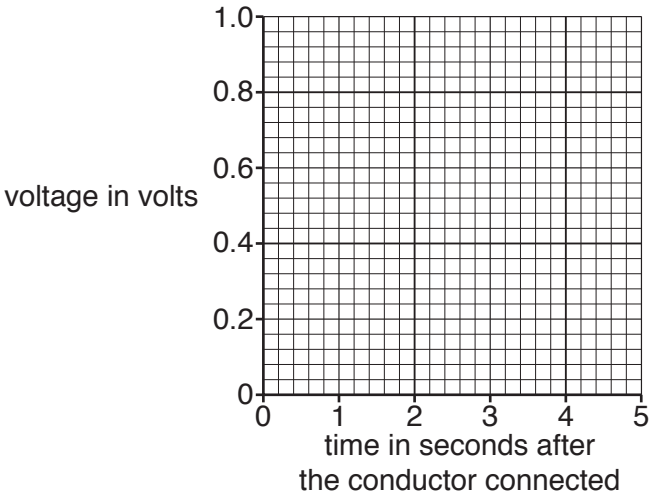
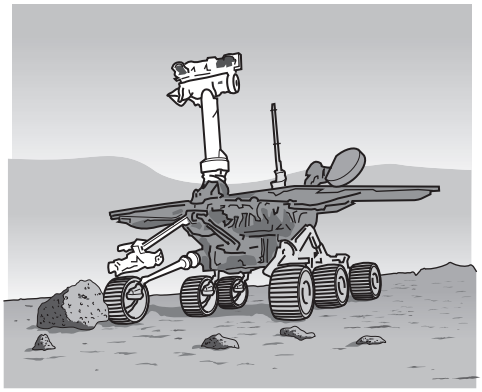
(ii) Dev connects a conductor across the fully charged capacitor.

Draw a line on the graph to show what happens to the voltage across the capacitor after it is connected.



[2]

(b) Space probes are transported long distances to Mars.



Glass capacitors are used to 'wake up' space probes when they reach Mars.

Space probes need large voltages for their electrical components to work.

Explain the risks **and** benefits of using capacitors in space probes.

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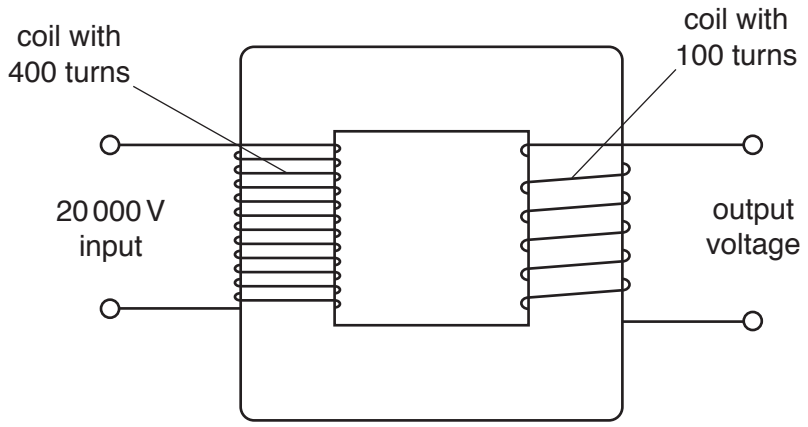
10 **(a)** Transformers are constructed using wire and an iron core.



(i) Describe the construction of **this** transformer.

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

(ii) Calculate the output voltage.

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answer ..... V **[2]**

(b) Isolating transformers have two main features:

- the primary and secondary coils have equal numbers of turns
- they improve safety in some mains circuits.

Explain why these **two** features are important in a bathroom shaver socket.

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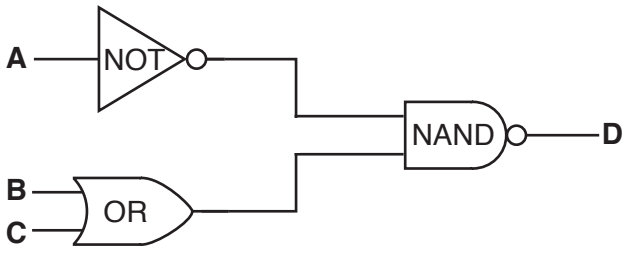
..... **[2]**

11 Gary builds a logic circuit containing three logic gates.



A	B	C	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

He wants to use the circuit to switch on a powerful motor.

When the output at **D** is high, a relay switches on a current in a circuit containing the motor.

Complete the truth table and use it to explain when the relay switch works and why a relay is needed.

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

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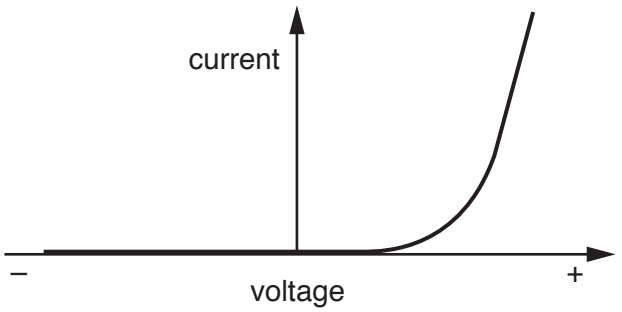
12 Tanya uses different components in a circuit.

(a) (i) She measures the current and voltage across one of the components.



Tanya looks at the graph and decides this component is a silicon diode.

Explain why Tanya is correct.

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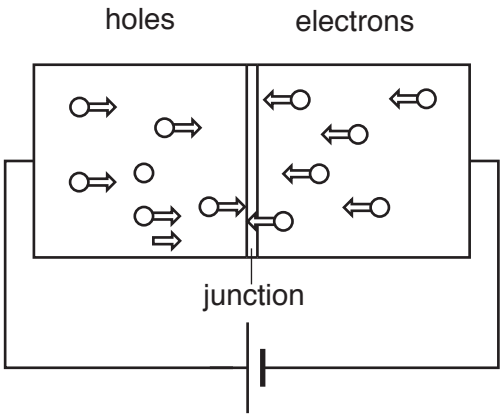
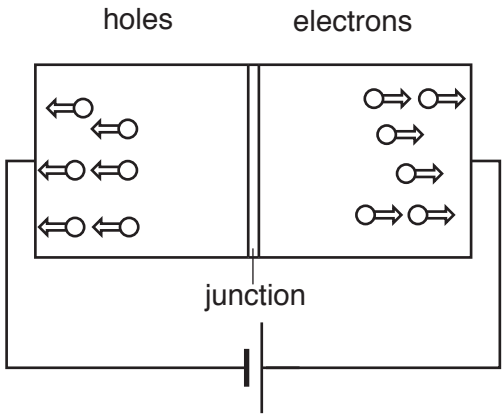
(ii) Tanya draws two diagrams to show how a silicon diode works.



current across the junction



no current across the junction

The holes are positive (+) and the electrons are negative (–).

Use the diagrams to explain how a diode works.

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

(b) Another component in the circuit is a thermistor.

Tanya measures the resistance of this thermistor at different temperatures.

Temperature in °C	Resistance in ohms
15	15.8
20	12.4
25	10.0
30	8.0
35	6.5
40	5.3

Describe, in detail, how the resistance of **this** thermistor varies with temperature.

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

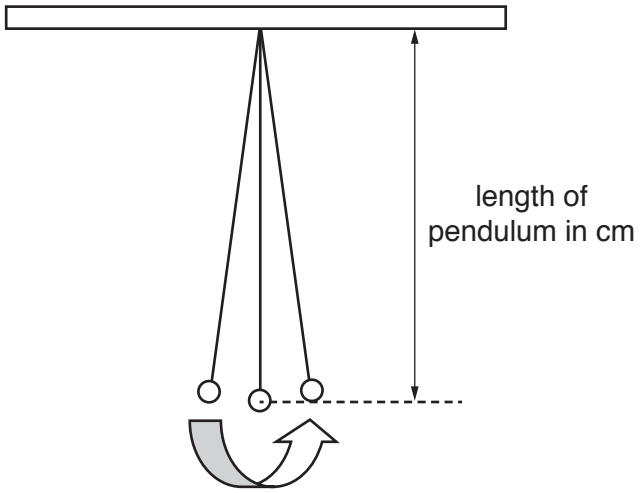
SECTION D

13 Helen investigates children's swings.

She models the swings in the laboratory using weights attached to a string.

This type of swing is called a **pendulum**.

She sets up a pendulum and makes it swing.



(a) Helen uses a pendulum that has a length of 60 cm.

She measures the time it takes the pendulum to complete 10 swings.

She repeats this three times, **A**, **B** and **C**.

Look at her results.

Length of pendulum in cm	**Time for 10 swings in s**			
	A	**B**	**C**	**Mean (average)**
60	16.35		15.65	16.00

The results table is incomplete.

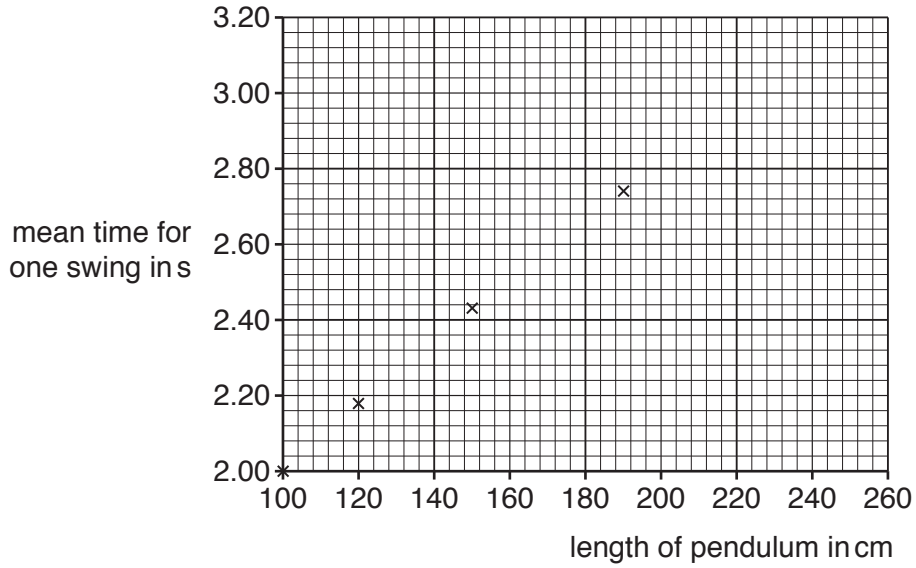
Use the data to calculate the missing value **B**.

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

(b) Helen wants to find out about real swings, like those used by children.

She uses longer pendulums and investigates the effect of changing the length.

Look at the graph of Helen's results.



Helen wants to make a pendulum that takes 3 s for one complete swing.

Predict the length of this pendulum.

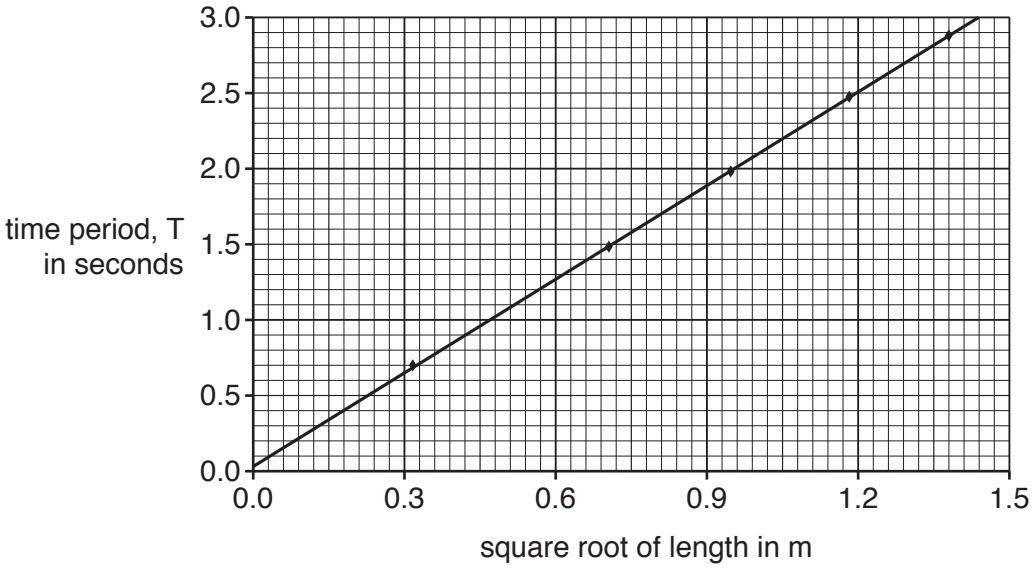
Show your working on the graph.

answer ..... cm **[2]**

(c) Helen collects more results using a pendulum.

She processes her results.

Look at her graph.



(i) Describe the relationship shown in the graph.

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(ii) Helen does some research.

She finds out this information:

- the time it takes for one complete swing is called the time period, T.
- **g** = 10 m/s^2 (the acceleration due to gravity)
- **L** = the length of the pendulum
- π = 3.142

Helen finds an equation which describes the behaviour of pendulums.

$$T = 2\pi \sqrt{\frac{L}{g}}$$

She wants to find the time period, T for a longer swing.

Calculate the time period for a swing that is **3 m** long.

Give your answer to one decimal place.

answer ..... s. **[3]**

(iii) Helen needs to make a swing with a time period, T, of 1 second.

Calculate the length of a pendulum with a time period of 1 second.

answer ..... m. **[2]**

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 margin(s).