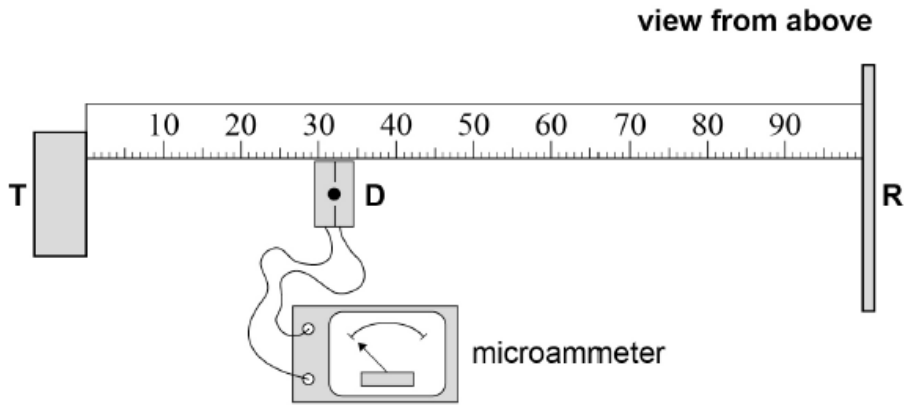
AQA – Waves – AS Physics P2

1. June/2021/Paper_7407_02/No.01

0 1 A student investigates stationary waves using microwaves.

Figure 1 shows a metre ruler fixed to a bench. The student places a microwave transmitter **T** at one end of the ruler and a vertical metal reflector **R** at the other end. **R** is at a right angle to the ruler.

Figure 1



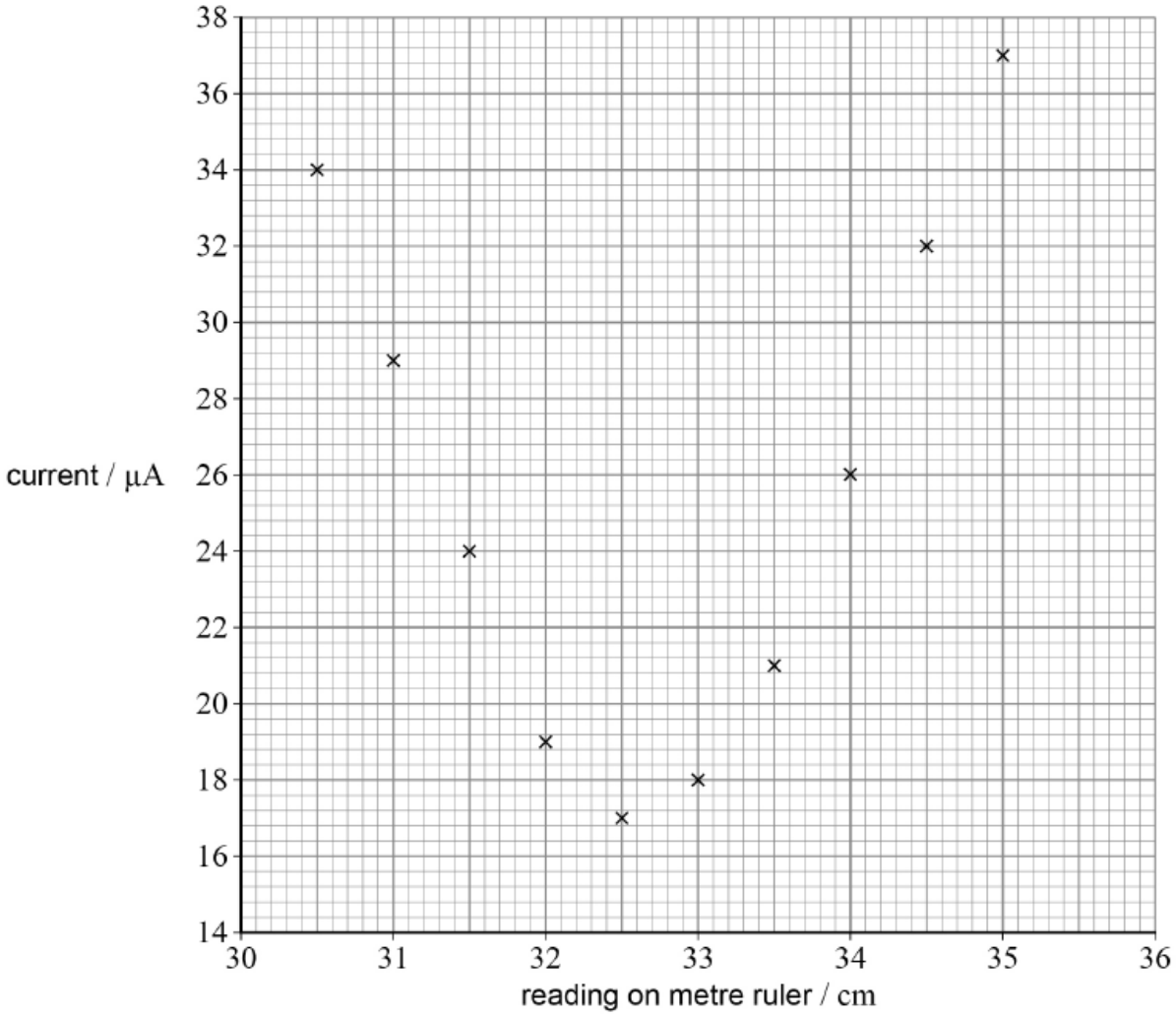
The student places a microwave detector **D** approximately one-third of the distance from **T** to **R**. When **T** is switched off, the microammeter connected to **D** reads zero.

When **T** is switched on, stationary waves are produced between **T** and **R**, and the microammeter registers a current. When the student moves **D** along the ruler, the size of the current changes between maximum and minimum values.

The student measures the current at different positions of **D** along the ruler to identify a position **P** of the minimum current.

Figure 2 is a plot of the measurements taken near **P**.

Figure 2



0 1 . 1 Draw a line of best fit for these data.

[2 marks]

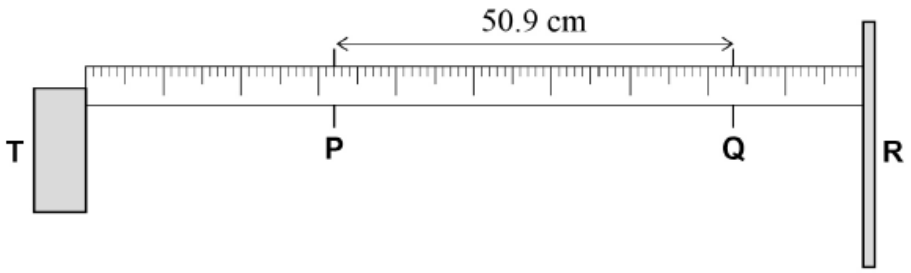
0 1 . 2 State a value for the position of **P**.

[1 mark]

position of **P** = _____ cm

The student moves **D** along the metre ruler towards **R** and observes a series of maximum and minimum readings on the microammeter. He identifies **Q** as the position of the **8th minimum** current from **P**. He measures the distance **PQ** to be 50.9 cm, as shown in **Figure 3**.

Figure 3



0 1 . 3 The absolute uncertainty in identifying any minimum current is ± 0.2 cm.

Determine the percentage uncertainty in the distance **PQ**.

[2 marks]

percentage uncertainty in **PQ** = _____ %

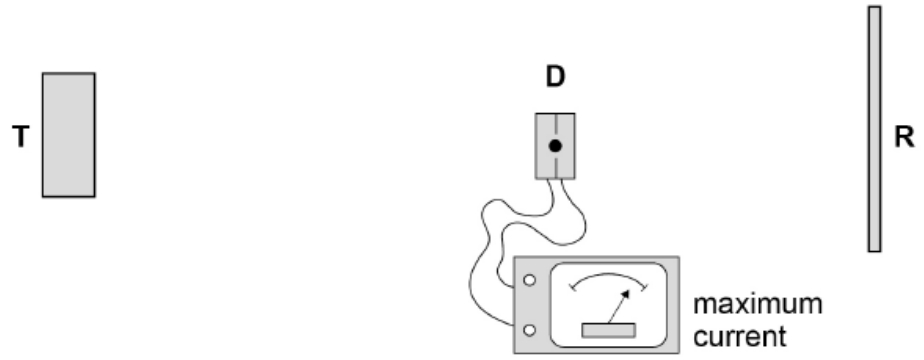
0 1 . 4 Deduce the frequency of the microwaves produced by **T**.

[3 marks]

frequency = _____ Hz

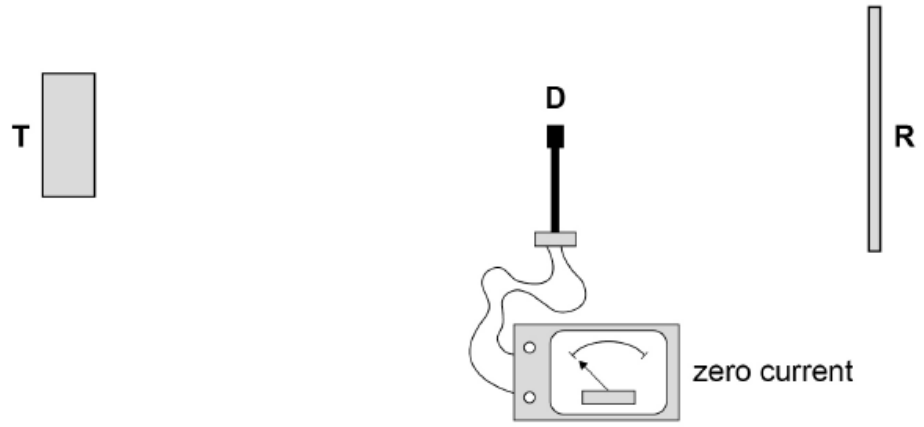
0 1 . 5 **Figure 4** shows **D** placed at a position where the current is a maximum.

Figure 4



The student rotates **D** by 90°, without changing its distance from **T**, to the position shown in **Figure 5**. The current is now zero.

Figure 5



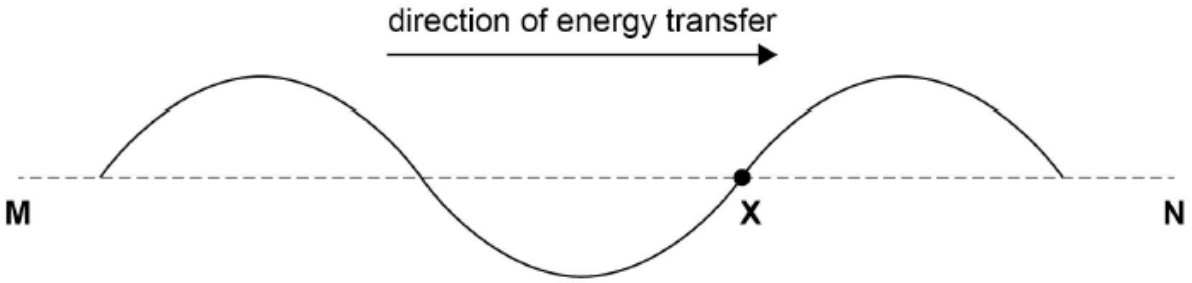
State the property of microwaves that is shown by this change in current.

[1 mark]

2. June/2021/Paper_7407_02/No.15

A progressive wave travels along a rope in the direction **M** to **N**.

X marks a point on the rope.



The wave has a frequency of 5.0 Hz, a wavelength of 1.0 m and an amplitude of 0.20 m.

Where will **X** be after 0.15 s?

[1 mark]

A below **MN** by 0.20 m ⬭

B above **MN** by 0.20 m ⬭

C nearer **N** by 0.15 m ⬭

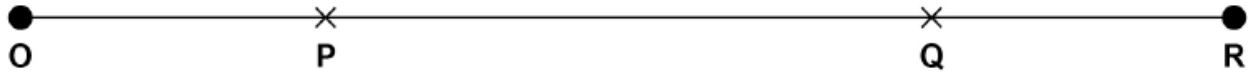
D nearer **N** by 0.75 m ⬭

3. June/2021/Paper_7407_02/No.17

The diagram shows a string stretched between two fixed points **O** and **R** which are 120 cm apart.

P and **Q** are points on the string.

OP = 30 cm
OQ = 90 cm



At a certain frequency the string vibrates at its first harmonic.

P and **Q** oscillate in phase.

The frequency is gradually increased.

What is the next harmonic at which **P** and **Q** will oscillate in phase?

[1 mark]

A second ⬭

B third ⬭

C fourth ⬭

D fifth ⬭

4. June/2021/Paper_7407_02/No.18

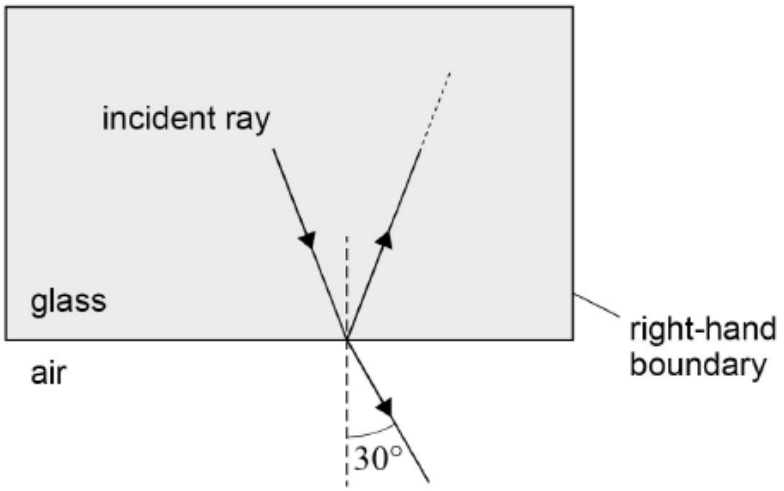
A ray of light is incident on the internal boundary of a rectangular glass block in air.

Part of the light refracts out of the block at an angle of 30°.

Some of the remaining light reflects within the block to become incident on the right-hand boundary.

refractive index of glass = 1.48

not to scale



What is the angle of incidence of the ray at the right-hand boundary?

[1 mark]

A 20° ⬭

B 42° ⬭

C 48° ⬭

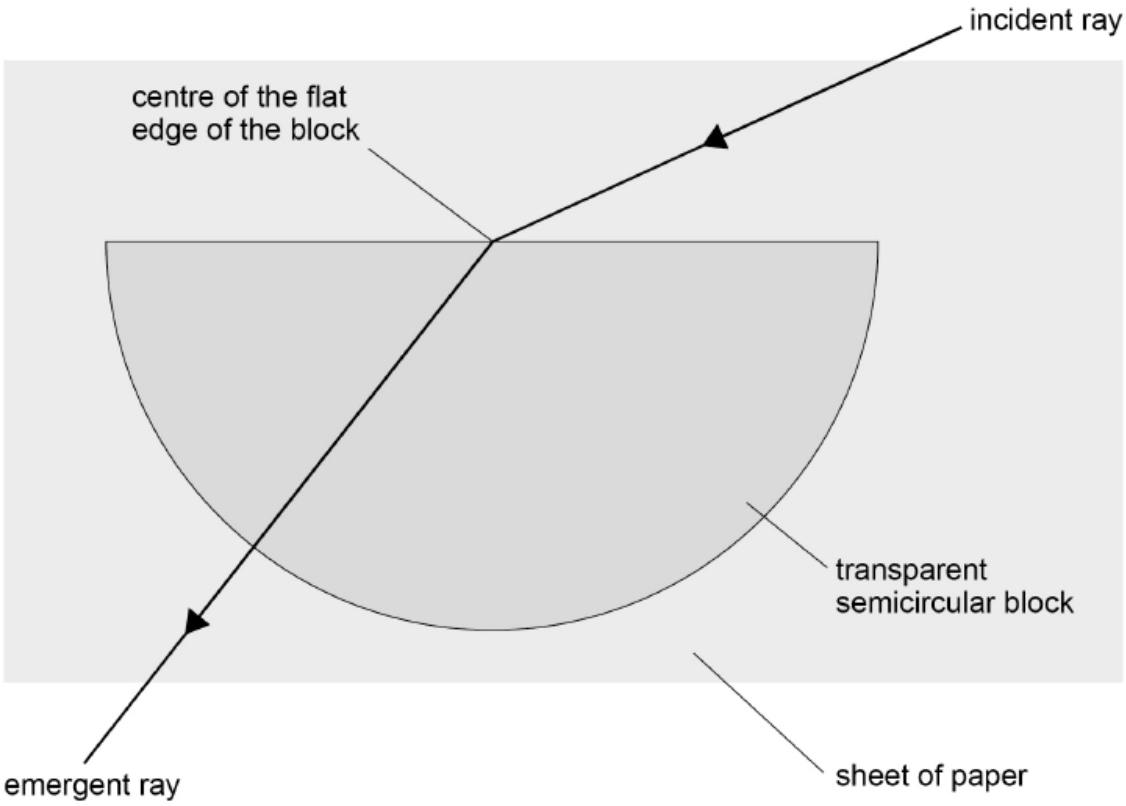
D 70° ⬭

5. June/2020/Paper_7407_02/No. 01.1_ 01.3

0 1 A student places a transparent semicircular block on a sheet of paper and draws around the block. She directs a ray of light at the centre of the flat edge of the block.

Figure 1 shows the path of the ray through the block.

Figure 1



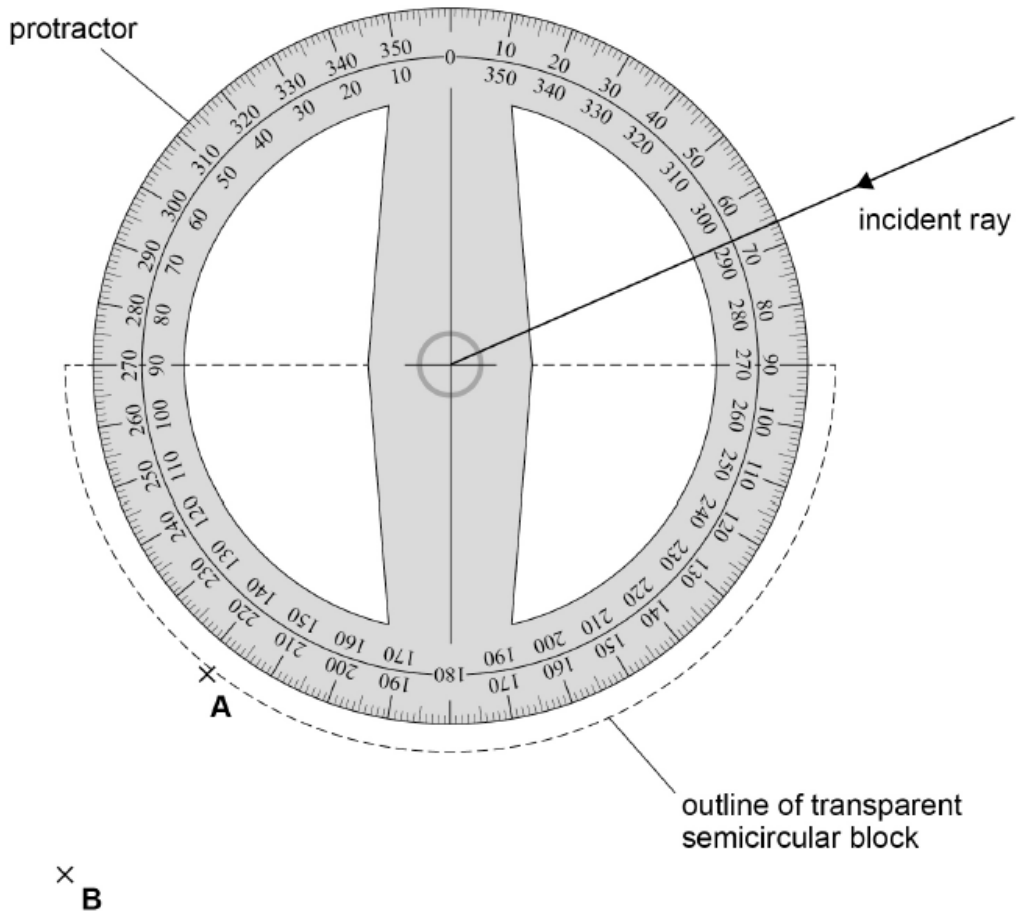
0 1 . 1 State why the emergent ray does not change direction as it leaves the block.

[1 mark]

0 1 . 2 The student draws an arrow on the paper to mark the incident ray. She marks the path of the emergent ray with crosses **A**, **B** and **C**.

She removes the block from the paper and places a protractor over the outline of the block, as shown in **Figure 2**.

Figure 2



Determine, using **Figure 2**, the refractive index of the block.

[4 marks]

refractive index = _____

The student uses a different method to determine the refractive index of the block. She focuses a travelling microscope on some dots on a sheet of paper for each of the three situations shown in **Figure 3**.

Figure 3

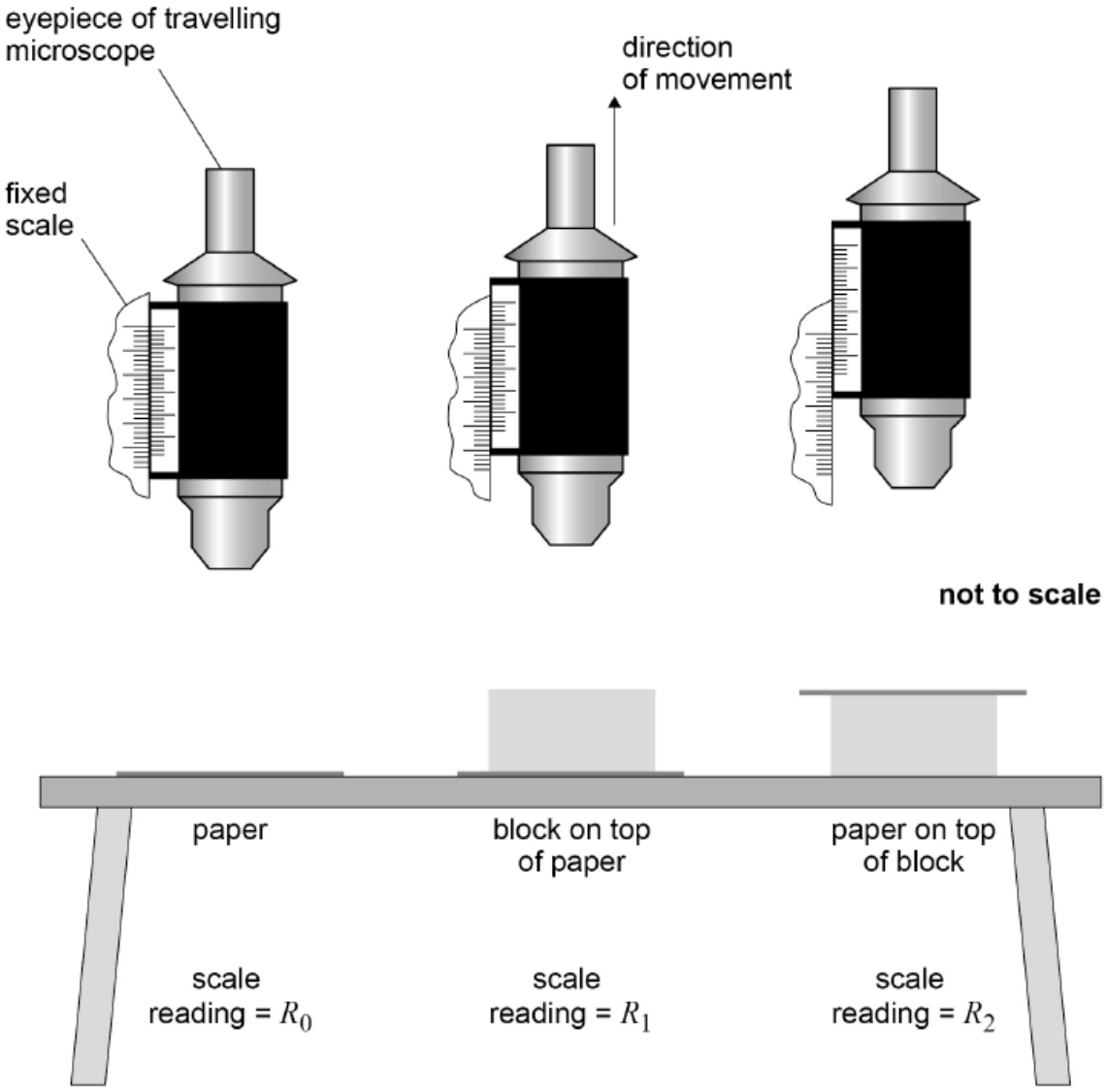


Table 1 shows the readings made by the student.

Table 1

R_0 / mm	R_1 / mm	R_2 / mm
5.74	10.31	20.02

6. June/2020/Paper_7407_02/No. 03.4

0 4 . 4 The electron hits the first electrode and causes the release of several electrons. **Figure 9** shows how a series of accelerations and collisions produces a large number of electrons. These electrons hit the anode and produce a pulse of current in an ammeter.

Figure 9

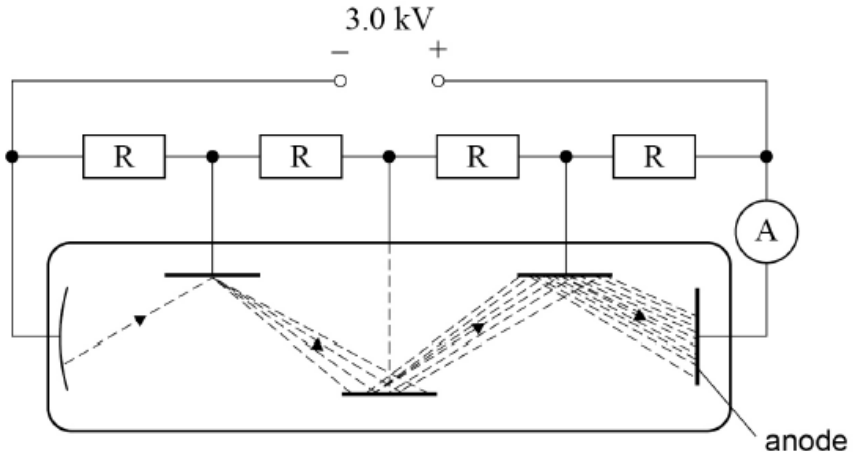
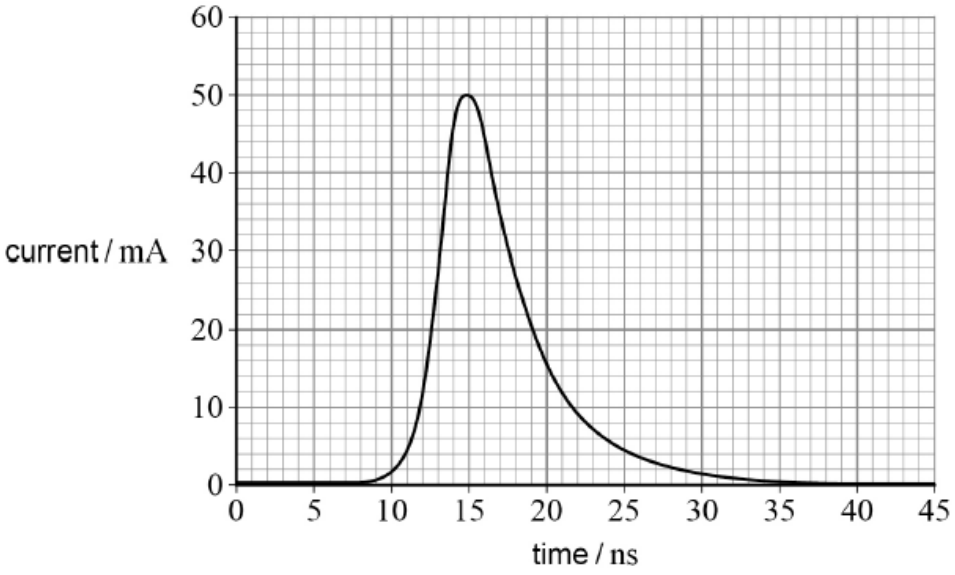


Figure 10 shows the variation of current in the ammeter with time due to this pulse.

Figure 10



Determine the number of electrons that flow through the ammeter.

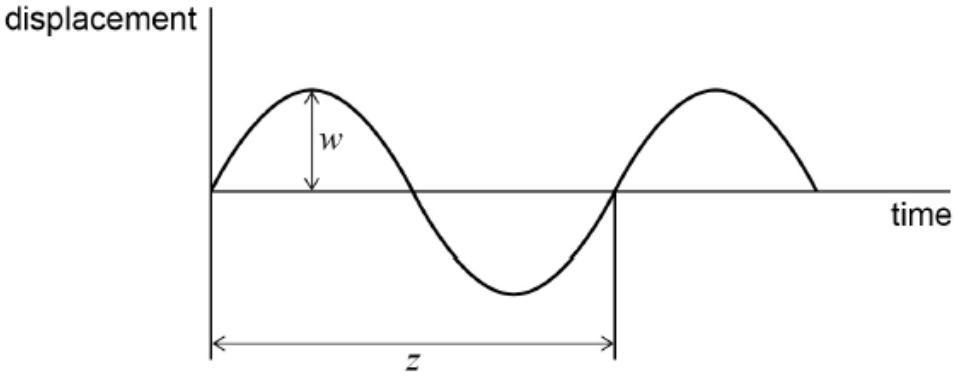
[4 marks]

number of electrons = _____

7. June/2020/Paper_7407_02/No.12

A wave travels along a water surface.

The variation with time of the displacement of a water particle at the surface is shown.



What properties of the wave are represented by w and z?

[1 mark]

	w	z	
A	phase	frequency	⬭
B	amplitude	wavelength	⬭
C	wavelength	phase	⬭
D	amplitude	period	⬭

8. June/2020/Paper_7407_02/No.13

Two points on a progressive wave are out of phase by 0.41 rad.

What is this phase difference?

[1 mark]

A $23°$ ⬭

B $47°$ ⬭

C $74°$ ⬭

D $148°$ ⬭

9. June/2020/Paper_7407_02/No.14

Light of wavelength λ is incident normally on two parallel slits of separation s.
Fringes of spacing w are seen on a screen at a distance D from the slits.

Which row gives another arrangement that produces a fringe spacing of w?

[1 mark]

	Wavelength	Slit separation	Distance between slits and screen	
A	2λ	$2s$	$2D$	⬭
B	2λ	$4s$	$2D$	⬭
C	2λ	$2s$	$4D$	⬭
D	4λ	$2s$	$2D$	⬭

10. June/2020/Paper_7407_02/No.15

A narrow beam of monochromatic light is incident normally to a diffraction grating.
The first-order diffracted beam makes an angle of $20°$ with the normal to the grating.

What is the highest order visible with this grating at this wavelength?

[1 mark]

A 2 ⬭

B 3 ⬭

C 4 ⬭

D 5 ⬭

11. June/2020/Paper_7407_02/No.16

The speed of light decreases by 40% when it travels from air into a transparent medium.

What is the refractive index of the medium?

[1 mark]

A 0.6 ⬭

B 1.4 ⬭

C 1.7 ⬭

D 2.5 ⬭

12. June/2021/Paper_7407_02/No. 19

In a Young's double-slit experiment, monochromatic light is incident on two narrow slits and the resulting interference pattern is observed on a screen.

Which change **decreases** the fringe separation?

[1 mark]

A decreasing the separation between the two slits ⬭

B increasing the distance between the slits and the screen ⬭

C using monochromatic light of higher frequency ⬭

D using monochromatic light of longer wavelength ⬭