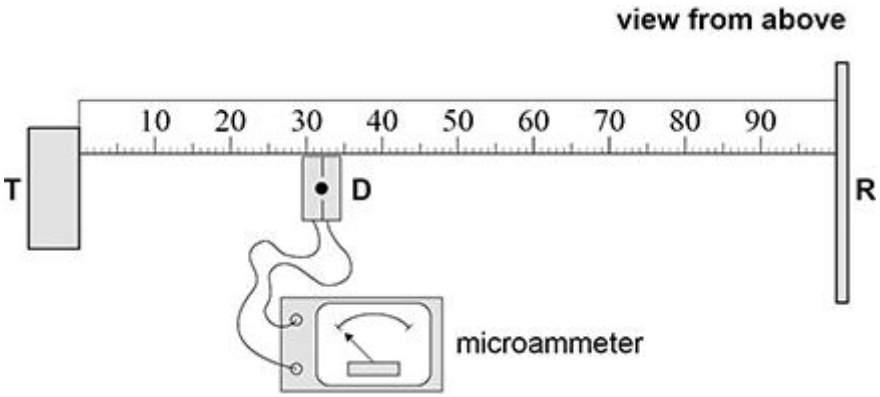
Name of the Student:_____
Max. Marks : 17 Marks **Time : 17 Minutes**

Q1.

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.

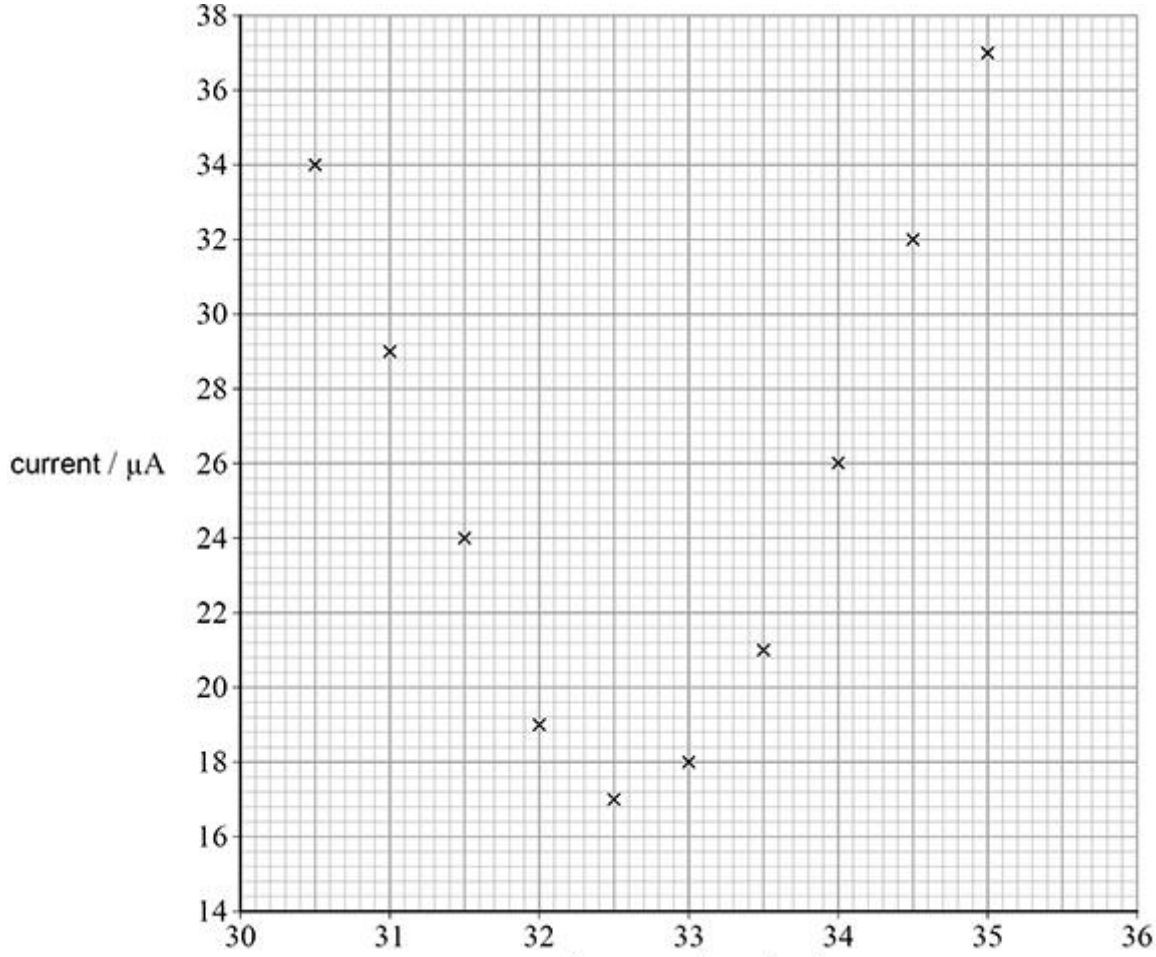
When **T** is switched on, stationary waves are produced between **T** and **R**, and the microammeter registers a current. When the student moves **D** along the ruler, the size of the current changes between maximum and minimum values.

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

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(a) Draw a line of best fit for these data.

(2)

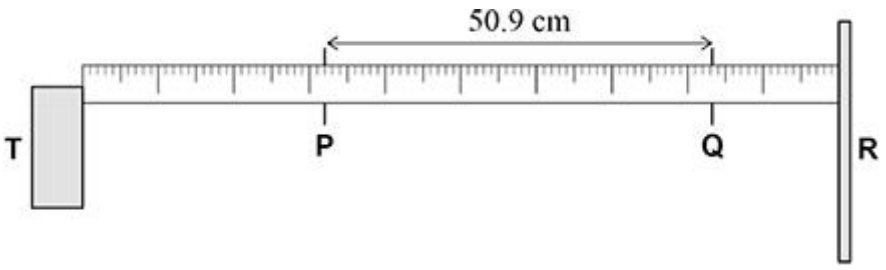
(b) State a value for the position of **P**.

position of **P** = _____ cm

(1)

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



(c) The absolute uncertainty in identifying any minimum current is ± 0.2 cm.

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

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percentage uncertainty in **PQ** = _____ %

(2)

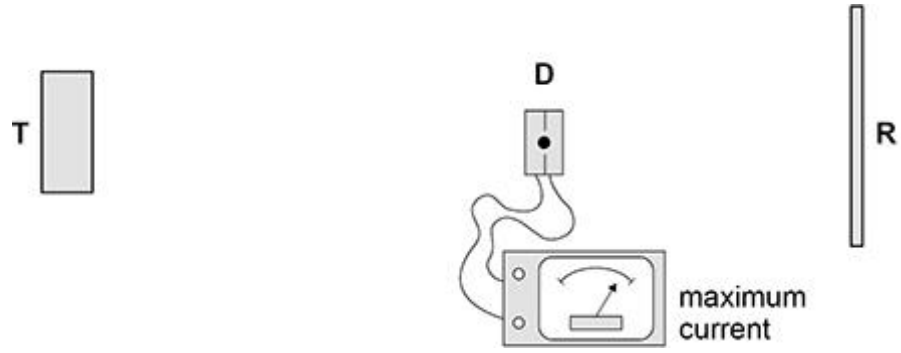
(d) Deduce the frequency of the microwaves produced by **T**.

frequency = _____ Hz

(3)

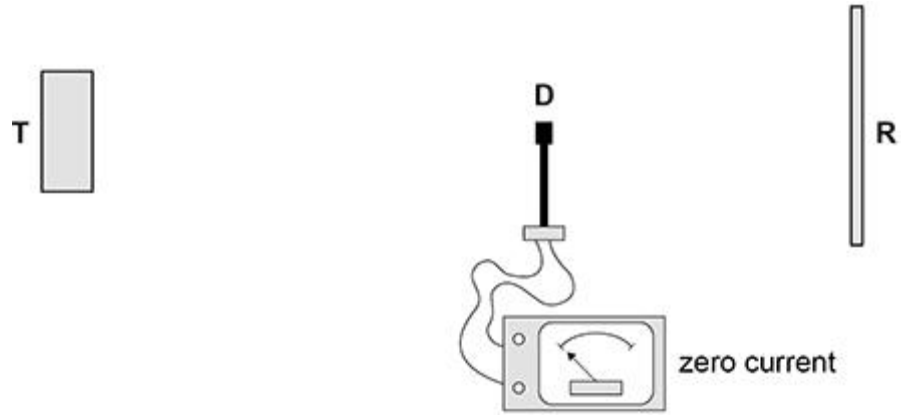
(e) **Figure 4** shows **D** placed at a position where the current is a maximum.

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.

_____

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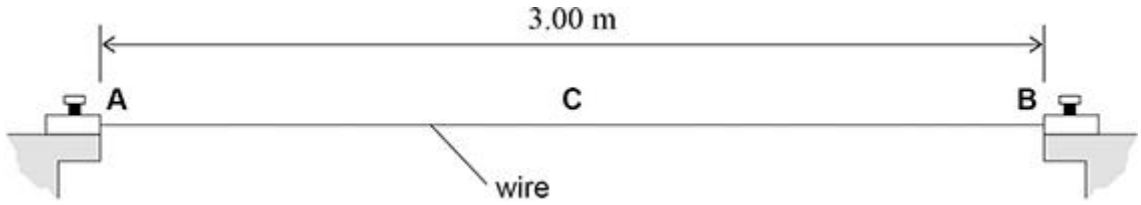
(1)

(Total 9 marks)

Q2.

A student does an experiment to determine the Young modulus of a metal.
Figure 1 shows a wire made from the metal clamped at points **A** and **B** so that the wire is horizontal.
The horizontal distance between **A** and **B** = 3.00 m.
C is the mid-point on the wire between **A** and **B**.

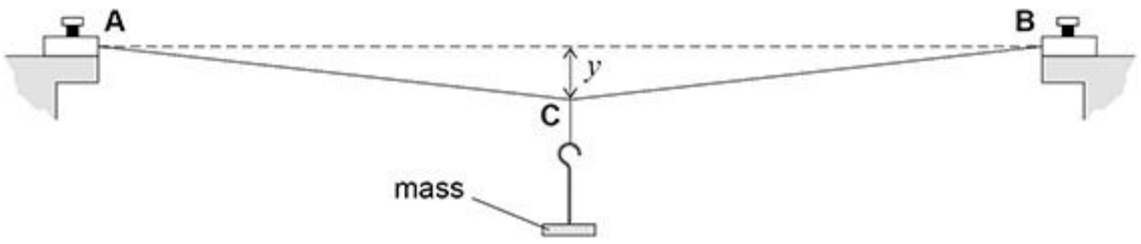
Figure 1



A mass of weight W is suspended at **C** to extend the wire. **Figure 2** shows that **C** moves vertically downwards by a distance y.

Figure 2

not to scale



(a) When W is 1.0 N, y is 6.34 cm.

Show that the wire extends by approximately 3 mm.

(1)

(b) Calculate the tension in the wire when W is 1.0 N.

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tension = _____ N

(2)

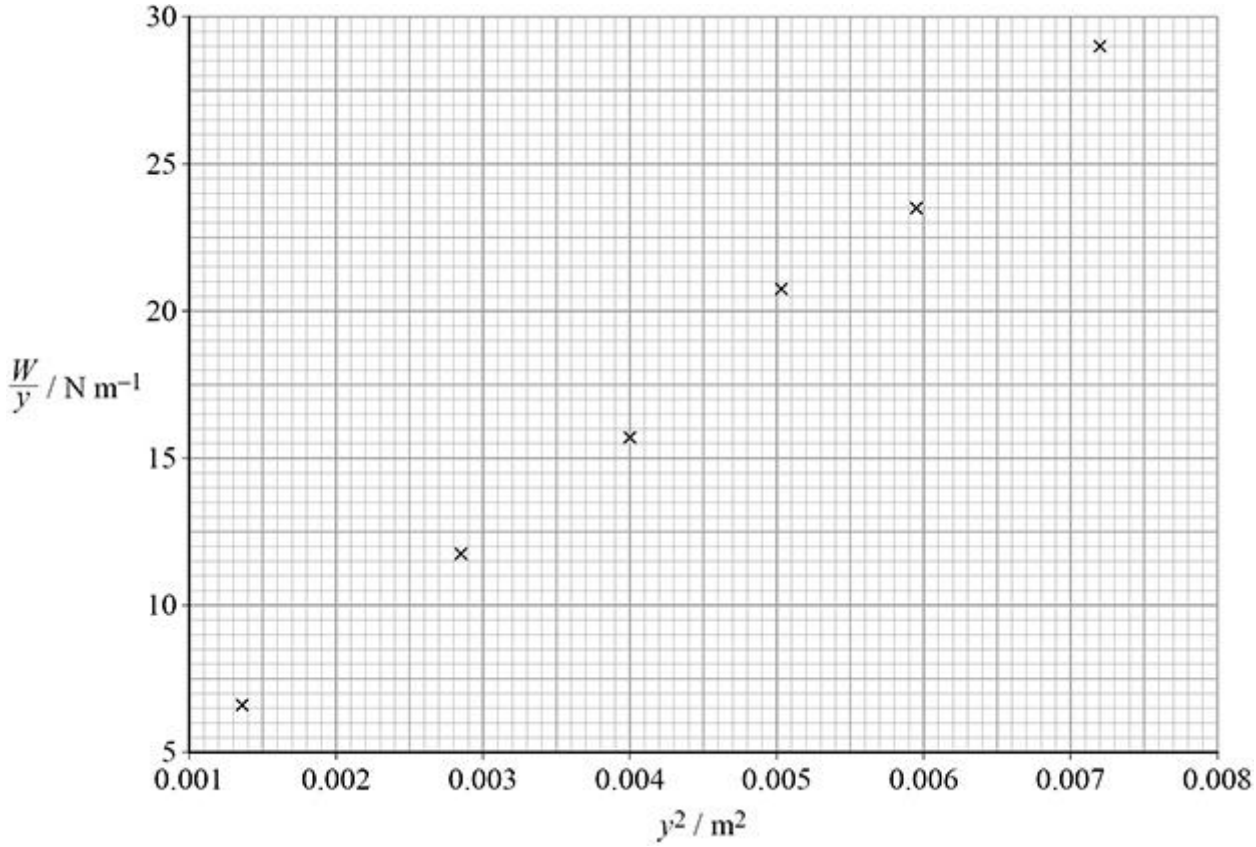
It can be shown that

$$\frac{W}{y} = \frac{EAy^2}{x^3} + k$$

where E = Young modulus of the metal
A = 1.11×10^{-7} m^2
x = 1.50 m
k = a constant.

A student measures y for different values of W and plots the graph shown in **Figure 3**.

Figure 3



(c) Determine E using **Figure 3**.

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E = _____ Pa

(4)

(d) Deduce the fundamental base units for k.

fundamental base units for k = _____

(1)

(Total 8 marks)

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