Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Waves

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Name of the Student:_____
Max. Marks : 22 Marks **Time : 22 Minutes**

Q1.

Figure 1 shows an arrangement used to investigate double slit interference using microwaves.
Figure 2 shows the view from above.

Figure 1

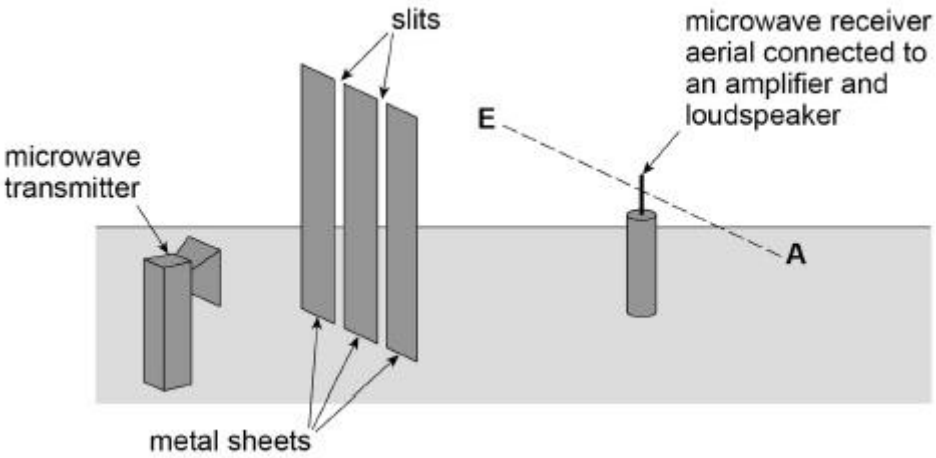
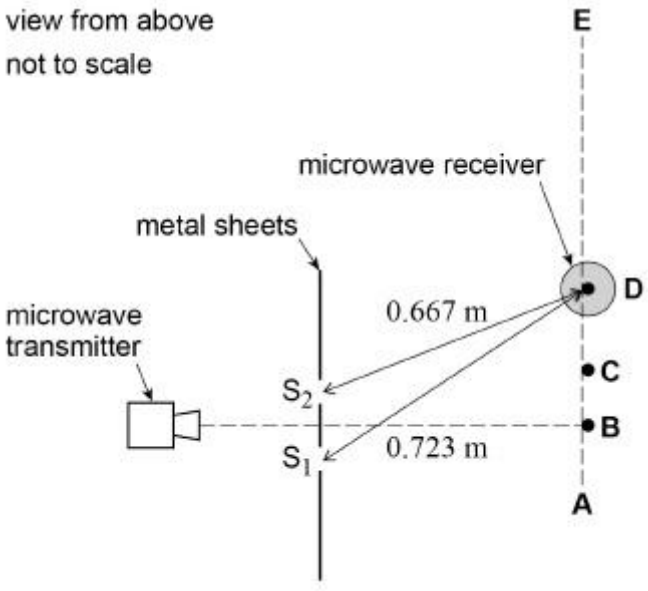


Figure 2



The microwaves from the transmitter are polarised. These waves are detected by the aerial in the microwave receiver (probe). The aerial is a vertical metal rod.

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The receiver is moved along the dotted line **AE**. As it is moved, maximum and minimum signals are detected. Maximum signals are first detected at points **B** and **C**. The next maximum signal is detected at the position **D** shown in **Figure 2**.

Figure 2 shows the distances between each of the two slits, S_1 and S_2, and the microwave receiver when the aerial is in position **D**.
S_1D is 0.723 m and S_2D is 0.667 m.

(a) Explain why the signal strength falls to a minimum between **B** and **C**, and between **C** and **D**.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) Determine the frequency of the microwaves that are transmitted.

frequency = _____ Hz

(3)

(c) The intensity of the waves passing through each slit is the same.

Explain why the minimum intensity between **C** and **D** is not zero.

_____

_____

_____

_____

_____

_____

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_____

(2)

(d) The vertical aerial is placed at position **B** and is rotated slowly through 90° until it lies along the direction **AE**.

State and explain the effect on the signal strength as it is rotated.

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q2.

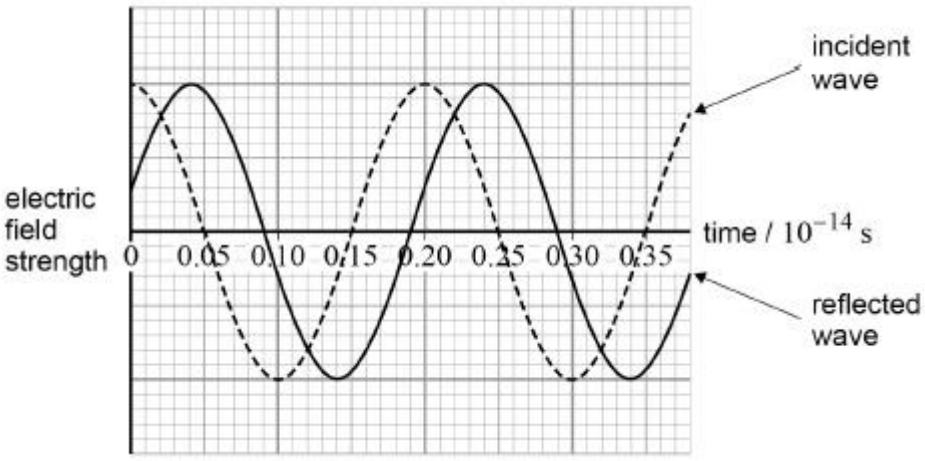
A gravimeter is an instrument used to measure the acceleration due to gravity. The gravimeter measures the distance fallen by a free-falling mirror in a known time.

To do this, monochromatic light is reflected normally off the mirror, creating interference between the incident and reflected waves. The mirror is released from rest and falls, causing a change in the phase difference between the incident and reflected waves at a detector.

At the point of release of the mirror, the waves are in phase, resulting in a maximum intensity at the detector. The next maximum is produced at the detector when the mirror has fallen through a distance equal to half a wavelength of the light. The gravimeter records the number of maxima detected in a known time as the mirror falls. These data are used by the gravimeter to compute the acceleration of the free-falling mirror.

Figure 1 illustrates the phase relationship between the incident and reflected waves at the detector for one position of the mirror.

Figure 1



(a) Show that the wavelength of the light is 600 nm.

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(3)

(b) Determine the phase difference, in rad, between the incident and reflected waves shown in **Figure 1**.

phase difference = _____ rad

(2)

(c) A maximum is detected each time the mirror travels a distance equal to half a wavelength of the light.

In one measurement 2.37×10^5 maxima are recorded as the mirror is released from rest and falls for 0.120 s.

Using an appropriate equation of motion, calculate the acceleration due to gravity that the gravimeter computes from these data.

State your answer to 3 significant figures.

wavelength of the light = 600 nm

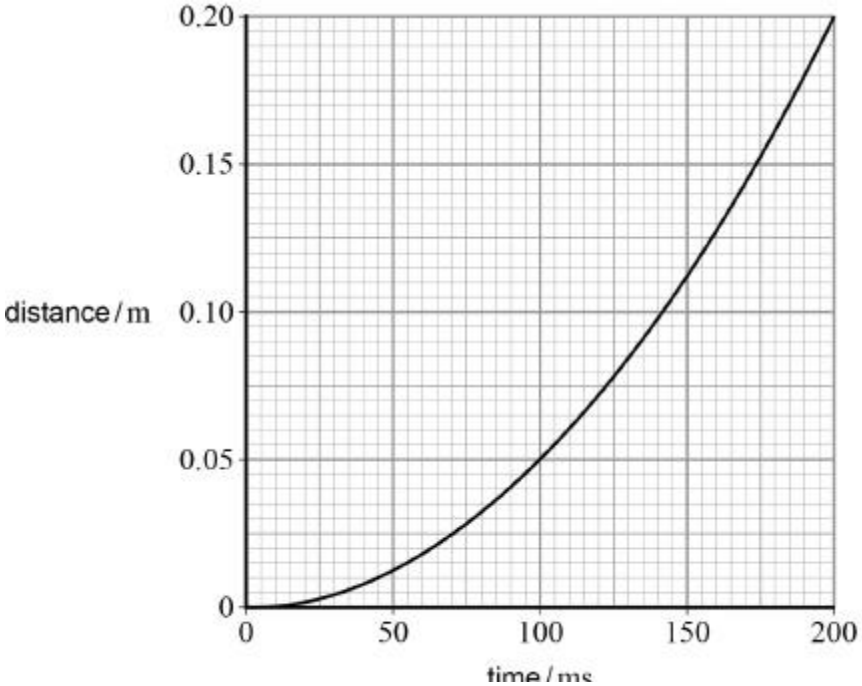
acceleration due to gravity = _____ m s^{-2}

(3)

(d) **Figure 2** is a graph that the gravimeter could produce to show how the distance travelled by the mirror varies with time as it falls.

Figure 2

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Determine the gradient of the line when the time is 0.12 s.

gradient = _____

(2)

(e) State what this gradient represents.

_____

(1)

(Total 11 marks)

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