

Q1. Maxwell's theory suggested the existence of electromagnetic waves that travel at a speed

of $\sqrt{\frac{1}{\epsilon_0 \mu_0}}$

Hertz later discovered radio waves and performed experiments to investigate their properties.

The figure below shows a radio wave transmitter and a detector. The wave is transmitted by a dipole aerial. The detector consists of a metal loop connected to a meter.



- (a) Explain how the detection of the wave by the loop demonstrates the magnetic nature of the radio waves.

.....

(2)

- (b) Explain how the electric nature of the waves emitted by the dipole could be demonstrated.

.....

(1)

- (c) Hertz used an arrangement like that shown in the figure above to determine the speed of radio waves.

Describe how the speed was determined. Go on to discuss how the experiments of Hertz confirmed Maxwell's prediction and the experimental evidence that suggests that light is also an electromagnetic wave.

.....

.....

.....

.....

.....

.....

.....

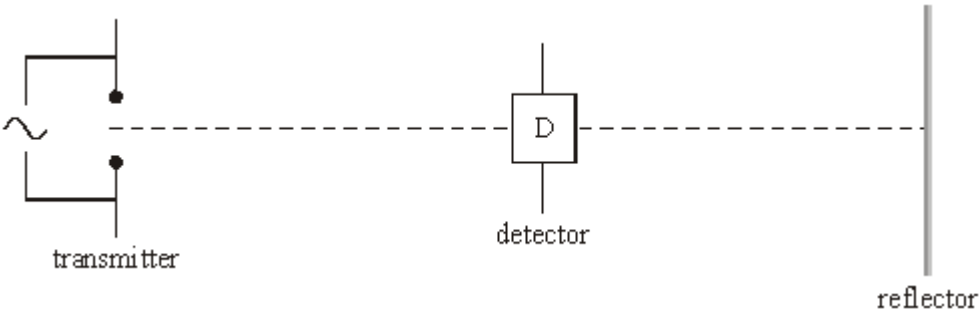
.....

.....

.....

(6)
(Total 9 marks)

Q2. Hertz discovered how to produce and detect radio waves. He measured the wavelength of radio waves produced at a constant frequency using the arrangement shown in the diagram below.



(i) Explain why the strength of the detector signal varied repeatedly between a minimum and a maximum as the detector was moved slowly away from the transmitter along the dotted line.

You may be awarded marks for the quality of written communication in your answer.

.....

.....

.....

.....

.....

.....

.....

- (ii) Hertz found that a minimum was detected each time the detector was moved a further 1.5 m away from the transmitter.
Calculate the frequency of the radio waves.

.....
.....
.....
.....

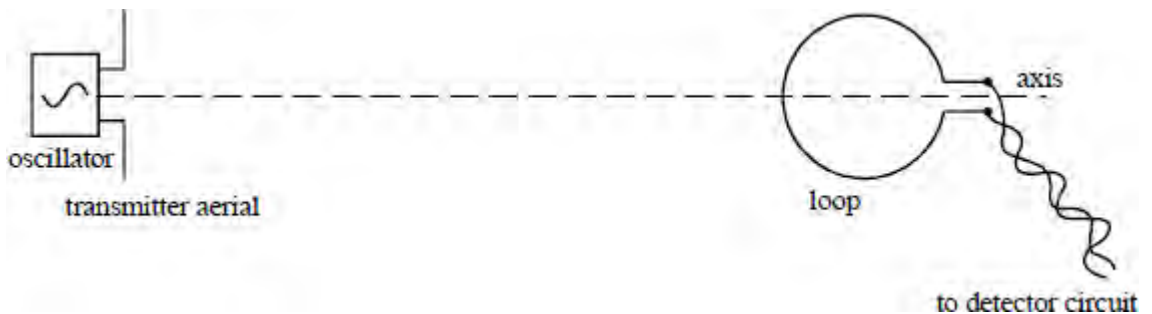
(Total 5 marks)

- Q3.(a)** Describe, with the aid of a diagram, an electromagnetic wave propagating through free space.

.....
.....
.....
.....
.....
.....

(3)

- (b) When an alternating potential difference of a suitably high frequency is applied to a transmitter, an alternating emf of the same frequency is induced in a detector loop as shown. The loop and transmitter aerial are in the same vertical plane.



- (i) Explain, in terms of electromagnetic waves, why an emf is induced in the loop when in this position.

.....

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) The alternating emf decreases to zero when the loop is rotated about the axis through 90° until it is horizontal. Explain why the emf is zero when the loop is horizontal.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(4)
(Total 7 marks)