3

(a)

State what is meant by *coherent sources*.

……

……

[1]

(b)

Two coherent microwave emitters S_1 and S_2 are in phase with one another. They emit waves of equal frequency, equal intensity and with the same direction of polarisation. A microwave detector is placed at point P, as shown in Fig. 3.1.

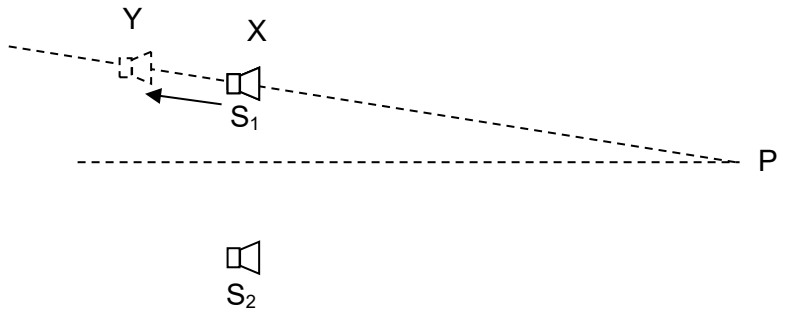

Fig. 3.1

The initial distances of S_1 and S_2 from P are equal. The intensity of the individual microwaves from S_1 and S_2 at P is I.

(i)

S_1 is moved slowly away from P along the line PXY as shown.

Explain why the intensity of the microwave detected at P fluctuates.

……

……

……

……

……

[3]

(ii)

S_1 is moved from point X to Y and the intensity of the microwave at P changes from a maximum to a minimum. The distance XY is 8.2 cm.

Calculate the frequency of the microwaves emitted by the sources.

frequency = …… Hz

[2]

(iii)

S_1 remains at point Y.

A polariser is placed between S_1 and P. The direction of polarisation of the microwave from S_1 is changed by 40°. The power of S_1 is adjusted such that the intensity of the microwave from S_1 at P remains as I.

Explain, without numerical calculation, the intensity of the microwave at P.

……

……

……

……

[2]

(c)

Fig. 3.2 shows the variation with time of the displacement of the microwave from S_2 at P.

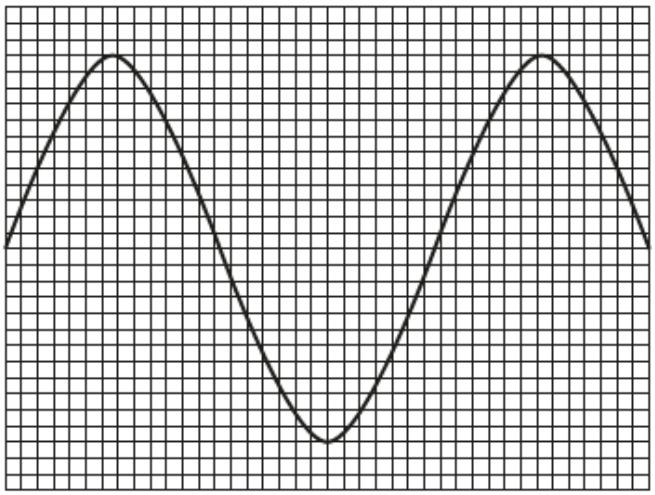

Fig. 3.2

(i)

The polariser in **(b)(iii)** is removed and the intensity of the microwave from S_1 at P is reduced to $\frac{1}{2}I$.

Show that the amplitude of the microwave from S_1 at P is approximately 8.5 units.

[2]

(ii)

Sketch the variation with time of the displacement of the microwave from S_1 at P in Fig 3.2.

[2]

[Total: 12]