Section B

Answer **one** question from this Section in the spaces provided.

7 **(a)** Fig. 7.1 shows two sources S_1 and S_2 emitting waves of the same wavelength. The lines represent crests. The sources are coherent and are 6.0 cm apart.

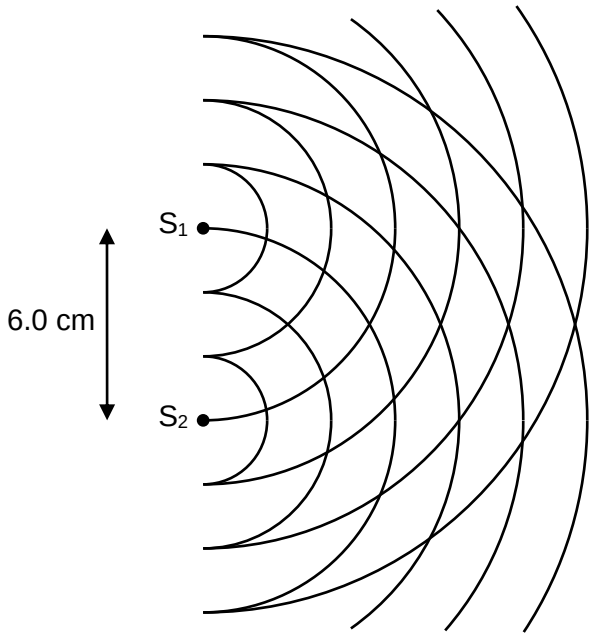

Fig. 7.1

(i) Explain what is meant by a *progressive* wave.

……...……

……...……... [1]

(ii) Other than being coherent, state 2 other conditions that must be satisfied for waves from the two sources to produce an observable interference pattern.

1……...…….

……...……

2……...……

……...……... [2]

(iii) On Fig. 7.1, draw a line passing through the points where the path difference is zero and label the line C.

[1]

(iv) On Fig. 7.1, mark a point where the path difference is one and a half wavelength, label the point P.

Draw a line passing through point P and other points where the path difference is one and half wavelength and label the line D.

[2]

(v) Show that the wavelength of the waves is 2.0 cm.

[1]

(b) A screen is placed 15 cm from the sources as shown in Fig. 7.2. Point O is equidistant from the sources. Point X is at the first maxima from O and Point Y is the first minima from X. The distance OX is 5.4 cm.

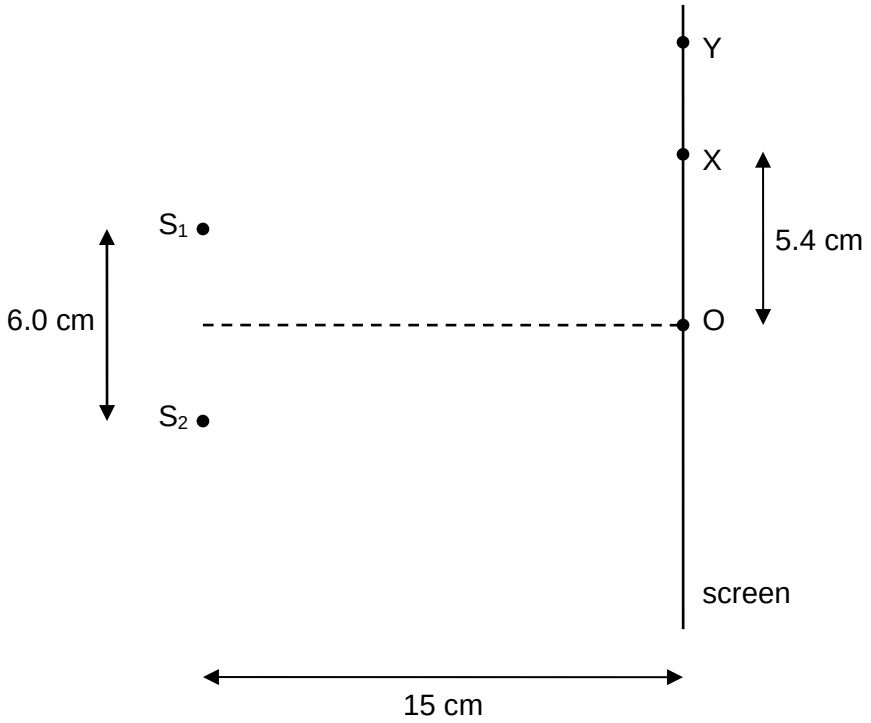

Fig. 7.2

(i) Show quantitatively that X is the point of the first maxima from O.

[2]

(ii) State the path difference $S_2Y - S_1Y$.

path difference = …… cm [1]

(iii) Hence calculate the distance OY.

OY = …… cm [2]

Each source has power 20 W and emits waves in all directions in three dimensions.

(iv) Show that the intensity at O due to S_1 is 68 W m^{-2}.

[1]

(v) Hence, calculate the resultant intensity at O.

intensity at O = …… W m^{-2} [1]

(c) On the line between S_1 and S_2, a stationary wave is formed where S_1 is an antinode.

(i) State the distance from S_1, on the line between S_1 and S_2, where the first antinode from S_1 is found.

distance from S_1 = …… cm [1]

(ii) A detector moves from S_1 to S_2 at a constant speed of 3.0 cm s^{-1}. Determine the rate of fluctuations picked up by the detector.

rate of fluctuations = …… s^{-1} [1]

(d) Two light sources L_1 and L_2 emitting light of wavelength 500 nm and separated 6.0 cm apart are to be observed by an observer 15 km away through a single slit of slit width 0.10 m as shown in Fig. 7.3.

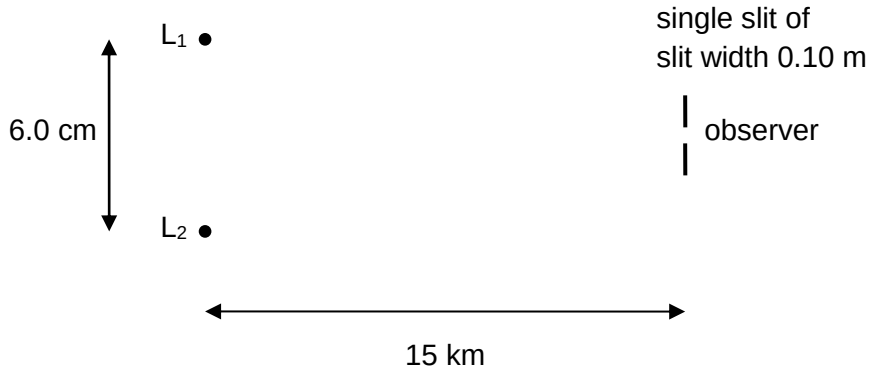

Fig. 7.3

(i) Calculate the limiting angle of resolution of the slit.

limiting angle = …… rad [2]

(ii) Calculate the angle of separation of the two light sources relative to the observer.

angle of separation = …… rad [1]

(iii) Hence, explain whether the two sources can be resolved.

……..……

……..…… [1]

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