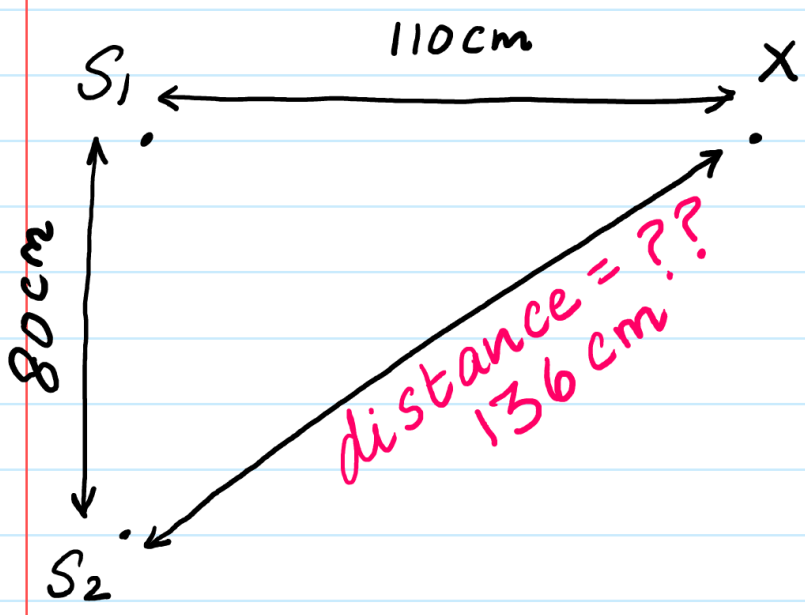
Waves 3

14 January 2021 09:14

Ex. The diag shows two Sources S_1 & S_2. The waves produced meet at X. It is given that the freq. of both Sources is simultaneously varied from 1000 Hz until it reaches 4000 Hz. The speed of the waves is 340 m/s. Cal on how many occasions would you expect the phenomena of Destructive Interference to occur at the point X.



for D.I to occur,
path diff = $\frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda \ldots$

136 − 110
$26 = \frac{1}{2}\lambda, \frac{3}{2}\lambda, \frac{5}{2}\lambda, \frac{7}{2}\lambda, \frac{9}{2}\lambda$

- $V = 340$ P
  $f = 1000$
  $v = f\lambda$
  $\lambda = 34$ cm

$V = 340$
$f = 4000$
$v = f\lambda$
$\lambda = 8.5$ cm

$8.5 \leq \lambda \leq 34$

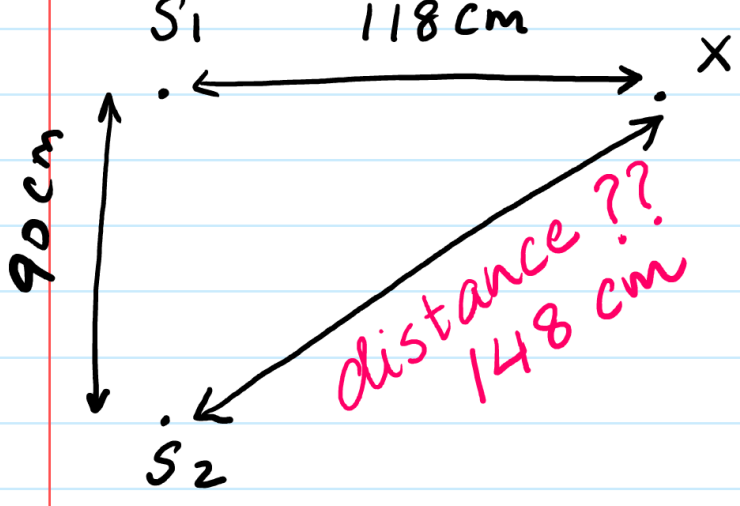
$\lambda = 52$cm ✗
$\lambda = 17.3$cm ✓
$\lambda = 10.4$ cm ✓
$\lambda = 7.4$ cm ✗
$\lambda = 6.5$cm ✗

= 2 occasions

Q $f = 200$ Hz ⟶ $f = 4500$ Hz.

$v = 250$ m/s.

(Use 3 s.f while working)



On how many occasions will Constructive Interference occur at X.

for C.I to occur

Path diff = $1\lambda, 2\lambda, \ldots$

148 − 118

$30 = 1\lambda, 2\lambda, 3\lambda, 4\lambda, 5\lambda, 6\lambda \ldots$

$\lambda = 30$ cm ✓
$\lambda = 15$ cm ✓
$\lambda = 10$ cm ✓
$\lambda = 7.5$ cm ✓
$\lambda = 6$ cm ✓
$\lambda = 5$ cm ✗

$f = 200$ $V = 250$
$v = f\lambda$
$\lambda = 80$cm

$f = 4500$ $V = 250$
$v = f\lambda$
$\lambda = 5.55$ cm

$5.55 \leq \lambda \leq 80$

= 5 occasions Ans.