Mastering Physics Solutions Chapter 28 Physical Optics: Interference and Diffraction

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Chapter 28 Physical Optics: Interference and Diffraction Q.1CQ
When two light waves interfere destructively, what happens to their energy?
Solution:
When two waves interfere destructively at one place, then at some other place, these waves interfere constructively. The energy at the point of destructive interference at one place is always balanced by that at constructive interference. In destructive interference, the net energy of the resultant wave is less than the sum of energies of two individual waves, which interfere destructively to give destructive interference.
In constructive interference, the net energy of the resultant wave is more than the sum of energies of two individual waves which interfere constructively to give constructive interference. Thus, when two waves interfere destructively at one place, then the energy of individual waves at that place goes to the point where these waves constructively interfere. Thus, at a place of destructive interference, the energy is nearly zero, and at a place of constructive interference, energy is more than the sum of energies of individual waves. Hence, energy is redistributed from a place of destructive interference to a place of constructive interference.
Chapter 28 Physical Optics: Interference and Diffraction Q.1P

Two sources emit waves that are coherent, in phase, and have wavelengths of 26.0 m. Do the waves interfere constructively or destructively at an observation point 78.0 m from one source and 143 m from the other source?

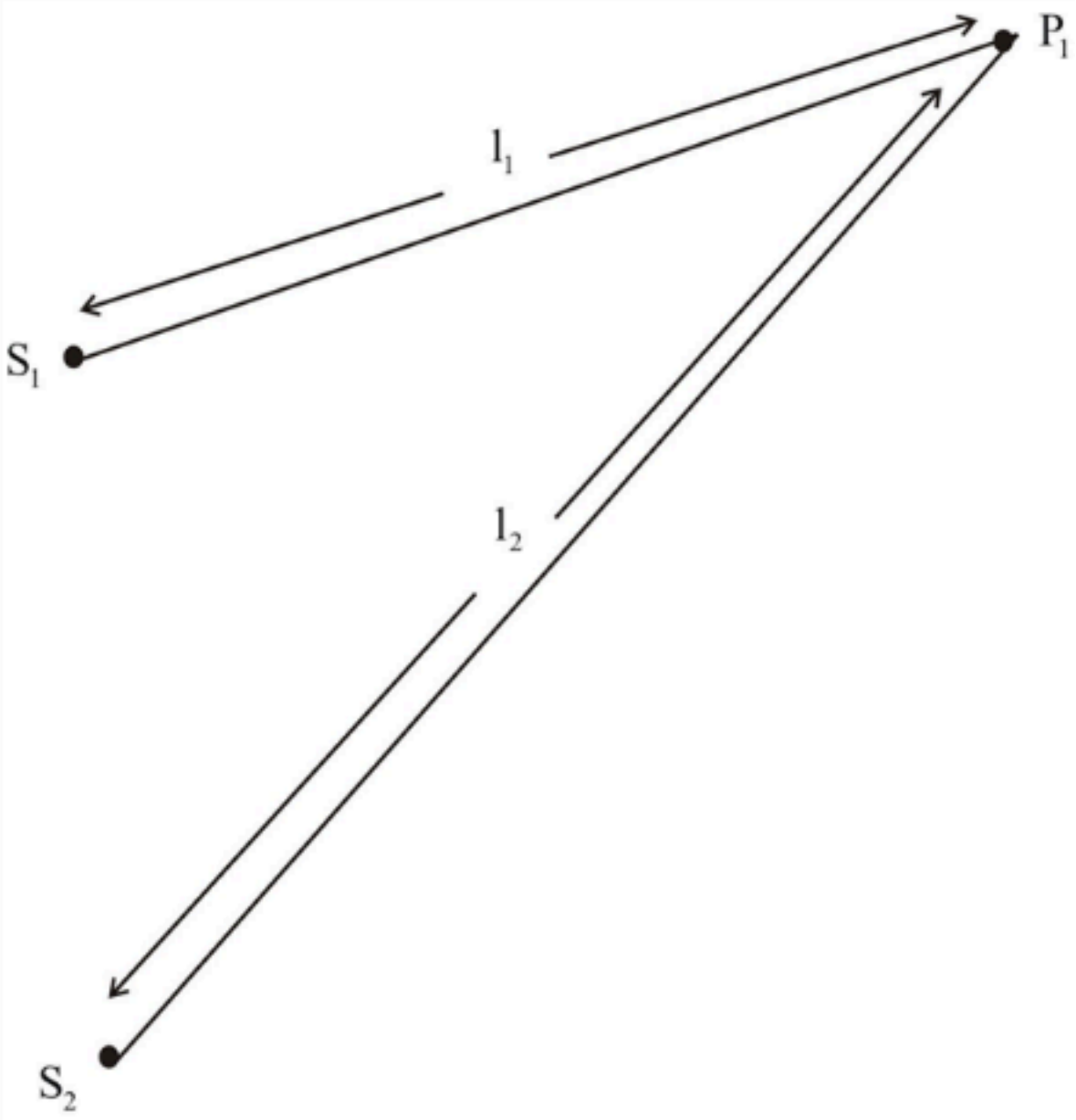
Solution:

Given that

Two sources emit waves that are coherent, in phase and have wavelength $(\lambda) = 26.0\ \text{m}$

The first source gives interference pattern at a distance of $(l_1) = 78\ \text{m}$

The second source gives interference pattern at a distance of $(l_1) = 143\ \text{m}$



To reach the point P_1, the waves from the two sources have traveled different distances. The difference in these distances

$$l_2 - l_1 = m\lambda$$

Where l_2 and l_1 are the distances from the two sources and λ is the wavelength and *m* is the order of the interference pattern

$$143\ \text{m} - 78\ \text{m} = m(26.0\,\text{m})$$

$$65\,\text{m} = m(26.0\,\text{m})$$

$$m = \frac{65\,\text{m}}{26\,\text{m}}$$

$$= 2.5$$

This can be written as

$$l_2 - l_1 = \left(m - \frac{1}{2}\right)\lambda$$

$$= \left(3 - \frac{1}{2}\right)\lambda$$

$$\boxed{l_2 - l_1 = \left(3 - \frac{1}{2}\right)\lambda}$$

This is the form for destructive interference. So, the waves interfere destructively.