2022 Ph H2 Q10

Section: Particles and Waves

Topic: Interference of Waves

Experiment with two loudspeakers connected to signal generator. (a) Define coherent. (b) Explain how a maximum is produced. (c) Given $\lambda = 0.400$ m, $L_2P = 6.00$ m, third order maximum, find L_1P. (d) Identify type of interference used in ANC headphones.

Worked solution

(a) Coherent waves have a constant phase difference and the same frequency.

(b) A maximum occurs when waves from L_1 and L_2 arrive in phase, i.e. path difference = $n\lambda$, leading to constructive interference.

(c) For the 3rd order maximum, path difference $\Delta = m\lambda = 3 \times 0.400 = 1.20$ m.
Given $L_2P = 6.00$ m, $L_1P = 6.00 - 1.20 = 4.80$ m.

Answer: $L_1P = 4.80$ m

(d) Active noise cancelling uses destructive interference to reduce sound levels.

Final answers

(a) Coherent = constant phase difference, same frequency

(b) Maximum from constructive interference

(c) $L_1P = 4.80$ m

(d) Destructive interference

Revision tips

- Coherence requires same frequency and fixed phase relationship.
- Constructive interference: path difference = nλ.
- Destructive interference: path difference = (n+½)λ.
- Interference patterns explain maxima and minima in wave experiments.
- ANC headphones use destructive interference to cancel unwanted sound.