Two waves with equal amplitude but with slightly different frequencies are traveling in the same direction. At a given point their displacements are described by \( y_1 = A_0 \cos \omega_1 t \) and \( y_2 = A_0 \cos \omega_2 t \).

Evaluate \( y = y_1 + y_2 \). Identify the factor which is responsible for the beats

A) \( \sin \left[ \frac{(\omega_1 - \omega_2) t}{2} \right] \).

B) \( \cos \left[ \frac{(\omega_1 - \omega_2) t}{2} \right] \).

C) \( \sin \left[ \frac{(\omega_1 + \omega_2) t}{2} \right] \).

D) \( \cos \left[ \frac{(\omega_1 + \omega_2) t}{2} \right] \).

Using

\[
\sin \alpha + \sin \beta = 2 \sin \frac{\alpha + \beta}{2} \cos \frac{\alpha - \beta}{2},
\]

\[
y = y_1 + y_2 = 2 A_0 \cos \left( \frac{\omega_1 - \omega_2}{2} t \right) \cos \left( \frac{\omega_1 + \omega_2}{2} t \right).
\]

Since the difference between \( \omega_1 \) and \( \omega_2 \) is small, the first cosine factor corresponds to a low frequency oscillation term.

Its maxima give rise to beats.

Answer B

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