

Beats.

When two sound waves of slightly different frequencies, travelling in a medium along the same direction, superimpose on each other, the intensity of the resultant sound at a particular position rises and falls regularly with time. This phenomenon of regular variation in intensity of sound with time at a particular position is called beats.

Important points

- (1) One beat: If the intensity of sound is maximum at time $t = 0$, one beat is said to be formed when intensity becomes maximum again after becoming minimum once in between.
- (2) Beat period: The time interval between two successive beats (i.e. two successive maxima of sound) is called beat period.
- (3) Beat frequency: The number of beats produced per second is called beat frequency.
- (4) Persistence of hearing: The impression of sound heard by our ears persist in our mind for $1/10$ th of a second. If another sound is heard before $1/10$ second is over, the impression of the two sound mix up and our mind cannot distinguish between the two.

So for the formation of distinct beats, frequencies of two sources of sound should be nearly equal (difference of frequencies less than 10)

- (5) Equation of beats: If two waves of equal amplitudes 'a' and slightly different frequencies n_1 and n_2 travelling in a medium in the same direction are.

$$y_1 = a \sin \omega_1 t = a \sin 2\pi n_1 t; \quad y_2 = a \sin \omega_2 t = a \sin 2\pi n_2 t$$

By the principle of super position: $\vec{y} = \vec{y}_1 + \vec{y}_2$

$y = A \sin \pi(n_1 + n_2)t$ where $A = 2a \cos \pi(n_1 - n_2)t =$ Amplitude of resultant wave.

- (6) Beat frequency: $n = n_1 \sim n_2$.

$$(7) \text{ Beat period: } T = \frac{1}{\text{Beat frequency}} = \frac{1}{n_1 \sim n_2}$$