

# Assignment

## 11.15-23

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QUESTION:

Q23) A narrow sound pulse (for example, a short pip by a whistle) is sent across a medium.

(a) Does the pulse have a definite (i) frequency, (ii) wavelength, (iii) speed of propagation?

(b) If the pulse rate is 1 after every 20 s, (that is the whistle is blown for a split of second after every 20 s), is the frequency of note produced by whistle equal to 1/20 or 0.05 Hz ?

SOLUTION:

Table of Parameters

Parameter	Name of Parameter
$\nu_0$	first harmonic
$\nu_n$	$n^{th}$ harmonic
$l$	length of short pip
$V$	velocity of sound wave
$\lambda$	wavelength of sound wave
$A$	amplitude of sound wave
$x, y$	co-ordinates of point on wave
$k$	wave number
$\omega$	angular frequency of wave
$t$	time

(a) Let us assume, equation of sound pulse (*in resonance*) produced in short pip and is given by:

$$y = A \sin(kx) \cos(\omega t) \quad (1)$$

if pip is opened at both ends

$$\nu_n = (2n + 1) \left( \frac{V}{4L} \right) \text{ and } l = (2n + 1) \left( \frac{\lambda}{4} \right) \quad (3)$$

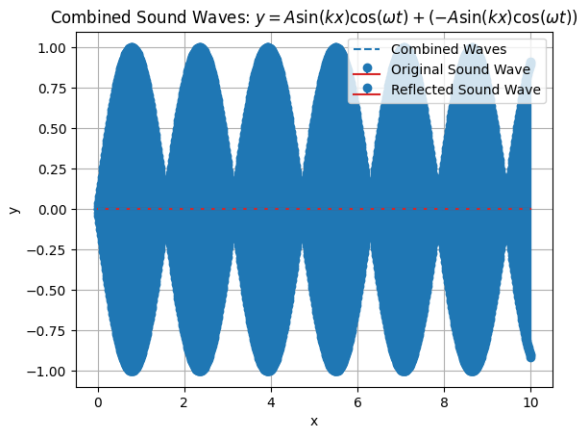
Therefore, from (2) and (3)

We can say that frequency  $\nu_n$  and wavelength  $\lambda$  of sound pulse in pip are not constant but velocity  $V$  of sound pulse in pip is constant

(b) And we know the relation that:

$$\nu_n = n \left( \frac{V}{2L} \right) \text{ or } \nu_n = (2n + 1) \left( \frac{V}{4L} \right) \quad (4)$$

Hence, The frequency of the note  $\nu_n$  produced will not be equal to 0.05 Hz or  $\frac{1}{20}$  Hz



Hence from (1) we know that,  
if pip is closed at one end

$$\nu_n = n \left( \frac{V}{2L} \right) \text{ and } l = n \left( \frac{\lambda}{2} \right) \quad (2)$$