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 ?

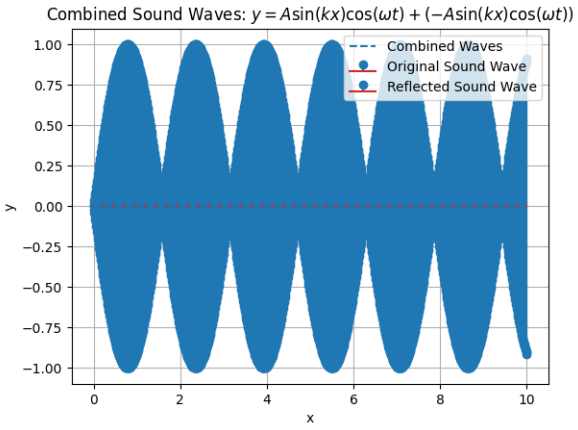
SOLUTION:

Table of Parameters

Parameter	Name of Parameter
ν_0	first harmonic
ν_n	n^{th} harmonic
l	length of short pip
V	velocity of sound wave
λ	wavelength of sound wave
A	amplitude of sound wave
x,y	co-ordinates of point on wave
k	wave number
ω	angular frequency of wave
t	time

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

$$y = A\ \sin kx\ \cos\omega t \tag{1}$$



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

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

if pip is opened at both ends

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

Therefore, from (2) and (3)

We can say that frequency ν_n and wavelength λ 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:

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

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