11.15-24

EE23BTECH11023-ABHIGNYA GOGULA

Question:

One end of a long string of linear mass density $8.0 \times 10^{-3}\,\text{kg m}^{-1}$ is connected to an electrically driven tuning fork of frequency 256 Hz. The other end passes over a pulley and is tied to a pan containing a mass of 90 kg. The pulley end absorbs all the incoming energy so that reflected waves at this end have negligible amplitude. At $t = 0$, the left end (fork end) of the string $x = 0$ has zero transverse displacement ($y = 0$) and is moving along positive y-direction. The amplitude of the wave is 5.0 cm. Write down the transverse displacement y as a function of x and t that describes the wave on the string.

Solution

parameter	description	value
μ	linear mass density	$8.0 \times 10^{-3}\,\text{kg m}^{-1}$
f	frequency	256 Hz
m	mass	90 kg
a	amplitude	5.0 cm

The displacement equation of wave:

$$y(x,t) = a\sin(\omega t - kx) \tag{1}$$

$$\omega = 2\pi \times 256 \tag{2}$$

$$\omega = 1.6 \times 10^3\,\text{rad/s} \tag{3}$$

$$V = \sqrt{\frac{T}{\mu}} \tag{4}$$

$$V = 332\,\text{m/s} \tag{5}$$

$$\lambda = \frac{V}{f} \tag{6}$$

$$\lambda = 1.29\,\text{m} \tag{7}$$

$$k = \frac{2\pi}{\lambda} \tag{8}$$

$$k = 4.84\,\text{m}^{-1} \tag{9}$$

then from (1)

$$y(x,t) = 0.05 sin\langle 1.6 \times 10^3 \times t - 4.84x\rangle m \tag{10}$$