

Answer on Question #49805-Physics-Mechanics-Kinematics-Dynamics

A simple pendulum has an oscillation period of 1.90s, and a mass of 150g, the mass of the string is 2×10^{-4} kg which is distributed uniformly. If it is hanging vertically and its string is plucked, find the speed of the transverse wave.

Solution

The speed of a transverse wave on a string is given by

$$v = \sqrt{\frac{T}{\mu}}$$

where T is tension and μ is its mass per unit length.

The period of simple pendulum is

$$T = 2\pi \sqrt{\frac{l}{g}}$$

So, the length of string is

$$l = g \left(\frac{T}{2\pi} \right)^2$$

The tension is

$$T = (M + m)g.$$

$$\mu = \frac{m}{l} = \frac{m}{g \left(\frac{T}{2\pi} \right)^2} = \frac{m}{g} \frac{1}{\left(\frac{T}{2\pi} \right)^2}$$

The speed of a transverse wave on a string is

$$v = \sqrt{\frac{(M + m)g}{m} \cdot g \left(\frac{T}{2\pi} \right)^2} = \frac{gT}{2\pi} \sqrt{1 + \frac{M}{m}} = \frac{9.8 \cdot 1.9}{2\pi} \sqrt{1 + \frac{150 \cdot 10^{-3}}{2 \cdot 10^{-4}}} = 81.2 \frac{m}{s}$$

Answer: $81.2 \frac{m}{s}$.