Answer on Question #58904-Physics-Mechanics-Relativity

A uniform string of length 20 m is suspended from a rigid support. A short wave pulse is introduced at its lowest end. It starts moving up the string. The time taken to reach the support is (take g = 10 m/s2)

Solution

At any cords section at length x above lowest point,

$$T = \frac{mgx}{l} = \mu gx$$

Hence speed of wave,

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

So,

$$\frac{dx}{dt} = \sqrt{gx} \rightarrow \int_0^l \frac{dx}{\sqrt{gx}} = \int_0^t dt$$

$$t = \frac{1}{\sqrt{g}} \left(\frac{x^{\frac{1}{2}}}{\frac{1}{2}} \right)_0^l = 2\sqrt{\frac{l}{g}} = 2\sqrt{\frac{20}{10}} = 2\sqrt{2}\ s.$$