Problem 16.1

Verify that the quantity $c = \sqrt{T/\mu}$ that appears in the wave equation for a string does indeed have the units of a speed.

Solution

Consider the units of both sides, noting that T is the tension in the string and μ is the mass per unit length.

$$[\![c]\!] = \left[\!\!\left[\sqrt{\frac{T}{\mu}} \right]\!\!\right] = \sqrt{\frac{[\![T]\!]}{[\![\mu]\!]}} = \sqrt{\frac{\mathrm{N}}{\frac{\mathrm{kg}}{\mathrm{m}}}} = \sqrt{\frac{\cancel{\mathrm{kg}} \cdot \frac{\mathrm{m}}{\mathrm{s}^2}}{\frac{\cancel{\mathrm{kg}}}{\mathrm{m}}}} = \sqrt{\frac{\mathrm{m}^2}{\mathrm{s}^2}} = \frac{\mathrm{m}}{\mathrm{s}}$$

c does in fact have units of speed.