Singapore Physics Olympiad **2022**

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Solution:
We know that for a standing wave, $L = n\frac{\lambda}{2}$. We can derive an expression by the velocity function of a string wave.

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

$$\frac{\lambda}{2} = \frac{1}{2f}\sqrt{\frac{T}{\mu}} = \frac{1}{2f}\sqrt{\frac{mg}{\mu}}$$

$$n = 2fL\sqrt{\frac{\mu}{mg}}$$

$$\mu = mg\left(\frac{n}{2fL}\right)^2$$

From this expression, we know that mass is inversely proportional to n^2. Hence, we have the following:

$$\frac{n_1}{n_2} = \sqrt{\frac{447.0}{286.1}} = 1.24996 \approx \frac{5}{4}$$

Thus we have the values for n_1 and n_2 (which are both supposed to be integers). Thus,

$$\mu = m_1 g\left(\frac{n_1}{2fL}\right)^2$$

$$= 286.1 \times 9.81 \times \left(\frac{5}{2 \times 120 \times 1.20}\right)^2$$

$$= \mathbf{0.84594}$$