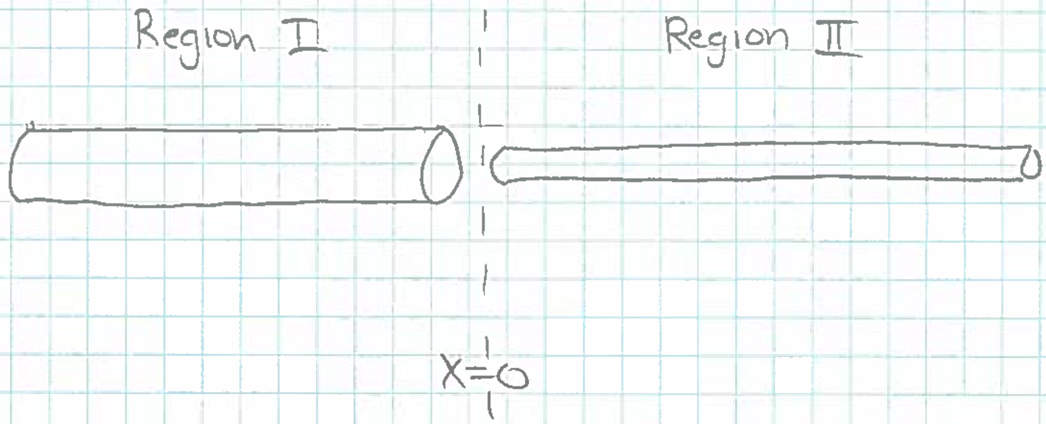


Two long pieces of string are joined at $x=0$. We are given

	String I	String II
ρ	$1.5\ g/cm^3$	$1.5\ g/cm^3 = 1500\ kg/m^3$
radius r	7.8 mm	3.9 mm

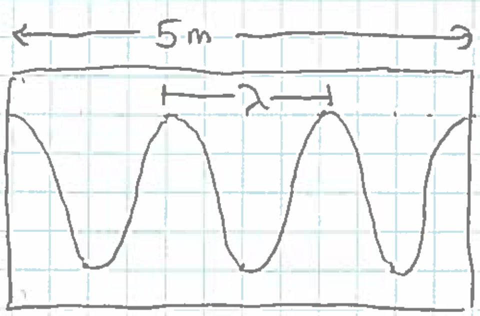
So we can compute

Cross section area A	$1.911\times10^{-4}\ m^2$	$4.778\times10^{-5}\ m^2$
linear density μ	$2.867\times10^{-1}\ kg/m$	$7.168\times10^{-2}\ kg/m$

Joe watches on point on the string and sees vertical motion with

total dist 1.54 cm $\rightarrow$ amplitude $A_I = \frac{1.54\,cm}{2} = 0.77\ cm$
$= 7.7\times10^{-3}\ m$

period $P = 3.0\ s$ $\rightarrow$ ang freq $\omega = \frac{2\pi}{P} = 2.094\ \frac{rad}{s}$



A photograph shows 4 peaks over a span of 5 m, so the wavelength must be

$$\lambda = \frac{5\ m}{3\ waves} = 1.66\ m$$

The impedance of the string in region I can be calculated via

$$\text{wave speed } v_I = f\lambda = \left(\frac{\omega}{2\pi}\right)\lambda = \left(\frac{2.094 \text{ rad/s}}{2\pi \text{ rad}}\right)(1.66 \text{ m})$$

$$= 0.556 \text{ m/s}$$

which allows us to determine the tension

$$v_I = \sqrt{\frac{T}{\mu_I}} \rightarrow T = \mu_I v_I^2 = \left(2.867\times10^{-1} \tfrac{\text{kg}}{\text{m}}\right)\left(0.566 \tfrac{\text{m}}{\text{s}}\right)$$

$$= 0.08849 \text{ N}$$

and then impedance

$$Z_I = \sqrt{T\mu_I} = \sqrt{(0.08849 \text{ N})(2.867\times10^{-1} \text{ kg/m})}$$

$$= 0.159 \text{ kg/s}$$

The wave travelling along string in region I carries power

$$P_I = \frac{1}{2}(\mu_I v_I)\,\omega^2 A_I^2$$

$$= \frac{1}{2}\left(2.867\times10^{-1} \tfrac{\text{kg}}{\text{m}}\right)\left(0.556 \tfrac{\text{m}}{\text{s}}\right)\left(2.094 \tfrac{\text{rad}}{\text{s}}\right)^2\left(7.7\times10^{-3} \text{ m}\right)^2$$

$$= 2.07\times10^{-5} \text{ W}$$

Now, in region II, the string has the same tension T, but different mass density. So its impedance is

$$Z_{II} = \sqrt{T\mu_{II}} = \sqrt{(0.08849 \text{ N})(7.168\times10^{-2} \text{ kg/m})}$$

$$= 7.96\times10^{-2} \tfrac{\text{kg}}{\text{s}} = \frac{1}{2} Z_I$$

We can compute the amplitude of the transmitted wave via

$$A_t = \frac{2 Z_I}{Z_I + Z_{II}} A_i$$

$$= \frac{2 Z_I}{1.5 Z_I} A_i = 1.33 A_i = 1.33 \left(7.7 \times 10^{-3} m\right)$$

$$= 1.027 \times 10^{-2} m$$

and so derive the power carried into region II by this transmitted wave

$$P_{II} = \frac{1}{2} (\mu_{II} V_{II}) \, \omega^2 A_t^2$$

where

$$V_{II} = \sqrt{\frac{T}{\mu_{II}}} = \sqrt{\frac{0.08849 \, N}{7.168 \times 10^{-2} \, \frac{kg}{m}}} = 1.111 \, \frac{m}{s}$$

$$= 2 V_I$$

So

$$P_{II} = \frac{1}{2} \left(7.168 \times 10^{-2} \, \frac{kg}{m}\right) \left(1.111 \, \frac{m}{s}\right) \left(2.094 \, \frac{rad}{s}\right)^2 \left(1.027 \times 10^{-2} m\right)^2$$

$$= 1.84 \times 10^{-5} \, W$$