

# Optics I: Theory CPHY 6/72250

## Assignment 3.

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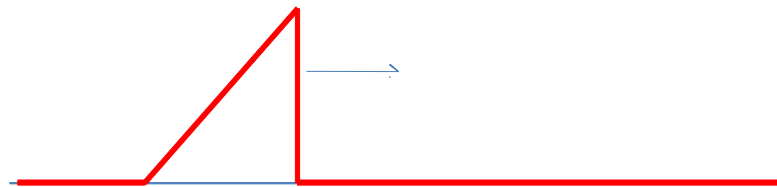
Due: Oct. 13, 2016

1. One end of a very long elastic string is attached to a wall, a person is holding the other end. The mass density of the string is  $\rho = 0.1 \text{ kg/m}$  and the tension in the string is  $T = 0.9 \text{ N}$ . The person is moving the end of string up and down so as to generate a wave, with frequency  $f = 3 \text{ Hz}$  and amplitude  $y_o = 0.5 \text{ m}$ , which travels towards the wall. (Ignore reflections.)
  - (a) What is the impedance of the string?
  - (b) Give an expression for the energy density in the string.
  - (c) Calculate the average energy density in the string.
  - (d) Calculate the average power propagating along the string.
  - (e) Give an expression for the vertical component of the force the person exerts on the string.
  - (f) Give an expression for the power produced by the person moving the end of the string.
  - (g) Calculate the average power produced by the person moving the end of the string.

2. The string below has mass density  $\rho = 0.4\text{kg/m}$  and tension  $T = 0.9\text{N}$ . It has two triangular waves propagating on it, as shown.  $y_o = 10\text{cm}$ , and  $L = 20\text{cm}$ .



- (a) Give an expression for the potential energy density and the kinetic energy density for each wave when the waves are far apart
- (b) Give an expression for the potential energy density and the kinetic energy density in the string for when the waves are right on top of each other, and the displacement of the string is  $y = 0$ .
3. The wave shown below is travelling on a string with mass density  $\rho = 0.4\text{kg/m}$  and tension  $T = 0.9\text{N}$ . It is incident on a string with  $\rho = 0.1\text{kg/m}$  and tension  $T = 0.4\text{N}$ .



Triangular wave on a string

- (a) If the amplitude of the incident wave is  $1.0\text{cm}$ , what will be the amplitudes of the reflected and transmitted waves?
- (b) Sketch the transmitted and reflected waves.