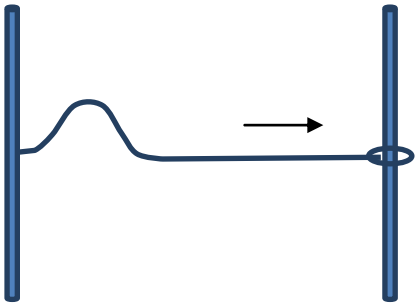
Name: _____ DISC: _____ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers.

Q1	Q2	Q3	Q4
10	10	5	5

1. A pulse travels down a string fixed at one end and free at the other as shown in the diagram (the ring on the end of the string allows the string end to be free).



LENGTH OF STRING	M (STRING)	v_{pulse}
$1.3\ m$	$0.2\ kg$	$1.5\ m/s$

Table 1: Properties of the System

a. The reflected pulse will be

Selection (2 pts):

i. Inverted.
(ii.) Upright.

b. Given the parameters in the table above, what is the tension T in the string (remember $v = \sqrt{\frac{T}{M/L}}$)?

Tension (2 pts):

$$v = \sqrt{\frac{T}{M/L}} \rightarrow T = v^2\left(\frac{M}{L}\right) = (1.5\frac{m}{s})^2\frac{0.2kg}{1.3\ m} = 0.35\ kg\frac{m}{s^2} = 0.35\ N$$

c. If you double the string tension, what is the speed of the pulse?

New speed (3 pts):

$$v = \sqrt{\frac{T}{\frac{M}{L}}} \propto \sqrt{T};\ \ v' = \sqrt{\frac{2\,T}{\frac{M}{L}}} = \sqrt{2}v$$

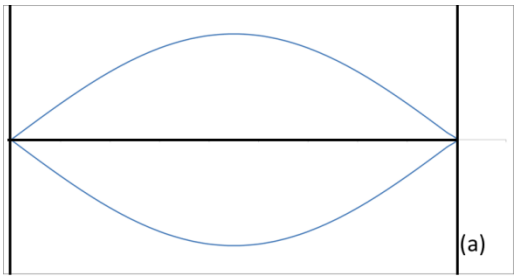
$$v' = 1.414 * 1.5\frac{m}{s} = 2.12\ m/s$$

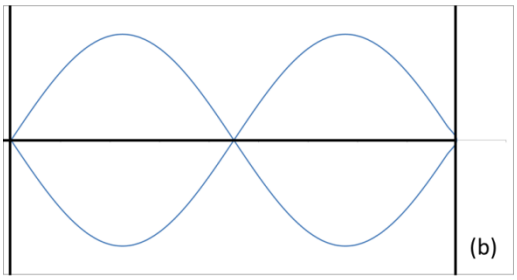
d. At the same time the original pulse is reflected, the string is plucked again. This produces a second pulse of the same amplitude. What will happen when the pulses meet?

Meeting of Pulses (3 pts):

Because the string is not fixed at the end, as illustrated by the wring on the right-hand end of the string, the reflected pulse will be upright. When the second upright pulse and the reflected pulse meet, they will interfere constructively with each other. This will result in a pulse whose amplitude is twice that of the original pulse (in an ideal case).

2. Consider the standing waves on a string as shown:





Mass of String	$0.1\ kg$
Length of String	$47\ cm$
Tension of String	$15\ N$
Speed of Wave	$v = f\lambda$

a. Which of figure (a) or (b) describes the first harmonic? Provide your reasoning.

First Harmonic (2 pts):

Figure (a) describes the first, or fundamental, harmonic. The first harmonic ($n = 1$) has no nodes between the fixed points, Figure (b) has one node between the fixed points, so it must be the second harmonic ($n = 2$).

b. What is the wavelength of each wave?

Wavelength (3 pts):

Figure (a)	Figure (b)
$\lambda = \frac{2L}{n} = 94\ cm$	$\lambda = \frac{2L}{n} = \frac{(2)(47\ cm)}{2} = 47\ cm$

c. Using the parameters in the table above, find the speed of each of the waves on this string.

Speed (2 pts):

Figure (a)	Figure (b)
$v = \sqrt{\frac{T}{M/L}} = \sqrt{\frac{15\ N}{(0.1\ kg)/(0.47\ m)}} = 8.4\ m/s$	Same as (b)

d. What are the frequencies of the waves?

Frequencies (3 pts):

Figure (a)	Figure (b)
$f = \frac{v}{\lambda} = \frac{\left(8.4\frac{m}{s}\right)}{(0.94\ m)} = 8.9\ s^{-1}$	$f = \frac{v}{\lambda} = \frac{\left(8.4\frac{m}{s}\right)}{(0.47\ m)} = 17.9\ s^{-1}$