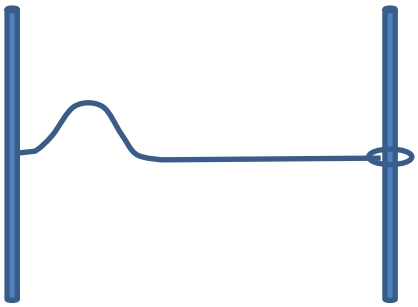
Name: _____ DISC: _____ Score: _____ / 20

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}
$0.25\ m$	$0.2\ kg$	$0.3\ m/s$

Table 1: Properties of the System

a. The reflected pulse will be
   i. Inverted.
   ii. Upright.

Selection (2 pts):

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):

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

New speed (3 pts):

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):

2. Consider organ pipes with the parameters given in the following table. The pipes are open at both ends.

PIPE	LENGTH	FIRST HARMONIC	WAVELENGTH	FREQUENCY	ANGULAR FREQUENCY
1	$2\ m$	$180\ Hz$	$\lambda_1 = 2L/n$	$f_1 = v/\lambda_1$	$\omega_1 = 2\pi f_1$
2	$0.25\ m$	$1440\ Hz$	$\lambda_2 = 2L/n$	$f_2 = v/\lambda_2$	$\omega_2 = 2\pi f_2$

a. For the first harmonic, what is the value of n? Explain your reasoning.

First Harmonic (2 pts):

b. Find the speed of sound in each pipe. Make sure your answers are clear.

Speeds (3 pts):

c. If both pipes are played simultaneously, when the waves meet will the sound waves interfere?

Interference (2 pts):

d. Remembering that a wave can be described as $A(t) = \mathrm{Acos}(\omega \mathrm{t})$,

i. Write down a wave function for pipe 1 and pipe 2. Use A as the amplitude for both waves.

Sum of 2 waves (1.5 pts):

ii. Find an expression for the superposition of the two waves. Can you sketch the result?
Remember: $\omega_L = \frac{1}{2}(\omega_1 - \omega_2)$ and $\omega_H = \frac{1}{2}(\omega_1 + \omega_2)$

Result (1.5 pts):