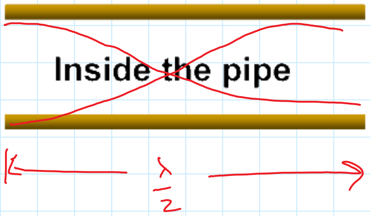
Phy 4C 2/13

Monday, February 13, 2017 10:41 AM

A pipe with two open ends is shown below. The length of the pipe is 1m and the speed of sound is 343 m/s. What is the first harmonic frequency of the sound wave created in this pipe?



$v = \lambda f$

$343 = (2) f$

$f = 172$ Hz

1. 343Hz

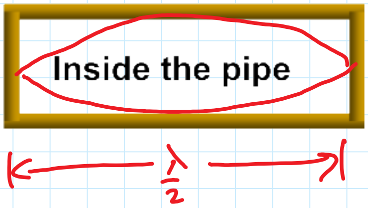
[✓ 2.] 172Hz

3. 686Hz

4. 1029Hz

5. None of the above

A pipe with two close ends is shown below. The length of the pipe is 1m and the speed of sound is 343 m/s. What is the first harmonic frequency of the sound wave created in this pipe?



1. 343Hz

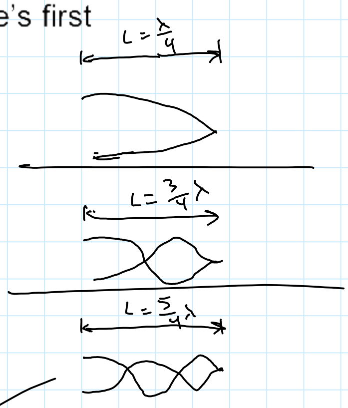
[✓ 2.] 172Hz

3. 686Hz

4. 1029Hz

5. None of the above

A pipe with one closed end is shown below. 428.75 Hz, 600.25 Hz and 771.75 Hz are three adjacent harmonic frequencies of sound waves created in this pipe. What is the pipe's first harmonic (lowest) frequency?



Inside the pipe

[✓ 1.] 86Hz
2. 172Hz
3. 343Hz
4. 257Hz
5. None of the above

1st Find L

$L = n\frac{\lambda}{4}$ $n = 1, 3, 5, \ldots$

$L = \frac{n}{4}\frac{v}{f}$ using $v = \lambda f$

$\frac{4Lf}{v} = n$

$\frac{4L}{v}\left(f_{n+2} - f_n\right) = n + 2 - n$

$\frac{4L}{343}\left(600.25 - 428.75\right) = 2$

$L = 1$

2nd Find Fundamental freq

$L = \frac{\lambda}{4}$

$\lambda = 4$ m

$f = \frac{343}{4} =$ 86 Hz

A string is vibrating at 300 Hz. Using a strobe light and an ultra fast camera you get a picture of the string as sketched below. The blue walls are separated by 1 meter. If the string were vibrating in its lowest possible frequency, what would that frequency be?

1. 50 Hz
[✓ 2.] 100 Hz
3. 150 Hz
4. 200 Hz
5. 300 Hz
6. None of the above

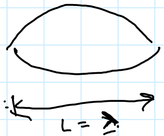
1st Find v

$L = \frac{3}{2}\lambda = 1$ m

$\lambda = \frac{2}{3}$ m

$V = \lambda f = \left(\frac{2}{3}\right)(300) = 200\ \frac{m}{s}$

Lowest



$\lambda = 2$ m

6. None of the above

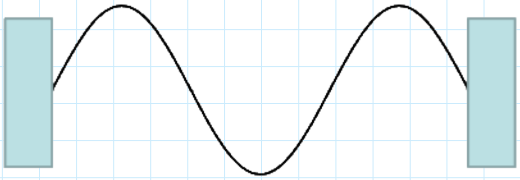
$\lambda = \frac{2}{3}$ m

$V = \lambda f = (\frac{2}{3})(300) = 200 \frac{m}{s}$

$\lambda = 2$ .m

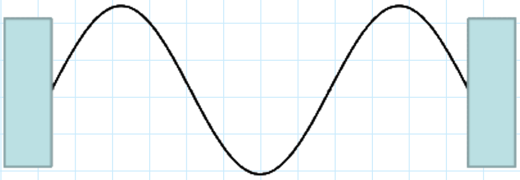
$f = 1.00$ Hz

A string is vibrating at 300 Hz. Using a strobe light and an ultra fast camera you get a picture of the string as sketched below. The blue walls are separated by 1 meter. What is the speed of the wave?



1. 50 m/s
2. 100 m/s
3. 150 m/s
[✓ 4.] 200 m/s
5. 300 m/s
6. None of the above

A string is vibrating at 300 Hz. Using a strobe light and an ultra fast camera you get a picture of the string as sketched below. The blue walls are separated by 1 meter. As determined in the previous question, the speed of the wave vibrating as shown is 200 m/s. what would its speed be if it were vibrating in the lowest possible frequency?



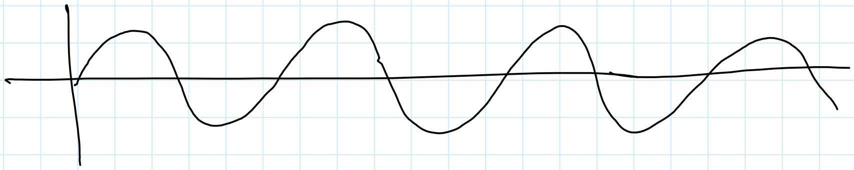
1. 50 m/s
2. 100 m/s
3. 150 m/s
[✓ 4.] 200 m/s
5. 300 m/s
6. None of the above.

Same string does Not change

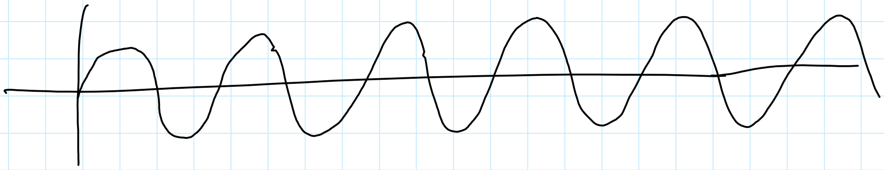
Beats

2 freq that are slightly different

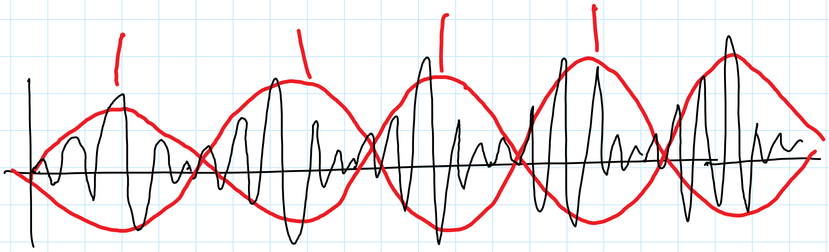
f_1



f_2



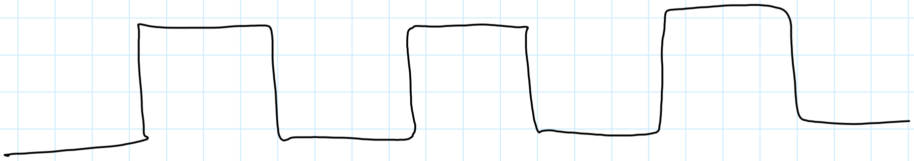
$f_1 + f_2$



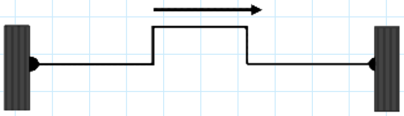
$$f_{beat} = |f_2 - f_1|$$

Fourier Transforms:

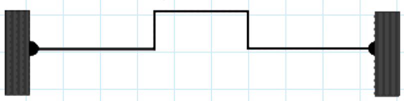
Square wave



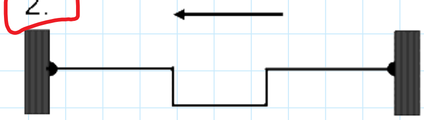
A symmetric pulse is approaching the right end of a string tied to two walls, as shown below on the right. Which of the following best represents the shape of the string after it has completely reflected off the wall on the right?

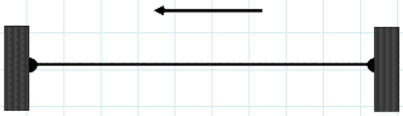


1.



[✓ 2.]

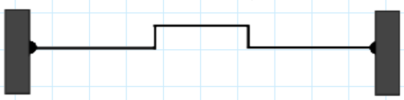




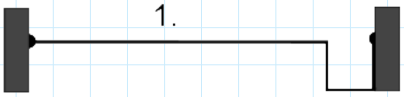
3.

4. None of the above.

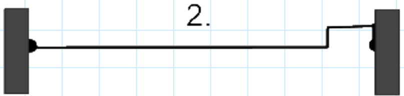
A symmetric pulse is approaching the right end of a string tied to two walls, as shown below on the right. At the precise moment when half of the wave has hit the wall, which of the following best represents the shape of the string?



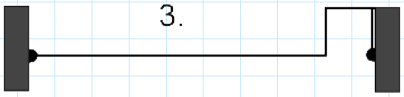
1.



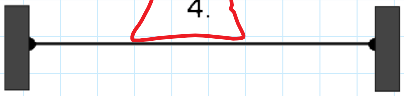
2.



3.

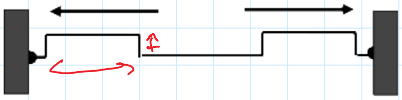


[✓ 4.]

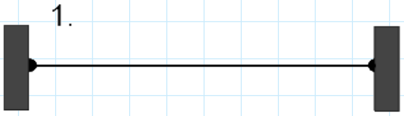


5. None of the above.

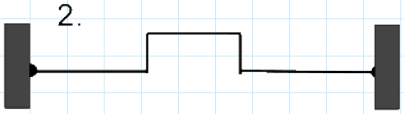
Two identical pulses move in opposite directions toward opposite ends of a string tied to two walls, as shown on the right. Which of the following represents possible shape(s) for the string after both pulses have undergone reflections and meet somewhere in the middle.



1.



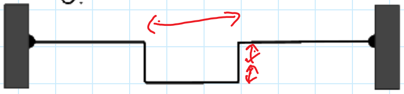
2.



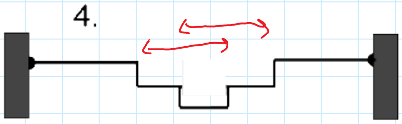
3

4.

3.



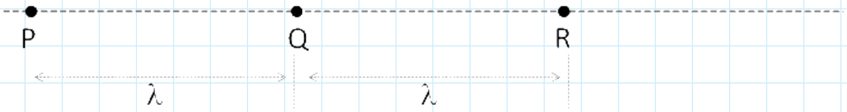
4.



[✓ 5. 3 AND 4.]

6. None of the above.

Two point sources, P and Q, emit sound waves of equal wavelengths (λ) and amplitudes (A). If you want to have **fully constructive interference** at point R, what has to be the phase difference between P and Q?



[✓ 1. 0]
2. 1/(2π)
3. 0.5
4. 1/π
5. 1
6. π
7. None of the above

Path difference = λ

Two point sources, P and Q, emit sound waves of equal wavelengths (λ) and amplitudes (A). If you want to have **fully destructive interference** at point R, what has to be the phase difference between P and Q?

1. 0
2. 1/(2π)
3. 0.5
4. 1/π
5. 1
[✓ 6. π]
7. None of the above

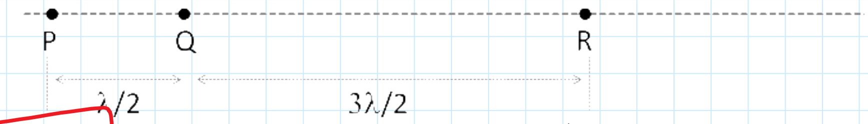
$$\text{phase change} = \left(\text{starting phase difference}\right) + \left(\text{path difference}\right)$$

$$+ \overset{\lambda}{\Delta L}\,\frac{2\pi}{\lambda}$$

$$\left(\text{odd mult. of } \pi \text{ for destructive}\right) = \pi$$

must be π

Two point sources, P and Q, emit sound waves of equal wavelengths (λ) and amplitudes (A). This time, the point source Q is moved closer to P as shown below. If you want to have **fully destructive interference** at point R, what has to be the phase difference between P and Q? (The distance between P & Q is λ/2; the distance between Q & R is 3λ/2.)



1. [✓ 0]
2. 1/(2π)
3. 0.5
4. 1/π
5. 1
6. π
7. None of the above

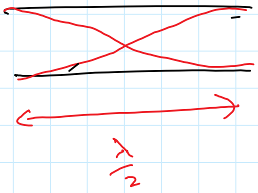
$$\begin{pmatrix}\text{Starting}\\ \text{phase}\end{pmatrix} + \begin{pmatrix}\text{Path}\\ \text{difference}\end{pmatrix} = \text{odd mult. of } \pi$$

$$\underset{\substack{\uparrow\\ \text{must be zero}}}{0} + \underbrace{\frac{\lambda}{2}\,\frac{2\pi}{\lambda}}_{\pi} = \pi$$

Prob 18-40

L = 32 cm open both ends $v = 343 \ \frac{m}{s}$

a) find lowest f

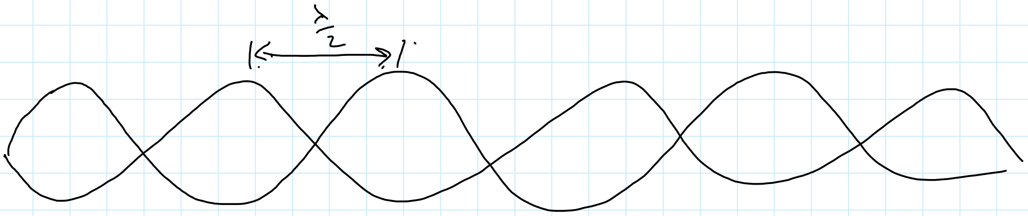


$v = \lambda f$

$343 = (0.64 \ m) f$

$f = 535.9$ Hz

b)



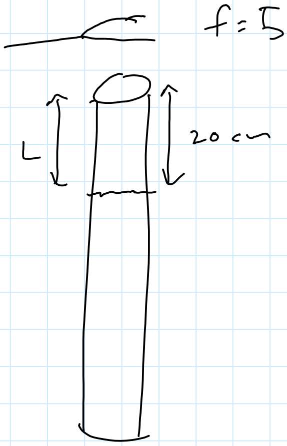
$\lambda = \frac{v}{f} = \frac{343}{4000} = 0.0858$ m

$\frac{\lambda}{2} = 0.0429$ Hz

---

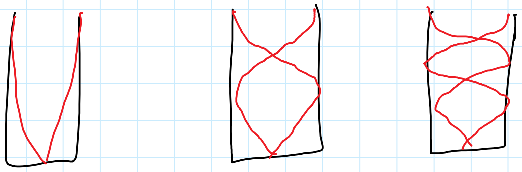
f = 512 Hz

18-44



$f = 512$ Hz

find 2 distances for L
(greater than 20 cm)
that give resonance



$L = \frac{1}{4}\lambda$ $L = \frac{3}{4}\lambda$ $L = \frac{5}{4}\lambda$

$$L = \frac{n\lambda}{4} \qquad n = 1, 3, 5, \ldots$$

and $v = \lambda f$

$$v = \frac{4L}{n} f$$

$$L = \frac{nv}{4f}$$

n	L
1	0.167 m
3	0.502 m ←
5	0.837 m ←
7	

Given: $y = 6\cos(3x + 15t - 2)$

$$y = \overset{A}{6}\cos(\overset{k}{3}x + \overset{\omega}{15}t - 2)$$

what direction is the wave moving? Left

Amplitude: 6 m

Period: $T = \frac{1}{f} = \frac{2\pi}{\omega} = \frac{2\pi}{15}$ s

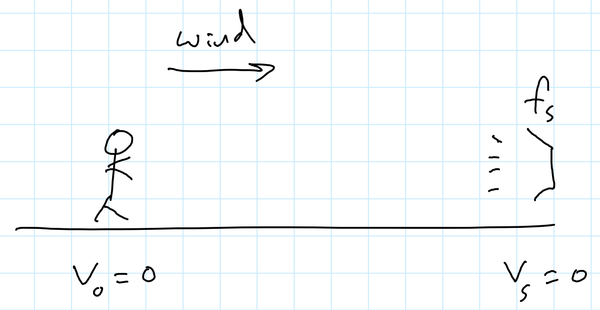
freq: $f = \frac{\omega}{2\pi} = \frac{15}{2\pi}$ Hz freq : $f = \frac{\;}{2\pi} = \frac{\;}{2\pi}$

Wavelength: $\lambda = \frac{2\pi}{k} = \frac{2\pi}{3}$ m

velocity : $v = \lambda f = \left(\frac{2\pi}{3}\right)\left(\frac{15}{2\pi}\right) = \frac{15}{3} = 5 \ \frac{m}{s}$

Doppler shift

I



$$f_o = f_s \left(\frac{V + V_o}{V - V_s}\right)$$

$V = 343 \ \frac{m}{s}$ wRT air

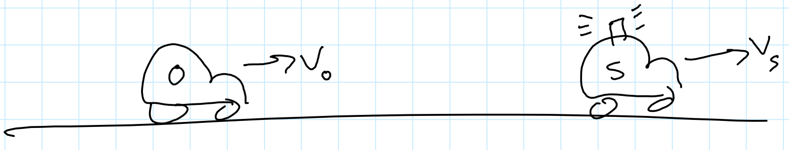
$V_s = V_w \leftarrow$

$V_o = V_w \leftarrow$

$$f_o = f_s \left(\frac{343 - V_w}{343 - V_w}\right)$$

No shift

II both moving at same speed in same direction (No wind)



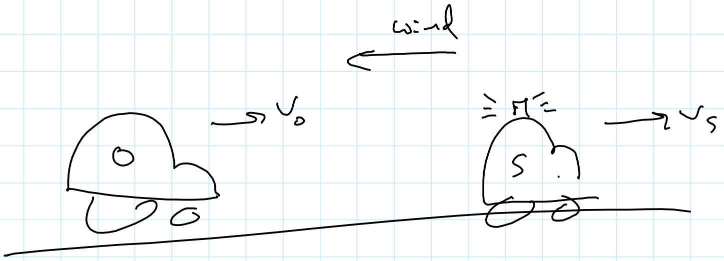
$V_s = V_o$

$$f_o = f_s \left(\frac{343 + V_o}{343 + V_s}\right)$$

↑ if $v_o = v_s$

shift

No shift



$$f_o = f_s \left(\frac{343 + (v_o + v_w)}{343 + (v_s + v_w)} \right)$$