CAPA 7

What is the longest wavelength for standing sound waves in a 104.2cm long tube that is open at both ends?

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What is the second longest wavelength?

Submit Answer Tries 0/10

What is the third longest wavelength?

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What is the longest wavelength for a standing wave, in the same length tube, that is open at one end and closed at the other?

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What is the second longest wavelength?

Submit Answer Tries 0/10

What is the third longest wavelength?

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A string has a linear density of 8.5E-3 kg/m and is under 248 N of tension. The string is 3.4 m long is fixed at both ends and is vibrating in the standing wave pattern shown in the drawing. Determine the speed of the traveling waves that make up the standing wave.

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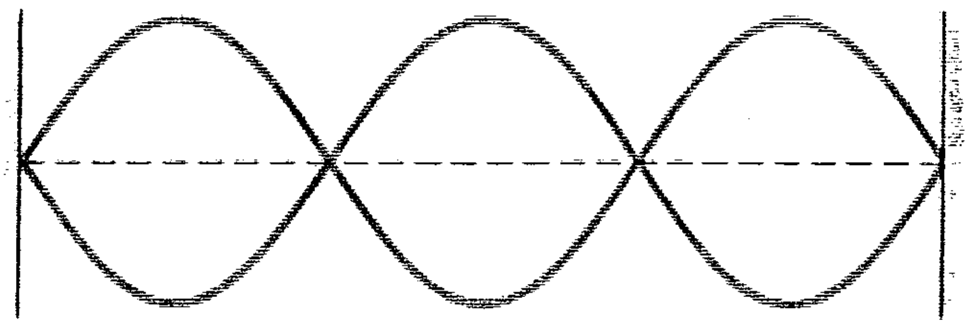

What is the wavelength?

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What is the frequency?

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A 0.0135kg, 2.20m long wire is fixed at both ends and vibrates in its simplest mode under a tension of 195N. When a tuning fork is placed near the wire, a beat frequency of 4.85Hz is heard. What are the possible frequencies of the tuning fork? (enter the smaller frequency first)

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What should the tension in the wire be if the beats are to disappear?

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A stretched wire vibrates in its fundamental mode at a frequency of 450Hz. What would be the fundamental frequency if the wire were half as long, its diameter were doubled, and its tension were increased two-fold?

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What is the longest wavelength for standing waves on a 458.0cm long string that is fixed at both ends?

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What is the second longest wavelength for standing waves?

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What is the third longest wavelength for standing waves?

Submit Answer Tries 0/10

If the frequency of the second-longest wavelength is 74.2Hz, what is the frequency of the third longest wavelength?

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Sound enters the ear travels through the auditory canal and reaches the ear drum, The auditory canal is approximately a tube open at only one end. The other end is closed by the eardrum. A typical length for the auditory canal in an adult is about 3.097 cm. The speed of sound is 343 m/s. What is the fundamental frequency of the canal? (Interestingly, the fundamental frequency is in the frequency range when human hearing is most sensitive).

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The fundamental frequency for a vibrating system is 686 Hz. For each of the following systems, give the three lowest frequencies (excluding the fundamental) at which standing waves can occur for a string fixed at both ends. Input the frequencies from lowest to highest.

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Submit Answer Tries 0/10

Submit Answer Tries 0/10

What are the frequencies for a cylindrical pipe with both ends open? Input the frequencies from lowest to highest.

Submit Answer Tries 0/10

Submit Answer Tries 0/10

Submit Answer Tries 0/10

What are the frequencies for a cylindrical pipe with only one end open? Input the frequencies from lowest to highest.

Submit Answer Tries 0/10

Submit Answer Tries 0/10

Submit Answer Tries 0/10

Two loudspeakers emit sound waves along the x-axis. The sound has maximum intensity when the speakers are 24.1cm apart. The sound intensity decreases as the distance between the speakers is increased, reaching zero at a separation of 81.8cm. What is the wavelength of the sound?

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If the distance between the speakers continues to increase, at what separation will the sound intensity again be a maximum?

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A 36.5cm long tube has a 36.5cm long insert that can be pulled in and out. A vibrating tuning fork is held next to the tube. As the insert is slowly pulled out, the sound from the tuning fork creates standing waves in the tube when the total length L is 43.820cm, 55.840cm, and 67.860cm. What is the frequency of the tuning fork? Take the speed of sound in air to be 343m/s.

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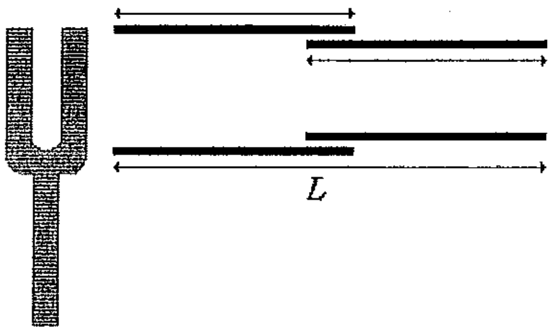

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Physics 1A03
Assignment 7

1. a) $\lambda = \frac{2L}{m}$; $m = 1$

$= \frac{2(1.042\,m)}{1}$

$= 2.08\,m$

b) $\lambda = \frac{2L}{m}$; $m = 2$

$= \frac{2(1.042\,m)}{2}$

$= 1.042\,m$

c) $\lambda = \frac{2L}{m}$; $m = 3$

$= \frac{2(1.042\,m)}{3}$

$= 0.695\,m$

d) $\lambda = \frac{4L}{m}$; $m = 1$

$= \frac{4(1.042\,m)}{1}$

$= 4.168\,m$

e) $\lambda = \frac{4L}{m}$; $m = 3$

$= \frac{4(1.042\,m)}{3}$

$= 1.389\,m$

f) $\lambda = \frac{4L}{m}$; $m = 5$

$= \frac{4(1.042\,m)}{5}$

$= 0.834\,m$

2. a) $c = \sqrt{\frac{T}{\mu}}$

$= \sqrt{\frac{248N}{8.53e^{-3} kg/m}}$

$= 170.5 m/s$

b) can tell visually λ is $2/3$ string length;

$3.4m \cdot 2/3 = 2.27m$

c) $f = c/\lambda$

$= \frac{170.5 m/s}{2.27m}$

$= 75.1 Hz$

3. a) $c = \sqrt{\frac{T}{\mu}}$ $\quad c = \lambda f$

$\lambda f = \sqrt{\frac{T}{\mu}}$

$\frac{2L}{n} f = \sqrt{\frac{T}{\mu}}$

$f = \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}}$

$= \frac{1}{2(2.20m)} \cdot \sqrt{\frac{195N}{\frac{(0.0135kg)}{(2.20m)}}}$

$= 40.5 Hz$

$f_{fork} = f_{wire} \pm f_{beat}$

$= 40.5Hz \pm 4.85 Hz$

$= 35.67 Hz$ OR $45.35 Hz$

b) $T = (2L \cdot f)^2 \cdot \mu$

if $f = 35.67Hz$

$T = 151.16N$

if $f = 45.35Hz$

$T = 244.33N$

4. $f = \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}} = 450\,Hz$

how does diameter, d, factor in?

$$\mu = \frac{m}{l} = \frac{m}{\frac{V}{a}} = \frac{m \cdot a}{V}$$

$$a = \pi \left(\frac{D}{2}\right)^2$$

so: if d is doubled, a is quadrupled

so: $\mu = \frac{m \cdot 4a}{V}$

$$f = \frac{1}{2\left(\frac{L}{2}\right)} \cdot \sqrt{\frac{2T}{\frac{m \cdot 4a}{V}}}$$

$$= 2 \cdot \frac{1}{2L} \cdot \sqrt{\frac{2}{4} \cdot \frac{T}{\frac{m \cdot a}{V}}} \ \mu$$

$$= 2 \cdot \frac{\sqrt{2}}{2} \cdot \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}}$$

the new frequency is changed by a factor of $2 \cdot \frac{\sqrt{2}}{2} = \sqrt{2}$.

$450\,Hz \cdot \sqrt{2} = 636.4\,Hz$

5. a) $\lambda_1 = \frac{2L}{1}$

$= 4.58\,m \cdot 2$

$= 9.16\,m$

b) $\lambda_2 = \frac{2L}{2}$

$= 4.58\,m$

c) $\lambda_3 = \frac{2L}{3}$

$= \frac{2(4.58\,m)}{3}$

$= 3.05\,m$

d) $c = \lambda_2 f_2$

$= (4.58\,m)(74.2\,Hz)$

$= 339.84\,m/s$

$f_3 = \dfrac{3c}{2L}$

$= \dfrac{3(339.8\,m/s)}{2(4.58\,m)}$

$= 111.3\,Hz$

6. $\lambda = 4L$

$= 4(0.03097\,m)$

$= 0.12388\,m$

$f = \dfrac{c}{\lambda}$

$= \dfrac{343\,m/s}{0.12\cancel{3}88\,m}$

$= 2768.8\,Hz$

7. ~~a~~ standing waves occur at the nodes of the system.

at $n = 1$, $f = 68.6\,Hz$

a) $n = 2$ $f_2 = 2 \cdot f_1 = 137.2\,Hz$

b) $n = 3$ $f_3 = 3 \cdot f_1 = 205.8\,Hz$

c) $n = 4$ $f_4 = 274.4\,Hz$

d)
e)
f)] same as a) b) c) $n = 2, 3, 4$

g)
h)
i)] same as above <u>but</u> since closed on both ends, n can only be odd: $n = 3, 5, 7$

8. a) Δd between the two: $81.8cm - 24.1cm$
$= 57.7cm$

note: this is ½ of a full wavelength!

so: $\lambda = \Delta d \cdot 2$
$= 0.577m \cdot 2$
$= 1.154m$

b) $\frac{1}{2}$ a full λ away from minimum intensity would give max intensity again, so:

$81.8cm + \Delta d$
$= 81.8cm + 57.7cm$
$= 139.5cm$
$= 1.40m$

9. each ½ λ increase in length causes standing waves.

so: $55.840cm - 43.820cm$
$= 12.02cm$
$= \frac{1}{2}\lambda$
$\lambda = 24.04cm$

$c = \lambda \cdot f$
$f = \frac{c}{\lambda}$
$= \frac{343m/s}{0.2404m}$
$= 1426.8Hz$