Exercise 15.22 - Enhanced - with Feedback

Review | Constants

A piano wire with mass 2.60 g and length 83.0 cm is stretched with a tension of 29.0 N. A wave with frequency 120 Hz and amplitude 1.60 mm travels along the wire.

Part A

Calculate the average power carried by the wave.

Express your answer in watts.

P = _______ W

Submit   Request Answer

Part B

What happens to the average power if the wave amplitude is halved?

Express your answer in watts.

P = _______ W

Submit   Request Answer

Exercise 15.34

Review | Constants

Adjacent antinodes of a standing wave on a string are 15.0 cm apart. A particle at an antinode oscillates in simple harmonic motion with amplitude 0.850 cm and period 0.0750 s. The string lies along the $+x$-axis and is fixed at $x = 0$.

Part A

How far apart are the adjacent nodes?

Express your answer in centimeters.

Δx = ____ cm

Submit Request Answer

Part B

What is the wavelength of the two traveling waves that form this pattern?

Express your answer in centimeters.

λ = ____ cm

Submit Request Answer

Part C

What is the amplitude of the two traveling waves that form this pattern?

Express your answer in centimeters.

A = cm

Submit Request Answer

Part D

What is the speed of the two traveling waves that form this pattern?

Express your answer in meters per second.

v = m/s

Submit Request Answer

Part E

Find the maximum and minimum transverse speeds of a point at an antinode.

Enter your answers in meters per second separated by a comma.

v_{max}, v_{min} = $\mathrm{m/s}$

Submit Request Answer

Part F

What is the shortest distance along the string between a node and an antinode?

Express your answer in centimeters.

Δx = cm

Review | Constants

One string of a certain musical instrument is 72.0 cm long and has a mass of 8.80 g. It is being played in a room where the speed of sound is 344 m/s.

Part A

To what tension must you adjust the string so that, when vibrating in its second overtone, it produces sound of wavelength 0.763 m? (Assume that the breaking stress of the wire is very large and isn't exceeded.)

Express your answer in newtons.

ΑΣφ ?

T = N

Submit Request Answer

Part B

What frequency sound does this string produce in its fundamental mode of vibration?

Express your answer in hertzes.

ΑΣφ ?

f = Hz

Submit Request Answer

Problem 15.57

Review | Constants

A 1.80-m-long uniform bar that weighs 688 N is suspended in a horizontal position by two vertical wires that are attached to the ceiling. One wire is aluminum and the other is copper. The aluminum wire is attached to the left-hand end of the bar, and the copper wire is attached 0.400 m to the left of the right-hand end. Each wire has length 0.600 m and a circular cross section with radius 0.250 mm.

Part A

What is the fundamental frequency of transverse standing waves for the aluminium wire?

Express your answer with the appropriate units.

f = Value Units

Submit Request Answer

Part B

What is the fundamental frequency of transverse standing waves for the copper wire?

Express your answer with the appropriate units.

f = Value Units

Submit Request Answer

Review | Constants

A 70.0-m-long brass rod is struck at one end. A person at the other end hears two sounds as a result of two longitudinal waves, one traveling in the metal rod and the other traveling in air.

Part A

What is the time interval between the two sounds? (The speed of sound in air is 344 $\mathrm{m/s}$; see Tables 11.1 and 12.1 in the textbook for relevant information about brass.)

Express your answer with the appropriate units.

t = Value Units

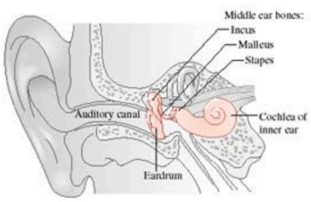
Submit Request Answer

Sound is detected when a sound wave causes the tympanic membrane (the eardrum) to vibrate (see (Figure 1)). Typically, the diameter of this membrane is about 8.4 mm in humans.

For related problemsolving tips and strategies, you may want to view a Video Tutor Solution of Temporary "or permanent" hearing loss.

Figure

1 of 1



Review | Constants

Part A

How much energy is delivered to the eardrum each second when someone whispers (20 dB) a secret in your ear?

Express your answer with the appropriate units.

E = Value Units

Submit Request Answer

Part B

To comprehend how sensitive the ear is to very small amounts of energy, calculate how fast a typical 2.0 mg mosquito would have to fly (in $\mathrm{mm/s}$) to have this amount of kinetic energy.

Express your answer in millimeters per second to two significant figures.

v = $\mathrm{mm/s}$

Submit Request Answer

Provide Feedback

Next

Exercise 16.22

The pattern of displacement nodes *N* and antinodes *A* in a pipe is *ANANANANANA* when the standing-wave frequency is 1710 Hz. The pipe contains air at $20^\circ\mathrm{C}$. The speed of sound in air is 344 $\mathrm{m/s}$.

Review | Constants

Part A

Is it an open or a closed (stopped) pipe?

- It is an open pipe.
- It is a closed pipe.
- It cannot be determined.

Submit Request Answer

Part B

Which harmonic is this?

- This is the second harmonic.
- This is the third harmonic.
- This is the fourth harmonic.
- This is the fifth harmonic.

Submit Request Answer

Part C

What is the length of the pipe?

Express your answer with the appropriate units.

L = Value Units

Submit Request Answer

Part D

What is the fundamental frequency?

Express your answer with the appropriate units.

f_1 = Value Units

Submit Request Answer

Part E

What would be the fundamental frequency of the pipe if it contained helium at $20^\circ\mathrm{C}$. The speed of sound in helium is 999 $\mathrm{m/s}$.

Express your answer with the appropriate units.

μÅ ?

f_1 = Value Units

Submit Request Answer

Exercise 16.26

Many opera singers (and some pop singers) have a range of about $2\frac{1}{2}$ octaves or even greater. Suppose a soprano's range extends from A below middle C (frequency 220 Hz) up to E-flat above high C (frequency 1244 Hz). Although the vocal tract is quite complicated, we can model it as a resonating air column, like an organ pipe, that is open at the top and closed at the bottom. The column extends from the mouth down to the diaphragm in the chest cavity. Assume that the lowest note is the fundamental.

Review | Constants

Part A

How long is this column of air if v = 354 $\mathrm{m/s}$?

Express your answer with the appropriate units.

L = Value Units

Submit Request Answer

Part B

Does your result seem reasonable, on the basis of observations of your own body?

- yes
- no

Submit

Request Answer

Exercise 16.30 - Enhanced - with Feedback

Review | Constants

You have a stopped pipe of adjustable length close to a taut 62.0 cm, 7.25 g wire under a tension of 4510 N. You want to adjust the length of the pipe so that, when it produces sound at its fundamental frequency, this sound causes the wire to vibrate in its second *overtone* with very large amplitude. The speed of sound in air is 344 $\mathrm{m/s}$.

Part A

How long should the pipe be?

Express your answer with the appropriate units.

L = Value Units

Submit   Request Answer

Problem 16.55

Review | Constants

The mean molar mass of air is $M = 28.8 \times 10^{-3}\ \mathrm{kg/mol}$ and the ratio of its heat capacities is $\gamma = 1.40$.

Part A

Use the equation $v = \sqrt{\frac{\gamma R T}{M}}$ to determine the speed of sound in air at $0^\circ\mathrm{C}$.

Express your answer with the appropriate units.

$v_{0^\circ\mathrm{C}}$ = Value Units

Submit Request Answer

Part B

Using the first two terms of the power series expansion of $(1+x)^n = 1 + nx + \frac{n(1-n)}{2!}x^2 + \ldots$, determine the speed of sound in air with respect to Celsius temperature T_C.

- $v = (332\ \mathrm{m/s}) \cdot T_C/546$
- $v = (332\ \mathrm{m/s})(1 + T_C/273)$
- $v = (332\ \mathrm{m/s})(1 + T_C/546)$
- $v = (332\ \mathrm{m/s}) \cdot T_C/273$

Submit

Request Answer