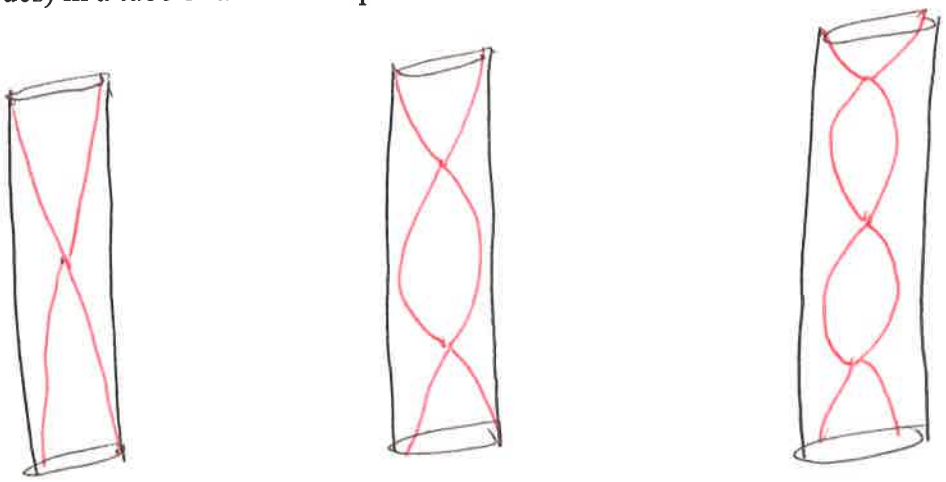
PHYS 201 SFQ on air column vibrations Name: Key

1. Draw a pictorial representation of longitudinal standing waves (fundamental and two higher modes) in a tube of air that is open at both ends.

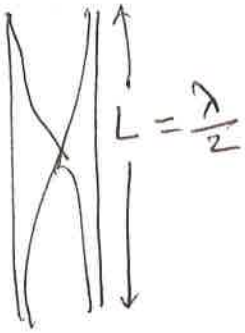


2. The range of human hearing is roughly from twenty hertz to twenty kilohertz. Based on these limits and a value of 343 m/s for the speed of sound, what are the lengths of the longest and shortest pipes (open at both ends and producing sound at their fundamental frequencies) that you expect to find in a pipe organ?

20 Hz ⟶ 20,000 Hz

$\lambda = \frac{v}{f} = \frac{343}{20} = 17.15\text{m}$ $\quad \frac{343}{20{,}000} = 0.01715\text{m}$

$L = \frac{17.15}{2} = 8.575\text{m}$ $\quad = \frac{0.01715}{2} = 0.00857\text{m}$



$L = 8.6\text{m}$ —— 0.0086m

longest shortest

PHYS 201 SFQ on waves Name:_____

1. Distinguish a transverse wave from a longitudinal wave.

↳ Disturbance is at right angle to the propagation direction.
" " parallel to the propagation direction

2. What is the relationship between the period and frequency of a periodic wave?

$$T = \frac{1}{f}$$

3. Express wave speed in terms of wavelength and frequency.

$$V = \lambda f$$

4. AM and FM radio waves are transverse waves that consist of electric and magnetic disturbances. These waves travel at a speed of 3.00×10^8 m/s. Find the wavelength of the radio waves emitted by AM 1340 kHz and FM 107.9 MHz.

$$\lambda_{AM} = \frac{V}{f} = \frac{3 \times 10^8}{1340 \times 10^3} = 224\ m$$

$$\lambda_{FM} = \frac{V}{f} = \frac{3 \times 10^8}{107.9 \times 10^6} = 2.78\ m$$

5. Visible light has the wavelength range 400-750 nm. Calculate the frequency range. Assume a speed of light of 3.00×10^8 m/s.

$$f = \frac{V}{\lambda} = \frac{3 \times 10^8}{400 \times 10^{-9}}$$

$$= 0.0075 \times 10^{17}$$

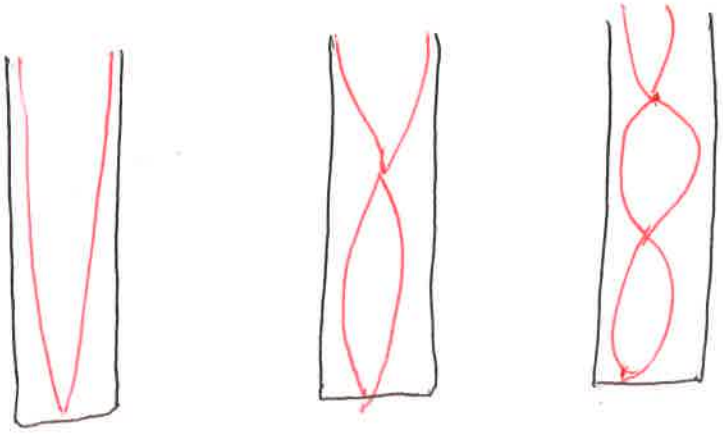
$$= 7.5 \times 10^{14}\ Hz$$

$$\frac{3 \times 10^8}{750 \times 10^{-9}}$$

$$4 \times 10^{14}\ Hz$$

PHYS 201 SFQ on air column vibrations Name: Key

1. Draw a pictorial representation of longitudinal standing waves (fundamental and two higher modes) in a tube of air that is closed at one end.



2. Sound enters the ear, travels through the auditory canal, and reaches the eardrum. 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 2.9 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 where human hearing is most sensitive.)

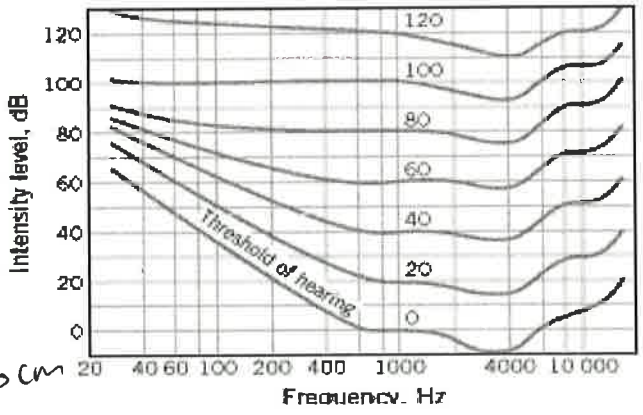
2.9 cm = half a loop

loop length = 2.9×2

$\lambda = 2.9 \times 2 \times 2$

$\lambda = 2.9 \times 4 = 11.6\ cm$

$\lambda = 0.116\ m$



$f = \frac{v}{\lambda} = \frac{343}{0.116} = 2957\ Hz$

$f_{fundamental} = 2957\ Hz$