Arvind Borde / PHY 11, Week 10: Sound

Sound travels as _____. It needs a _____ (something to do the "waving.") It cannot travel in a vacuum.

The back-and-forth motion of air molecules as a sound wave travels gives rise to pressure differences in the air.

1

The speed of sound in air is given by

_____ (T in °C).

(**1**) At $20°C$, $v =$ _____.
(**2**) At $0°C$, $v =$ _____.

To compare, speed of light is $c = 3 \times 10^8$ m/s.

2

$20°C$ is a pretty typical temperature, so we'll take 343 m/s as the standard sound speed in air.

How long does it take sound to typically travel
(**3**) 1 m at (a) 343 m/s and (b) 331 m/s?
(a)   (b)

(**4**) $2,000$ m at (a) 343 m/s and (b) 331 m/s?
(a)   (b)

3

There are two important aspects to sound, especially audible.

1. _____:

_____

Human ear sensitivity: 20 Hz–$20,000$ Hz.
Dogs: up to $50,000$ Hz (ultrasonic range).

4

2. _____:
I measured in   .

A related concept is that of _____.
It's measured in _____.

$$\beta =$$

where $I_0 = 10^{-12} \frac{W}{m^2}$ is lowest audible intensity.

5

The *log* in this formula is "to the base 10.". It expresses numbers as powers of 10.

For example,

$$log(100) = log(10^2) = 2.$$

(**5**) What is $log(1000)$? _____
(**6**) What is $log(0.1)$? _____

6

ADDITIONAL NOTES

_____

_____

_____

_____

_____

_____

(**7**) How loud do we perceive a sound to be if it's 100 times as intense as the reference level $(I = 10^{-10}\,\text{W/m}^2)$?

7

(**8**) What is I for $75\,\text{dB}$?

8

(**9**) If one musical instrument sounds $50\,\text{dB}$ loud, how loud will four sound?

9

(**10**) The sensitivity of the human ear to sound changes is about $\pm 3\,\text{dB}$. How does that translate into intensities?

10

ADDITIONAL NOTES