

PHY2010 HW 3 Fall 2013 . Show your work. Answer on separate paper

Use 345 m/s for the speed of sound

- In a given string, the tension is 200N and the mass per unit length is 0.1 kg/m. What is the wave speed?
a) 20 m/s b) 45 m/s c) 450 m/s d) 2000 m/s
- A string on a particular bass instrument as a length of 80.0 cm, a mass per unit length of 0.50 g/m, and its fundamental frequency is 200Hz. What is the tension in the string?
a) 51.2 N b) 63.4 N c) 78.5 N d) 98.2 N
- A pipe 50 cm long has one end open and one end closed. If the air is at room temperature, what are the frequencies of the first 3 harmonics?
- We can model a flute as a tube with both ends open, and a clarinet as a tube with one end open and one closed. If they have the same length...
 - What is the ratio of the fundamental frequency of the flute to that of the clarinet?
a) 2:1 b) 1:2 c) 3:1 d) 4:1
 - What is the difference in the harmonic series generated by each instrument?
- A 2 m long "Kundt's tube" shows dust gathered in three places:



If the speed of sound in air is 345 m/s, what is the **period** of the sound this tube was playing?

- a) 1.56 ms b) 2.37 ms c) 2.84 ms d) 3.86 ms
- Michael Hedges (cf. www.nomadland.com) tuned his guitar strings way, way down on occasion. If he decreased the tension on the heaviest string by a factor of 8, what is the ratio of the new frequency to the old frequency? (i.e., what is the value of the fraction $f_{\text{New}} / f_{\text{Old}}$)
a) 8 b) 0.35 c) 2 d) 0.125
 - When a whip is cracked, the pulse accelerates until it is traveling at supersonic speed. Describe the physics that make this acceleration possible.



- Ben is playing at The Anchor, but unfortunately nobody can hear his intricate bass playing because the low end is muddled by the resonant frequencies of the room/barn. Looking around, you estimate the length of the room to be 5m. Assuming the air is at room temperature, and regarding the room as a pipe with both ends closed, what is the corresponding frequency of the first overtone?
a) 6.9 Hz b) 17.25 Hz c) 34.5 Hz d) 69.0 Hz
- (from Michael Fowler) Humans can only hear sounds in the frequency range 20 Hz to 20,000 Hz. What would be the longest and shortest organ pipes there is any point in manufacturing? Assume the pipes are open at **both** ends.
- Berg & Stork, Chapter 3, Problem 5: A certain stretched string has a fundamental frequency of 175 Hz. What is the new frequency if one
 - Decreases the tension by a factor of 4
 - Doubles the length
 - Decreases the mass per unit length by a factor of 9
 - Triplies the diameter.