Problems 16.2,7,10,21,24,26 from MasteringPhysics with minor clarifications.

16.2 - Sound in Water

For sound waves in air with frequency 1000 Hz, a displacement amplitude of 1.2×10^{-8} m produces a pressure amplitude of 3.0×10^{-2} Pa above and below atmospheric pressure $p_a = 1.013 \times 10^5$ Pa. Water at 20°C has a bulk modulus of $B = 2.2 \times 10^9$ Pa, and the speed of sound in water at this temperature is $v = 1480$ m/s.

Part A

For 1000Hz sound waves in 20°C water, what displacement amplitude is produced if the pressure amplitude is $p_{\max} = 3.0 \times 10^{-2}$ Pa?

16.7 - Speed of Sound in Water and in Air

A submerged scuba diver hears the sound of a boat horn directly above her on the surface of the lake. At the same time, a friend on dry land $l_1 = 22.0$ m from the boat also hears the horn. The horn is $l_2 = 2.00$ m above the surface of the water.

Part A

What is the distance from the horn to the diver, L? Both air and water are at 20°C. (The numbers that you had may differ.)

16.10 - Speed of Sound verses Temperature

The speed of sound in air at a temperature of T was found to be v.

Part A

What is the change in speed, Δv, for a change in air temperature of ΔT?

16.21 - Loud Baby

A baby's mouth is a distance of L_1 from her father's ear and a distance of L_2 from her mother's ear.

Part A

What is the difference between the sound intensity levels heard by the father and by the mother?

16.24 - Open Pipe

The fundamental frequency of an open pipe is $f_1 = 594$ Hz.

Part A

What is the fundamental frequency, f_1', if one end is plugged?

16.26 - Open Pipe

Consider a pipe $L = 45.0$ cm long if the pipe is open at both ends. Use $v = 344$ m/s.

Part A

Find the fundamental frequency, f_1.

Part B

Find the frequency of the first overtone, f_2.

Part C

Find the frequency of the second overtone, f_3.

Part D

Find the frequency of the third overtone, f_4.

Part E

What is the number of the highest harmonic that may be heard by a person who can hear frequencies from 20 Hz to $f_{\max} = 20,000$ Hz?

Part F

Now pipe is closed at one end. Find the fundamental frequency, f_1.

Part G

Find the frequency of the first overtone, f_3.

Part H

Find the frequency of the second overtone, f_5.

Part I

Find the frequency of the third overtone, f_7.

Part J

What is the number of the highest harmonic that may be heard by a person who can hear frequencies from 20 Hz to $f_{\max} = 20{,}000$ Hz?