Physics 102.13
Quiz#1
Chapter 17

Instructor: Dr. A. Mekki

Name: Key Id:

1. A pipe 0.60 m long and closed at one end is filled with an unknown gas. The third harmonic frequency for the pipe is 750 Hz.

(a) What is the speed of sound in the unknown gas?

$$f_n = n\frac{v}{4L} \quad n = 1, 3, 5, \ldots$$

$$f_3 = 3\frac{v}{4L} \Rightarrow 750 = 3 \times \frac{v}{4\times 0.6} \Rightarrow \boxed{v = 600 \text{ m/s}}$$

(b) What is the fundamental frequency for this pipe when it is filled with this gas?

$$f_1 = \frac{v}{4L} = \frac{600}{4\times 0.6} = \boxed{250 \text{ HZ}}$$

2. Two sound levels differ by 30 dB. What is the ratio of their intensities?

$$\Delta\beta = \beta_2 - \beta_1 = 30 \text{ dB}$$

$$\left.\begin{aligned} \beta_1 &= 10 \log\left(\frac{I_1}{I_0}\right) \\ \beta_2 &= 10 \log\left(\frac{I_2}{I_0}\right) \end{aligned}\right\} \Rightarrow \Delta\beta = 10 \log\left(\frac{I_2}{I_1}\right)$$

$$\Rightarrow \frac{\Delta\beta}{10} = \log\frac{I_2}{I_1}$$

$$\Rightarrow \frac{I_2}{I_1} = 10^{\frac{\Delta\beta}{10}} = 10^{\frac{30}{10}} = 10^3 = 1000$$

$$\boxed{\frac{I_2}{I_1} = 1000}$$

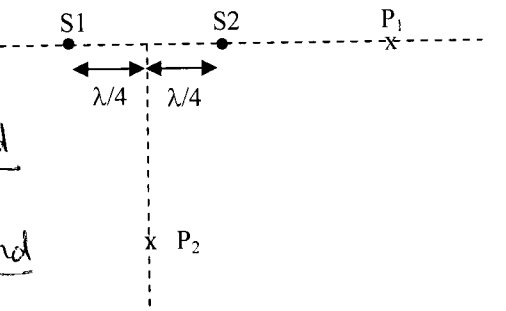
Physics 102.14
Quiz#2
Chapter 17

Instructor: Dr. A. Mekki

Name: Key Id:

1. Two sound waves, from two different sources, S1 and S2, with the same frequency travel in the same direction. The distance between the two sources is $\lambda/2$.
Is the sound intensity maximum or minimum at points P_1 and P_2? Explain.

- maximum Sound $\Rightarrow$ $\Delta L = n\lambda$ $n = 0, 1, 2, 3, \ldots$ (destructive interference)
- minimum Sound $\Rightarrow$ $\Delta L = n\frac{\lambda}{2}$ $n = 1, 3, 5, \ldots$ (constructive interference)



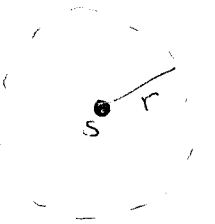
at Point P_1: $\Delta L = \frac{\lambda}{2} \Rightarrow$ minimum sound

at Point P_2: $\Delta L = 0 \Rightarrow$ maximum sound

2. The source of sound wave has a power of 1.0 μW. If it is a point source,
(a) what is the intensity 3.0 m from the source?

$$I = \frac{P}{A} = \frac{P_s}{4\pi r^2}$$

$$I = \frac{1 \times 10^{-6}}{4\pi (3)^2} = \boxed{8.84 \times 10^{-9}\ W/m^2}$$



(b) What is the sound level in decibels at that distance

$$\beta = 10 \log\left(\frac{I}{I_0}\right) = 10 \log\left(\frac{8.84 \times 10^{-9}}{10^{-12}}\right)$$

$$= 10 \log(8.8 \times 10^{3}) = 30 \log(8.84)$$

$$\boxed{\beta = 39.4\ dB}$$

Physics 102.15
Quiz#2
Chapter 17

Instructor: Dr. A. Mekki

Name: Key Id:

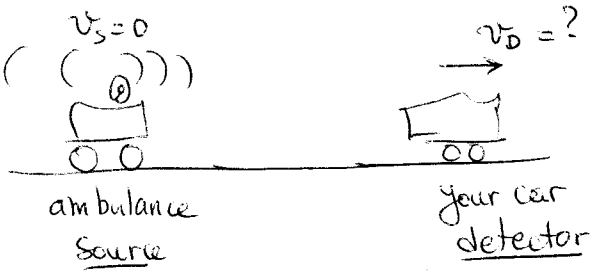
1. The pressure wave of a sound wave is given by: $\Delta P(x,t) = (2.5Pa)\sin(5x - 3000t)$, where x is in meter and t in second. Find the displacement wave that corresponds to this pressure wave. The density of the medium is 1000 kg/m^3.

$$S(x,t) = S_m \cos(kx - \omega t)$$

$$S_m = \frac{\Delta P_m}{\rho v \omega} = \frac{2.5}{1000 \times \frac{3000}{5} \times 3000} = 1.4 \times 10^{-9}\ m = 1.4\ nm$$

$$\Rightarrow \boxed{S(x,t) = (1.4\ nm)\cos(5x - 3000t)}$$

2. While receding an ambulance, you hear a frequency of the siren at 741 Hz. The ambulance driver hears a frequency of 797 Hz. What is the speed of your car? Take the speed of sound = 340 m/s.



$$f' = f\,\frac{v - v_D}{v}$$

$$741 = 797 \times \frac{340 - v_D}{340} \Rightarrow 0.93 = 1 - \frac{v_D}{340}$$

$$\Rightarrow v_D = 340(1 - 0.93) = \boxed{23.9\ m/s}$$