PHY 221 **Quiz #4** **Spg. 02/Sharma**

Name Key **ID #** _____

1. When a person wears a hearing aid, the sound level increases by 20.0 dB. Calculate the factor by which the sound intensity increases. 10

$$\beta_2 - \beta_1 = 10 \log \frac{I_2}{I_1} \Rightarrow 20 = 10 \log \frac{I_2}{I_1}$$

$$\log \frac{I_2}{I_1} = 2 \Rightarrow \frac{I_2}{I_1} = 100$$

2.a) A car traveling east at 40 m/s sounds its 2000 Hz horn. A truck driver traveling 25 m/s eastward in front of the car hears the horn. If the speed of sound in still (no wind) air is 343 m/s, what frequency does the truck driver hear? 10

$$f_{SD} = \frac{v - v_d}{v - v_s} f = \frac{343 - 25}{343 - 40} 2000\,Hz = 2099\ Hz$$

b) What frequency would have the truck driver heard if the car was being towed by the truck and why? 4

No change 2000 Hz.

In the above relation $v_d = v_s$ gives $f_{SD} = \frac{v - v_s}{v - v_s} f = f$.

3. A 4.5 m long string of mass 0.005 kg, fixed at both ends, is vibrating as shown in the figure. 8
a) Which **harmonic** is this and what is its **wavelength**?

3rd harmonic

$$3\frac{\lambda}{2} = 4.5\,m \Rightarrow \lambda = 3\,m$$

b) If the tension in the string is 27 N, calculate the **speed** and **frequency** of the waves in the string? 8

$$v = \sqrt{\frac{T}{m/L}} = \sqrt{\frac{27\,N}{(.005\,kg/4.5\,m)}} = \sqrt{\frac{27 \times 4.5}{.005}} = 156\ m/s$$

$$f = \frac{v}{\lambda} = \frac{156\ m/s}{3\,m} = 52\ Hz$$

4. What should be the diameter of a tweeter (smaller speaker) in a speaker system so that a 8.00 kHz sound produced by it has the **same** angular dispersion as a 2.00 kHz sound produced by a 0.3 m diameter speaker. 10

$$\sin\theta = 1.22 \frac{\lambda_1}{D_1} = 1.22 \frac{\lambda_2}{D_2} \Rightarrow \frac{D_1}{D_2} = \frac{\lambda_1}{\lambda_2} = \frac{v/f_1}{v/f_2}$$

$$\frac{D_1}{D_2} = \frac{f_2}{f_1} \Rightarrow \frac{D_1}{0.3} = \frac{2\,kHz}{8\,kHz} \Rightarrow D_1 = \frac{1}{4}(0.3\,m) = .075\,m$$

$$= 7.5\,cm.$$