**Physics 102Rec**
**Quiz#2**
**Chapter 18**

10 March, 2002

Name: Key Id: Sect:

1. If the power output of a point source of sound emitting waves is 100 W.
(a) What is the sound level 5.0 m from the source?

$$I = \frac{P}{A} = \frac{P}{4\pi r^2} = \frac{100}{4\pi(5)^2} = 0.318 \ W/m^2 .$$

$$\beta = 10 \log \frac{I}{I_0} = 10 \log \left(\frac{0.318}{10^{-12}}\right) = \boxed{115 \ dB}$$

(b) At what distance from the source is the sound level 80 dB?

$r_1 = 5m$ $\quad I_1 = 0.318 \ m$ $\quad \beta_1 = 115 dB$

$r_2 = ?$ $\quad \beta_2 = 80 dB \Rightarrow I_2 = 10^{-12} \ 10^{\frac{\beta}{10}} = 10^{-4} \ W/m^2$

$$\frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 \Rightarrow r_2 = r_1 \sqrt{\frac{I_1}{I_2}} = 5\sqrt{\frac{0.318}{10^{-4}}} = \boxed{282 m}$$

(c) What is the displacement amplitude of the sound wave at 5 m from the source if the frequency of the source is 2000 Hz? ( $\rho_{air}$ = 1.2 kg/m$^3$ and v = 340 m/s)

$$I = \frac{1}{2} \rho v \omega^2 s_m^2 \Rightarrow s_m = \sqrt{\frac{2I}{\rho v \omega^2}}$$

$$s_m = \sqrt{\frac{2 \times 0.318}{(1.2)(340)(2\pi * 2000)^2}} = \boxed{3.14 \times 10^{-6} \ m}$$