C1. At a distance of 10.0 m from a jackhammer, the sound intensity level is 120 dB. Assume that the sound radiates uniformly in all directions and that no energy is absorbed by the air.

(a) What is the sound intensity at that distance?

$1.00\ W/m^2$ $\quad \beta_1 = 10 \log\left(\frac{I_1}{I_0}\right)$

$\frac{\beta}{10} = \log\left(\frac{I_1}{I_0}\right) \Rightarrow \quad 10^{\beta/10} = \frac{I_1}{I_0} \Rightarrow \quad I_1 = I_0\, 10^{\beta/10}$

$I_1 = \left(1.00 \times 10^{-12}\ \frac{W}{m^2}\right) 10^{120/10} = 1.00\ W/m^2$

(b) How far away would you need to be for the sound intensity level to be 85.0 dB?

562 m $\quad \beta_2 = 10 \log\left(\frac{I_2}{I_0}\right)$

as above, $I_2 = \left(1.00 \times 10^{-12}\ W/m^2\right) 10^{85.0/10} = 3.16 \times 10^{-4}\ W/m^2$

$I = \frac{P}{A} = \frac{P}{4\pi r^2} \Rightarrow I \propto \frac{1}{r^2}$ for constant P, so $\frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$

$r_2 = r_1 \sqrt{\frac{I_1}{I_2}} = 10.0\,m \sqrt{\frac{1.00\ W/m^2}{3.16 \times 10^{-4}\ W/m^2}}$

$r_2 = 562\ m$