146.

Problem 20.25 (RHK)

We have to estimate the maximum possible sound level in decibels of sound waves in air.

Solution:

The intensity I of sound waves is related to the pressure amplitude, Δp, density, ρ, of the medium and the speed of sound in the medium, v_s, as

$$I = \frac{(\Delta p)^2}{2\rho v_s}.$$

For answering this problem we will use the following data:

$$\Delta p = 1 \text{ atm} = 1.013 \times 10^5 \text{ Pa},$$

$$\rho = 1.21 \text{ kg m}^{-3},$$

and

$$v_s = 343 \text{ m s}^{-1}.$$

Substituting the above data, we find that the maximum intensity of sound waves in air is

$$I = \frac{\left(1.013\times10^{5}\right)^{2}}{2\times1.21\times343}\ \text{W m}^{-2},$$
$$=1.24\times10^{7}\ \text{W m}^{-2}.$$

The sound level, *SL*, of this intensity is

$$SL = 10\log\frac{I}{I_0} = 10\log\left(\frac{1.24\times10^{7}}{10^{-12}}\right) = 191\ \text{dB}.$$