

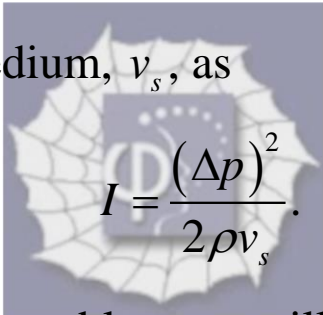
146.

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

$$I = \frac{(1.013 \times 10^5)^2}{2 \times 1.21 \times 343} \text{ W m}^{-2},$$
$$= 1.24 \times 10^7 \text{ W m}^{-2}.$$

The sound level, SL , of this intensity is

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

