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Holt Physics

Problem 13A

INTENSITY OF SOUND WAVES

PROBLEM

Your friend whispers a secret to you with a power output of 2.05×10^{-10} W. If the whisper has a sound intensity 4.1×10^{-10} W/m^2, how far are you from your friend?

SOLUTION

Given: $Intensity = 4.1 \times 10^{-10}\ \text{W/m}^2$ $P = 2.05 \times 10^{-10}\ \text{W}$

Unknown: $r = ?$

Choose the equation(s) or situation:

Use the equation for the intensity of a spherical wave.

$$Intensity = \frac{P}{4\pi r^2}$$

$$r = \sqrt{\frac{P}{4\pi(Intensity)}} = \sqrt{\frac{2.05 \times 10^{-10}\ \text{W}}{(4\pi)(4.1 \times 10^{-10}\ \text{W/m}^2)}} = \boxed{0.20\ \text{m}}$$

ADDITIONAL PRACTICE

1. Your friend tells you about what happened last weekend with a power output of 5.88×10^{-5} W and a sound intensity of 3.9×10^{-6} W/m^2. How far are you from your friend?
2. The power output of heavy street traffic is 1.57×10^{-3} W. At what distance is the sound intensity of the traffic 5.20×10^{-3} W/m^2?
3. A subway train in New York City produces sound with a power output of 4.80 W and an intensity of 7.2×10^{-2} W/m^2. How far are you from the subway train?
4. A loud clap of thunder has a power output of 151 kW and a sound intensity of 0.025 W/m^2. How far are you from the thunder's source?
5. What is the intensity of the sound waves produced by the jet engine of a plane taking off at a distance of 32 m when the power radiated as sound from the engine is 402 W? Assume that the sound waves are spherical.
6. Calculate the intensity of the sound waves from a car stereo at a distance of 0.50 m when the sound has power output of 3.5 W.
7. At a maximum level of loudness, the power output of portable radio headphones radiated as sound is 2.76×10^{-2} W. What is the intensity of these sound waves to a jogger whose ear is 5.0 cm from the headphone's speaker?

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8. If the intensity of a mosquito's buzzing is 9.3×10^{-8} W/m^2 at a distance of 0.21 m, how much sound power does that mosquito generate?

9. How much power is radiated as sound from a vacuum cleaner whose intensity is 4.5×10^{-4} W/m^2 at a distance of 1.5 m?

10. To perforate an eardrum, an intensity of 1.0×10^{4} W/m^2 at a distance of 1.0 m is required. Calculate how much sound power must be generated.