

Holt Physics

Problem 13A**INTENSITY OF SOUND WAVES****PROBLEM**

Kåre Walkert of Sweden reportedly snores loudly, with a record intensity of $4.5 \times 10^{-8} \text{ W/m}^2$. Suppose the intensity of Walkert's snores are measured 0.60 m from her mouth. What is the power associated with the record snore?

SOLUTION

Given: Intensity = $4.5 \times 10^{-8} \text{ W/m}^2$
 $r = 0.60 \text{ m}$

Unknown: $P = ?$

Use the equation for the intensity of a spherical wave.

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

$$P = 4\pi r^2(\text{Intensity}) = 4\pi(0.60 \text{ m})^2(4.5 \times 10^{-8} \text{ W/m}^2)$$

$$= \boxed{2.0 \times 10^{-7} \text{ W}}$$

ADDITIONAL PRACTICE

- Blue whales are the loudest creatures; they can emit sound waves with an intensity of $3.0 \times 10^{-3} \text{ W/m}^2$. If this intensity is measured 4.0 m from its source, what power is associated with the sound wave?
- Howler monkeys, found in Central and South America, can emit a sound that can be heard by a human 15.0 km away. The power associated with the sound is roughly $3.0 \times 10^{-4} \text{ W}$. Estimate the hearing threshold for the human ear. (The actual value is higher because the spherical wave approximation is not quite valid for this case.)
- Estimate how far away a cicada can be heard if the lowest audible intensity of the sound it produces is $1.0 \times 10^{-12} \text{ W/m}^2$ and the power of a cicada's sound source is $2.0 \times 10^{-6} \text{ W}$.
- The whistling sound that is characteristic of the language known as "silbo," which is used on the Canary Island of Gomera, is detectable at 8.0 km. Use the spherical wave approximation to find the power of a whistler's sound. Sound intensity at the hearing threshold is $1.0 \times 10^{-12} \text{ W/m}^2$.
- In 1988, Simon Robinson produced a sound having an intensity level of $2.5 \times 10^{-6} \text{ W/m}^2$ at a distance of 2.5 m. If Robinson screamed for 2.0 s, how much energy was emitted with the sound?
- In 1983, Roy Lomas became the world's loudest whistler; the power of his whistle was $1.0 \times 10^{-4} \text{ W}$. What was the sound's intensity at 2.5 m?