

Physics 151-01 (10 am)

November 15, 2006

Test 3

Name: _____

If any question is unclear, *please* ask immediately. Be sure to show your work **clearly** and **draw a box around your answer**. Partial credit may be given for work *if* it can be understood.

If you get stuck on the **math** at any point, be sure to indicate clearly the **physics** you are using and how you would continue if you could do the math.

1. (20 pts.) Standing just 0.5 m in front of the trumpet section of the Easton Red Rover Marching Band, you find that the sound is very loud, with an intensity of 10^{-2} W/m^2 (100 dB). Assuming the sound spreads out evenly in all directions, how far away must you be before the sound intensity decreases to a more reasonable 10^{-8} W/m^2 (40 dB)?

Name: Solutions

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1. (20 pts.) Standing just 0.5 m in front of the trumpet section of the Easton Red Rover Marching Band, you find that the sound is very loud, with an intensity of 10^{-2} W/m^2 (100 dB). Assuming the sound spreads out evenly in all directions, how far away must you be before the sound intensity decreases to a more reasonable 10^{-8} W/m^2 (40 dB)?

$$r_1 = 0.5 \text{ m} \quad I_1 = 10^{-2} \text{ W/m}^2$$

$$r_2 = ? \quad I_2 = 10^{-8} \text{ W/m}^2$$

$$\text{use } I_1 = \frac{P}{\text{Area}_1} = \frac{P}{4\pi r_1^2} \Rightarrow P$$

$$I_2 = \frac{P}{4\pi r_2^2}$$

$$\text{taking ratios: } \frac{I_1}{I_2} = \left(\frac{r_2}{r_1}\right)^2 \Rightarrow r_2 = r_1 \sqrt{\frac{I_1}{I_2}} =$$

$$r_2 = 0.5 \text{ m} \sqrt{\frac{10^{-2}}{10^{-8}}} = \boxed{500 \text{ m}}$$

(Reflections complicate the real situation!)