



Name: _____

Inverse Square Law

Worked Example

An ambulance started its siren 200 metres after it left the scene of an accident. The sound intensity heard at this distance was $8.0 \times 10^{-6} \text{ Wm}^{-2}$. After a short time the intensity of the siren's sound had fallen to $2.0 \times 10^{-6} \text{ Wm}^{-2}$. Assuming the volume does not change, how far was the ambulance from the accident scene at the time?

Solution

$$d_1 = 200 \text{ m}$$

$$I_1 = 8.0 \times 10^{-6} \text{ Wm}^{-2}$$

$$d_2 = ?$$

$$I_2 = 2.0 \times 10^{-6} \text{ Wm}^{-2}$$

Inverse square law gives us $I \propto \frac{1}{d^2}$ or $I = \frac{m}{d^2}$ or $Id^2 = m$

If the source does not change, then $m = \text{constant} \therefore I_1 d_1^2 = I_2 d_2^2$

Substituting in values gives us: $(8.0 \times 10^{-6})(200^2) = (2.0 \times 10^{-6})(d_2^2)$

$$\therefore d_2 = \sqrt{\frac{(8.0 \times 10^{-6})(200^2)}{2.0 \times 10^{-6}}} = 400 \text{ m}$$

Questions

1. The intensity of light 5.0 m away from a lamp is 128 lux. Calculate the intensity 20.0 m away from the same lamp.

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2. At a distance of 2.0 m away from a point source of infra red waves, the intensity is 4.0 Wm^{-2} . Calculate the intensity at a distance of:

- (A) 1.0 m from the source

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- (B) 4.0 m from the source

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3. The intensity of light detected from a light source is I units when the detector is placed 1.0 m from the source. If the detector is moved to 50 cm from the source, what is the new intensity reading?

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4. The intensity of light from a point source at a distance of 0.5 m is $2.4 \times 10^{-2} \text{ Wm}^{-2}$. The point source is now moved so that the intensity is now 0.6 Wm^{-2} . Calculate the new distance of the detector from the point source.

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5. Calculate the intensity of light from a source if the distance from the source is: Give your answers in terms of the original intensity I_0 .

(A) doubled

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(B) quadrupled

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(C) increased by 8 times

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(D) reduced to one third

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(E) reduced by one third

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SOLUTIONS

- 1. 8 lux
- 2. (A) 16 Wm^{-2}
(B) 1 Wm^{-2}
- 3. $4I$
- 4. 0.1 m
- 5. (A) $I_0/4$
(B) $I_0/16$
(C) $I_0/64$
(D) $9 I_0$
(E) $9 I_0/4$