

Exercise 29

Many physical quantities are connected by *inverse square laws*, that is, by power functions of the form $f(x) = kx^{-2}$. In particular, the illumination of an object by a light source is inversely proportional to the square of the distance from the source. Suppose that after dark you are in a room with just one lamp and you are trying to read a book. The light is too dim and so you move halfway to the lamp. How much brighter is the light?

Solution

The illumination in the room is governed by an inverse square law.

$$I(x) = \frac{k}{x^2}$$

If one is standing at a position x from the light source and then moves halfway to it, the illumination becomes

$$\frac{k}{\left(\frac{x}{2}\right)^2} = \frac{k}{\frac{x^2}{4}} = 4 \frac{k}{x^2} = 4I$$

four times as bright as before.