

## Quiz #6: Inverse Square Law

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Name: \_\_\_\_\_

A small light bulb emits light in all directions, and is positioned  $r = 3$  m away from a photovoltaic cell. The photovoltaic cell has a known efficiency of 2% and an area of  $4 \text{ cm}^2$ . Using the light it receives, the cell generates electrical power at the rate of  $3 \mu\text{W}$ .

1. Using *only* the efficiency and the generated power, compute the total rate of light energy that is incident on the photocell. Use scientific notation. Hint: it is *more* than  $3 \mu\text{W}$ !

$$P_{\text{incident}} = \underline{\hspace{10em}} \text{ W}$$

2. Unit conversion: determine the area of the photocell in  $\text{m}^2$ . Use scientific notation. Hint: it is not  $0.04 \text{ m}^2$ !!!

$$A_{\text{cell}} = \underline{\hspace{10em}} \text{ m}^2$$

3. Determine the area of the (imaginary) sphere surrounding the light bulb at this radial position  $r = 3$  m. Hint: area is not volume!

$$A_{\text{total}} = \underline{\hspace{10em}} \text{ m}^2$$

4. Using *only* your answers 2 and 3: Of the total area, what fraction is occupied by the photocell? Use scientific notation.

$$A_{\text{cell}} / A_{\text{total}} = \underline{\hspace{10em}}$$

5. Convert the previous answer into a solid angle:  $\Omega = \underline{\hspace{10em}}$

6. Use answers 1 and 4 to determine the rate at which the bulb emits light energy. Hint: The answer is a number between 10 and 200 Watts.

$$P_{\text{bulb}} = \underline{\hspace{10em}} \text{ W}$$