

7.38 At microwave frequencies, the power density considered safe for human exposure is 1 (mW/cm²). A radar radiates a wave with an electric field amplitude E that decays with distance as $E(R) = (3,000/R)$ (V/m), where R is the distance in meters. What is the radius of the unsafe region?

Solution:

$$S_{\text{av}} = \frac{|E(R)|^2}{2\eta_0}, \quad 1 \text{ (mW/cm}^2\text{)} = 10^{-3} \text{ W/cm}^2 = 10 \text{ W/m}^2,$$
$$10 = \left(\frac{3 \times 10^3}{R} \right)^2 \times \frac{1}{2 \times 120\pi} = \frac{1.2 \times 10^4}{R^2},$$
$$R = \left(\frac{1.2 \times 10^4}{10} \right)^{1/2} = 34.64 \text{ m.}$$
