

**9.24** A half-wave dipole TV broadcast antenna transmits 10 kW at 50 MHz. What is the power received by a home television antenna with 3-dB gain if located at a distance of 30 km?

**Solution:** At  $f = 50$  MHz,  $\lambda = c/f = (3 \times 10^8 \text{ m/s}) / (50 \times 10^6 \text{ Hz}) = 6$  m, for which a half wave dipole, or larger antenna, is very reasonable to construct. Assuming the TV transmitter to have a vertical half wave dipole, its gain in the direction of the home would be  $G_t = 1.64$ . The home antenna has a gain of  $G_r = 3 \text{ dB} = 2$ . From the Friis transmission formula (Eq. (9.75)):

$$P_{\text{rec}} = P_t \frac{\lambda^2 G_r G_t}{(4\pi)^2 R^2} = 10^4 \frac{(6 \text{ m})^2 \times 1.64 \times 2}{(4\pi)^2 (30 \times 10^3 \text{ m})^2} = 8.3 \times 10^{-6} \text{ W}.$$

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