

Problem 9.21 A half-wave dipole TV broadcast antenna transmits 1 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)):

$$P_{\text{rec}} = P_t \frac{\lambda^2 G_r G_t}{(4\pi)^2 R^2} = 10^3 \frac{(6 \text{ m})^2 \times 1.64 \times 2}{(4\pi)^2 (30 \times 10^3 \text{ m})^2} = 8.3 \times 10^{-7} \text{ W}.$$
