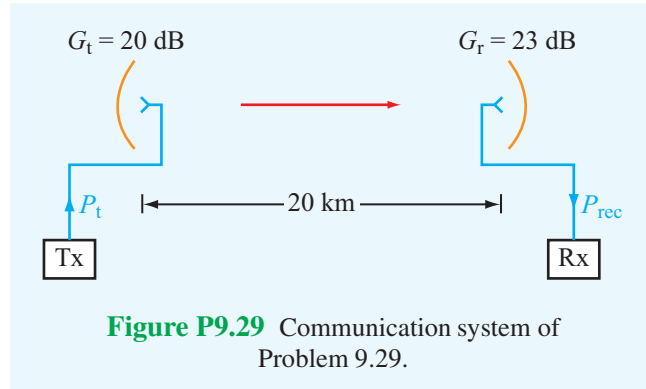


9.29 Consider the communication system shown in Fig. P9.29, with all components properly matched. If $P_t = 10$ W and $f = 6$ GHz:

- (a) What is the power density at the receiving antenna (assuming proper alignment of antennas)?
- (b) What is the received power?
- (c) If $T_{\text{sys}} = 1,000$ K and the receiver bandwidth is 20 MHz, what is the signal-to-noise ratio in decibels?



Solution:

- (a) $G_t = 20$ dB = 100, $G_r = 23$ dB = 200, and $\lambda = c/f = 5$ cm. From Eq. (9.72),

$$S_r = G_t \frac{P_t}{4\pi R^2} = \frac{10^2 \times 10}{4\pi \times (2 \times 10^4)^2} = 2 \times 10^{-7} \quad (\text{W/m}^2).$$

- (b)

$$P_{\text{rec}} = P_t G_t G_r \left(\frac{\lambda}{4\pi R} \right)^2 = 10 \times 100 \times 200 \times \left(\frac{5 \times 10^{-2}}{4\pi \times 2 \times 10^4} \right)^2 = 7.92 \times 10^{-9} \text{ W}.$$

- (c)

$$P_n = K T_{\text{sys}} B = 1.38 \times 10^{-23} \times 10^3 \times 2 \times 10^7 = 2.76 \times 10^{-13} \text{ W},$$

$$S_n = \frac{P_{\text{rec}}}{P_n} = \frac{7.92 \times 10^{-9}}{2.76 \times 10^{-13}} = 2.87 \times 10^4 = 44.6 \text{ dB}.$$
