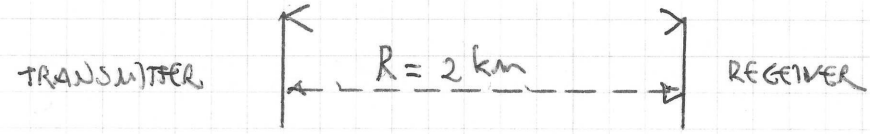
PROBLEM P5

A LOSSLESS ANTENNA IS USED TO TRANSMIT A SIGNAL AT THE FREQUENCY OF 868 MHz AND THE POWER AT ITS INPUT PORT IS 1 kW; THE DIRECTIVITY OF THAT ANTENNA IS 14 dB. AT A DISTANCE OF 2 km THERE IS A RECEIVING LOSSLESS ANTENNA HAVING A DIRECTIVITY OF 6 dB.
WHAT IS THE MAXIMUM POWER AVAILABLE AT THE RECEIVER?

SOLUTION



$P_T = 1\ kW \quad D_{T_{dB}} = 14\ dB \quad D_{R_{dB}} = 6\ dB \quad P_R = ?$

RECEIVING AND TRANSMITTING ANTENNAS ARE LOSSLESS: THE RADIATION EFFICIENCY IS UNITARY AND GAIN EQUALS DIRECTIVITY $G_R = D_R \quad G_T = D_T$

THE POWER AVAILABLE AT THE RECEIVER IS CALCULATED BY MEANS OF THE FRIIS FORMULA

$$P_R = G_T G_R \left(\frac{\lambda}{4\pi R}\right)^2 P_T$$

$$\lambda = \frac{c}{f} = \frac{3\,10^8}{868\,10^6} = 0,3456\ m$$

THE GAIN OF THE TWO ANTENNAS MUST BE EXPRESSED BY USING A LINEAR SCALE

$G_{T_{dB}} = 14\ dB \quad G_T = 10^{\frac{14}{10}} = 10^{1.4} = 25,12 \quad D_T = G_T = 25,12$

$G_{R_{dB}} = 6\ dB \quad G_R = 10^{\frac{6}{10}} = 10^{0.6} = 3,98 \quad D_R = G_R = 3,98$

WE HAVE ALL THE VALUES TO COMPUTE THE MAXIMUM RECEIVED POWER P_R

$$P_R = G_T G_R \left(\frac{\lambda}{4\pi R}\right)^2 P_T = 25,12 \; 3,98 \left(\frac{0,356}{4\pi \; 2000}\right)^2 1000$$

$$P_R = 18,9 \; 10^{-6} \; W = 18,9 \; \mu W$$