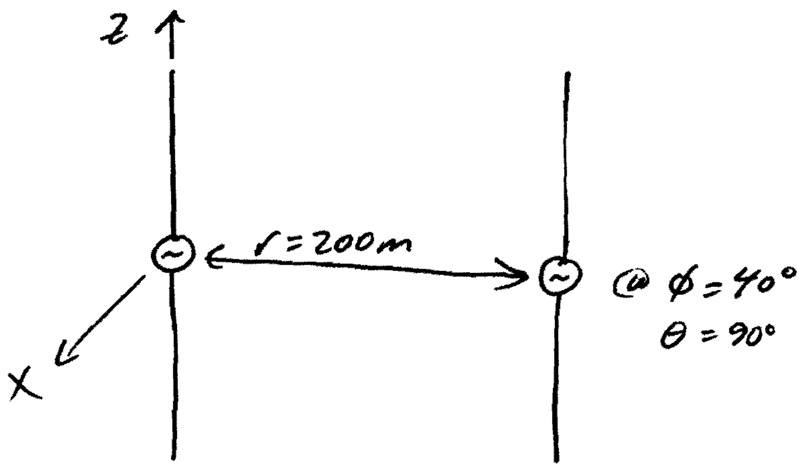
4.32 A $\lambda/2$ dipole situated with its center at the origin radiates a time-averaged power of 600 W at a frequency of 300 MHz. A second $\lambda/2$ dipole is placed with its center at a point $P(r, \theta, \phi)$, where $r = 200$ m, $\theta = 90°$, $\phi = 40°$. It is oriented so that its axis is parallel to that of the transmitting antenna. What is the available power at the terminals of the second (receiving) dipole?



$P_{rad,t} = 600\,W$

$f = 300\,MHz$

$$\lambda = c/f = \frac{2.9979 \times 10^8}{300 \times 10^6} = 0.9993\,m \simeq 1\,m$$

The Friis transmission equation (2-118) is

$$\frac{P_r}{P_t} = e_{cdt}\, e_{cdr}\,(1-|\Gamma_t|^2)(1-|\Gamma_r|^2)\left(\frac{\lambda}{4\pi R}\right)^2 D_t D_r |\hat{\rho}_t \cdot \hat{\rho}_r|^2$$

⇒ Assume lossless dipoles ⇒ $e_{cdt} = e_{cdr} = 1$

⇒ Assume matched dipoles $|\Gamma_t| = |\Gamma_r| \simeq 0$

⇒ From problem, dipoles are polarization matched $|\hat{\rho}_t \cdot \hat{\rho}_r|^2 = 1$

⇒ From (4-91) &/or notes $D_{t,\lambda/2} = D_{r,\lambda/2} = 1.643$ or 1.6409224

$$P_r = (600\,W)(1)(1)(1-0)(1-0)\left(\frac{0.9993}{4\pi(200)}\right)^2 1.6409224^2\,(1)$$

↳ $\underline{\underline{P_r = 0.2554\,mW}}$