CHAPTER 4

4.1 $P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2} = \frac{(1/3)^2(10)(1)(1)}{(4\pi)^2(1000)^2} = 7.036^{-9}\ W$

1.2 a) $P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2} = \frac{(50)(1)(1)(1/20)^2}{(4\pi)^2(10^4)^2} = 7.910^{-12}\ W$
$= -81\ dBm$

b) $P_r = P_d \cdot A_e = \left[\frac{|E|^2}{120\pi}\right] \cdot A_e = \frac{|E|^2}{120\pi} \cdot \frac{G_r \lambda^2}{4\pi}$

$A_e = \frac{G\lambda^2}{4\pi}$ $\qquad E = P_r \cdot (120\pi)(4\pi)/\lambda^2 G_r = 3.9\times10^{-3}\ V/m$

c) $P_r = \frac{\left[\frac{V_{ant}}{2}\right]^2}{50\Omega} \Rightarrow \sqrt{7.9\,10^{-12} \cdot 50 \cdot 4} = V_{ant}$ open circuit

$V_{ant} = 4 \cdot 10^{-5}$ Volts rms open circuit

$V_{rcvr} = \frac{V_{ant}}{2} = 2 \cdot 10^{-5}$ Volts rms

4.3 Fraunhofer Distance:

$$a = 4.6 \text{ cm} \tag{2}$$

$$b = 3.5 \text{ cm} \tag{3}$$

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{60 \times 10^9} = 0.005 \text{ m} \tag{4}$$

In azimuth:

$$HPBW = \frac{51\lambda}{b} = \frac{51 \times 0.005}{0.035} = 7.3^\circ \tag{5}$$

In elevation:

$$HPBW = \frac{51\lambda}{a} = \frac{51 \times 0.005}{0.046} = 5.5^\circ \tag{6}$$

$$G = \frac{4\pi A_e}{\lambda^2} = \frac{4\pi ab}{\lambda^2} = 29 \text{ dB} \tag{7}$$

$$D = \sqrt{a^2 + b^2} = 5.78 \text{ cm} \tag{8}$$

$$D_f = \frac{2D^2}{\lambda} = \frac{2 \times 0.0578^2}{0.005} = 1.34 \text{ m} \tag{9}$$