Homework 1

$d = 1\,m$
$\eta = 0.6$
$P_t = 1\,W$
$f = 2.4\,GHz$

1) $G_{max} = ?\quad \theta_{3dB} = ?\quad \theta_{3dB} = \frac{70c}{D \cdot f} = 8.75$

$G_{max} = \eta \left(\frac{\pi 70}{\theta_{3dB}}\right)^2 = 378.992 = 25.78\,dBi$

2) $F = \frac{P_t G_t}{4\pi R^2}$

$R \approx 8.84 \times 10^8\,m$

b) 3dB BD

$R_{min} \Rightarrow F = 1.14711 \times 10^{-16}$

$R_{max} \Rightarrow F = 9.174898514 \times 10^{-17}$

a) Full power $\Rightarrow$

$R_{min} = 2.254 \times 10^{-16}$

$R_{max} = 1.8349 \times 10^{-16}$

3) $L_{FSL} = ?$

$R = 400000 \times 10^3$

$L = \left(\frac{4\pi R}{\lambda}\right)^2 \Rightarrow L = \left(\frac{4\pi R \times f}{c}\right)^2$

$= 1.617 \times 10^{21}$

$L = -212.08\,dB$

If $f = 6.2\,GHz \Rightarrow L = 1.114 \times 10^{22}$

$= -220.46$

4) $T_{sys} = 200\,K$

$f = 2.4\,GHz$

$\eta = 0.7$

$d = ?$

$\frac{C}{N} = 6\,dB = 3.981$

$B = 10\,MHz$

$\frac{C}{N} = \frac{P_R G_R}{k T_{sys} B} \qquad G_R = \eta \left(\frac{\pi d}{\lambda}\right)^2$

$\frac{C}{N} = \frac{P_R \eta \left(\frac{\pi d}{\lambda}\right)^2}{k T_{sys} B}$

$\Rightarrow d^2 = \frac{C \cdot k T_{sys} B}{N P_R \eta} \cdot \left(\frac{c}{\pi f}\right)^2$