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AE 4361 Assignment 7

1) $\sin(\theta_h) = \frac{r_E}{r_{sat}}$

$\theta_h = \sin^{-1}\left(\frac{r_E}{r_{sat}}\right) = \sin^{-1}\left(\frac{6371}{384400}\right) = 0.9496$

$\theta_T = 2\theta_h = \mathbf{1.8993}$ degrees

2) G_T = 6289.6 = **+37.9862 dB**

3) G_T' = **+33.0862 dB**

4) r_{max} = **384,347.2 km**

5) P_R/P_T = 1.068e-21= **-209.71 dB**

6) P_R = -162.60 dB = **-132.60 dBm**

7) G_R = +3483.75 = **+35.42 dB**

8) E_b = -187.18 dBJ = **-157.18 dBmJ**

9) N_0 = **3.864e-21 W/s = -174.13 dBm/Hz**

10) E_b/N_0 = **16.95 dB**

The minimum E_b/N_0 for the lowest probability of bit error of 10^{-6} using BPSK is 10.5 dB. As our signal to noise ratio is above that threshold, and keeping a link margin above 3dB, the required link margin is achieved. We could even reduce the transmitted power as our margin is large.

LRO Link Budget		
Transmitted Power, P_T	40	W
Transmitted Power, P_T	+46.02	dBm
Transmit Antenna Gain, G_T	+37.9862	dB
Cable and Beam loss	-4.90	dB
Path Loss, P_R/P_T	-209.71	dB
Atmosphere Loss	-2.00	dB
Received Power, P_R	-132.60	dBm
Received antenna Gain, G_R	+35.42	dB
Required CTR, bps	60	dBhz
Energy per bit, E_b	-157.18	dBmJ
System Noise, N_0	-174.13	dB/hz
Achieved E_B/N_0	+16.95	dB
Required E_B/N_0	+10.50	dB
Required Link Margin	+6.45>**+3.00**	**dB**