(4a) Extend the GSM uplink example from the lecture 7 notes, and consider the GSM downlink, using the same system parameters with one difference. The difference is that the noise figure of a mobile receiver is 8 (linear) instead of the BS receiver, which we said had a noise figure of 2. What is EIRP of the base station is required for the identical range of 6 km?

**Solution:**

\[ P_N = F k T_0 B = 8(1.38 \times 10^{23} J/K)(294 K)(200 \times 10^3 Hz) \]

In dBW, \( P_N(dBW) = -141.9(dBW) \), 6.0 dB higher than it was for the uplink. So to achieve the same range as the downlink, we need the transmit power to be 6.0 dB higher as well. Since for the uplink, \( P_t = 0 \) dBW, now we need \( P_t \) to be 6 dBW. Thus the EIRP is \( P_t + G_t = 6 \) dBW + 12 dBi = 6 dBW + 14.15 dB = 20.15 dBW or about 103 W EIRP.