Exercise 1

1.1
A cellular operator has created a system for 900 MHz which covers the desired service area with 500 cells and a base station antenna height of 15 m. The operator is given a new frequency allocation at 1800 MHz. How many cells would be needed at the new frequency using the same antenna heights and transmit powers? How much higher would the antennas need to be to produce the same range as the 900 MHz system?

Help: Section 1 in the book provides the following approximated formula for path loss L

$$\frac{1}{L} = k\frac{h_m h_b^2}{r^4 f^2}$$

where h_b (m) is base station height over the terrain, h_m (m) the mobile terminal height over the terrain, f (Hz) the frequency and r (m) the path length.

4.3
Calculate the power reflected back to the source by an antenna with a VSWR of 2 and an input power of 10 W.

4.4
Calculate the VSWR of a thin loss-less half-wave dipole fed from a 50 Ω source.
(Hint: $Z_a = 73 + j42.5\ \Omega$ given in Section 4.4.4.)

4.9
What is the uplink and downlink gain of a 2.7 m diameter parabolic dish antenna at Ku-band (14/12 GHz), if it is to be used in a satellite ground station? Assume an antenna efficiency of 65%.
Comment: the frequency bands for satellite communications are often specified as f_1/f_2, where f_1 represents the uplink frequency (from Earth to satellite) and f_2 is the downlink frequency (from satellite to Earth).