9.15 A 50 cm long dipole is excited by a sinusoidally varying current with an amplitude $I_0 = 5$ A. Determine the time average power radiated by the dipole if the oscillating frequency is:

(a) 1 MHz,

(b) 300 MHz.

Solution: **(a)** At 1 MHz,

$$\lambda = \frac{3 \times 10^8}{10^6} = 300 \text{ m}.$$

Hence, the dipole length satisfies the "short" dipole criterion ($l \leq \lambda/50$).

Using (9.34),

$$P_{\text{rad}} = 40\pi^2 I_0^2 \left(\frac{l}{\lambda}\right)^2$$

$$= 40\pi^2 \times 5^2 \times \left(\frac{0.5}{300}\right)^2 = 27.4 \text{ mW}.$$

(b) At 300 MHz,

$$\lambda = \frac{3 \times 10^8}{3 \times 10^8} = 1 \text{ m}.$$

Hence, the dipole is $\lambda/2$ in length, in which case we can use (9.46) to calculate P_{rad}:

$$P_{\text{rad}} = 36.6 I_0^2 = 36.6 \times 5^2 = 915 \text{ W}.$$

Thus, at the higher frequency, the antenna radiates $[915/27.3 \times 10^{-3})] = 33,516.5$ times as much power as it does at the lower frequency!