

**Problem 9.13** 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),

$$\begin{aligned} P_{\text{rad}} &= 40\pi^2 I_0^2 \left( \frac{l}{\lambda} \right)^2 \\ &= 40\pi^2 \times 5^2 \times \left( \frac{0.5}{300} \right)^2 = 27.4 \text{ mW.} \end{aligned}$$

(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  $P_{\text{rad}}$ :

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

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!

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