

7.32 Repeat Problem 7.31 at 1 GHz.

Solution:

(a) From Eqs. (7.72) and (7.77b),

$$\delta_s = [\pi f \mu \sigma]^{-1/2} = [\pi \times 10^9 \times 4\pi \times 10^{-7} \times 5.8 \times 10^7]^{-1/2} = 0.0021 \text{ mm}.$$

Hence,

$$\frac{d}{\delta_s} = \frac{0.5 \text{ mm}}{0.0021 \text{ mm}} \approx 250.$$

Hence, conductor is plenty thick.

(b) From Eq. (7.92a),

$$R_s = \frac{1}{\sigma \delta_s} = \frac{1}{5.8 \times 10^7 \times 2.1 \times 10^{-6}} = 8.2 \times 10^{-3} \Omega.$$

(c) From Eq. (7.96),

$$R' = \frac{R_s}{2\pi} \left(\frac{1}{a} + \frac{1}{b} \right) = \frac{8.2 \times 10^{-3}}{2\pi} \left(\frac{1}{5 \times 10^{-3}} + \frac{1}{10^{-2}} \right) = 0.39 \quad (\Omega/\text{m}).$$
