

Problem 1.14 A certain electromagnetic wave traveling in seawater was observed to have an amplitude of 98.02 (V/m) at a depth of 10 m, and an amplitude of 81.87 (V/m) at a depth of 100 m. What is the attenuation constant of seawater?

Solution: The amplitude has the form $Ae^{\alpha z}$. At $z = 10$ m,

$$Ae^{-10\alpha} = 98.02$$

and at $z = 100$ m,

$$Ae^{-100\alpha} = 81.87$$

The ratio gives

$$\frac{e^{-10\alpha}}{e^{-100\alpha}} = \frac{98.02}{81.87} = 1.20$$

or

$$e^{-10\alpha} = 1.2e^{-100\alpha}.$$

Taking the natural log of both sides gives

$$\begin{aligned}\ln(e^{-10\alpha}) &= \ln(1.2e^{-100\alpha}), \\ -10\alpha &= \ln(1.2) - 100\alpha, \\ 90\alpha &= \ln(1.2) = 0.18.\end{aligned}$$

Hence,

$$\alpha = \frac{0.18}{90} = 2 \times 10^{-3} \quad (\text{Np/m}).$$
