Problem 1.20

An rms voltmeter specifies an accuracy of ±0.5 dB. If a vibration of 2.5 mm rms is measured, determine the millimeter accuracy as read by the voltmeter.

Solution

Using the definition of a decibel,

$$20 \log_{10} \left(\frac{x_1}{x_2} \right) = 0.5.$$

Solve this equation for the ratio.

$$\log_{10} \left(\frac{x_1}{x_2} \right) = 0.025$$
$$\frac{x_1}{x_2} = 10^{0.025} \approx 1.059$$

Multiplying this by the voltmeter reading gives us the upper bound due to error.

$$2.5 \text{ mm rms} \times 10^{0.025} \approx 2.648 \text{ mm rms}$$

The millimeter accuracy is therefore $\pm(2.648 - 2.5)$ mm rms $= \pm 0.148$ mm rms.