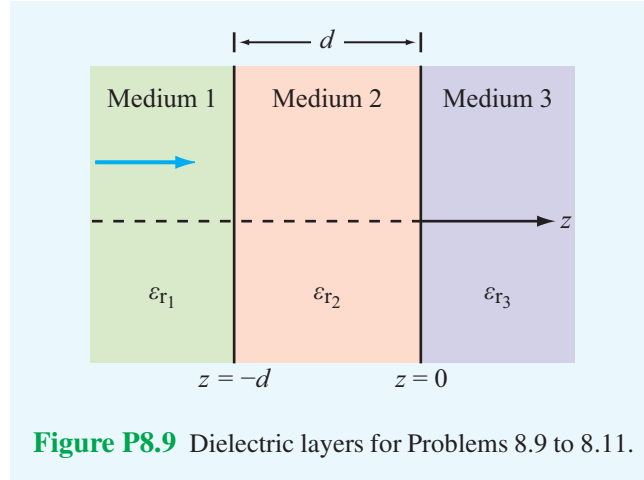


8.9 The three regions shown in Fig. P8.9 contain perfect dielectrics. For a wave in medium 1, incident normally upon the boundary at $z = -d$, what combination of ϵ_{r2} and d produces no reflection? Express your answers in terms of ϵ_{r1} , ϵ_{r3} and the oscillation frequency of the wave, f .



Solution: By analogy with the transmission-line case, there will be no reflection at $z = -d$ if medium 2 acts as a quarter-wave transformer, which requires that

$$d = \frac{\lambda_2}{4}$$

and

$$\eta_2 = \sqrt{\eta_1 \eta_3}.$$

The second condition may be rewritten as

$$\frac{\eta_0}{\sqrt{\epsilon_{r2}}} = \left[\frac{\eta_0}{\sqrt{\epsilon_{r1}}} \frac{\eta_0}{\sqrt{\epsilon_{r3}}} \right]^{1/2}, \quad \text{or} \quad \epsilon_{r2} = \sqrt{\epsilon_{r1} \epsilon_{r3}},$$

$$\lambda_2 = \frac{\lambda_0}{\sqrt{\epsilon_{r2}}} = \frac{c}{f \sqrt{\epsilon_{r2}}} = \frac{c}{f (\epsilon_{r1} \epsilon_{r3})^{1/4}},$$

and

$$d = \frac{c}{4f (\epsilon_{r1} \epsilon_{r3})^{1/4}}.$$