P.8–22 A uniform sinusoidal plane wave in air with the following phasor expression for electric intensity

$$\mathbf{E}_i(x, z) = \mathbf{a}_y 10 e^{-j(6x+8z)} \qquad \text{(V/m)}$$

is incident on a perfectly conducting plane at $z = 0$.

a) Find the frequency and wavelength of the wave.

b) Write the instantaneous expressions for $\mathbf{E}_i(x, z; t)$ and $\mathbf{H}_i(x, z; t)$, using a cosine reference.

c) Determine the angle of incidence.

d) Find $\mathbf{E}_r(x, z)$ and $\mathbf{H}_r(x, z)$ of the reflected wave.

e) Find $\mathbf{E}_1(x, z)$ and $\mathbf{H}_1(x, z)$ of the total field.

P.8–29 Consider the situation of normal incidence at a lossless dielectric slab of thickness d in air, as shown in Fig. 8–15 with

$$\epsilon_1 = \epsilon_3 = \epsilon_0 \qquad \text{and} \qquad \mu_1 = \mu_3 = \mu_0.$$

a) Find E_{r0}, E_2^+, E_2^-, and E_{t0} in terms of E_{i0}, d, ϵ_2, and μ_2.

b) Will there be reflection at interface $z = 0$ if $d = \lambda_2/4$? If $d = \lambda_2/2$? Explain.

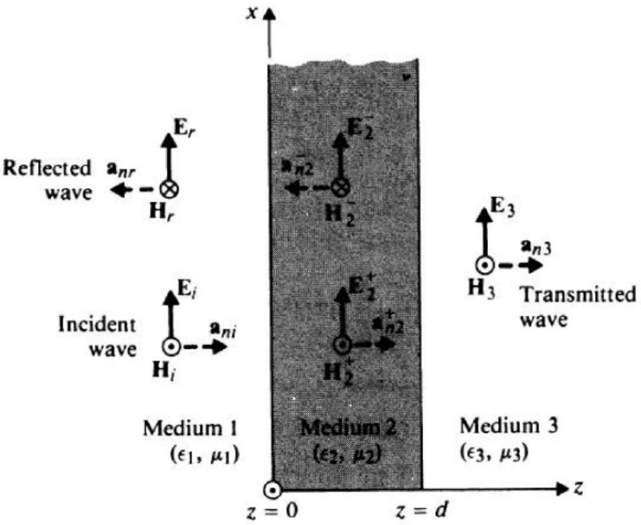

FIGURE 8–15
Normal incidence at multiple dielectric interfaces.

P.8–33 A uniform plane wave with $\mathbf{E}_i(z) = \mathbf{a}_x E_{i0} e^{-j\beta_0 z}$ in air propagates normally through a thin copper sheet of thickness d, as shown in Fig. 8–23. Neglecting multiple reflections within the copper sheets, find

a) E_2^+, H_2^+ **b)** E_2^-, H_2^- **c)** E_{30}, H_{30} **d)** $(\mathscr{P}_{av})_3/(\mathscr{P}_{av})_i$

Calculate $(\mathscr{P}_{av})_3/(\mathscr{P}_{av})_i$ for a thickness d that equals one skin depth at 10 (MHz). (Note that this pertains to the shielding effectiveness of the thin copper sheet.)

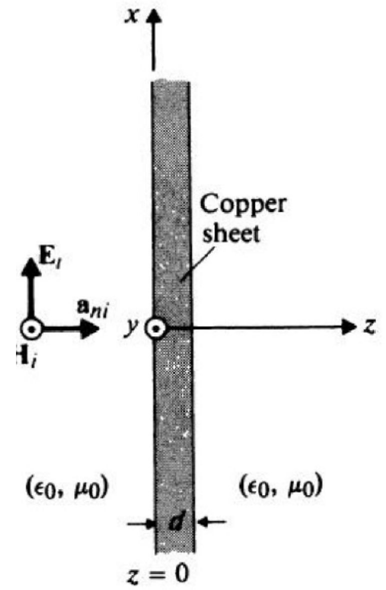

FIGURE 8–23
Plane wave propagating through a thin copper sheet (Problem P.8–33).

P.8–37 A uniform plane wave with perpendicular polarization represented by Eqs. (8–196) and (8–197) is incident on a plane interface at $z = 0$, as shown in Fig. 8–16. Assuming

$\epsilon_2 < \epsilon_1$ and $\theta_i > \theta_c$, (a) obtain the phasor expressions for the transmitted field $(\mathbf{E}_t, \mathbf{H}_t)$, and (b) verify that the average power transmitted into medium 2 vanishes.

$$\mathbf{E}_i(x, z) = \mathbf{a}_y E_{i0} e^{-j\beta_1(x \sin\theta_i + z\cos\theta_i)} \tag{8-196}$$

$$\mathbf{H}_i(x, z) = \frac{E_{i0}}{\eta_1}(-\mathbf{a}_x \cos\theta_i + \mathbf{a}_z \sin\theta_i) e^{-j\beta_1(x \sin\theta_i + z\cos\theta_i)}. \tag{8-197}$$

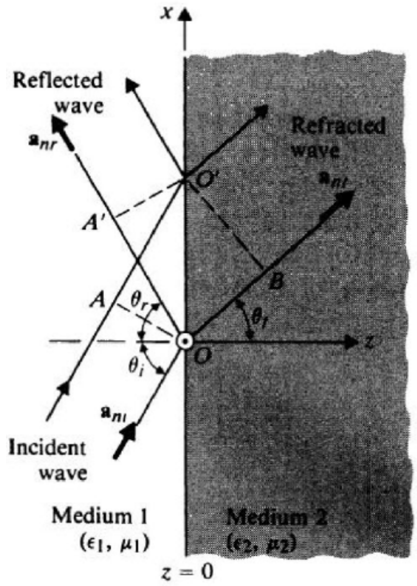

FIGURE 8–16
Uniform plane wave incident obliquely on a plane dielectric boundary.

P.8–40 Glass isosceles triangular prisms shown in Fig. 8–25 are used in optical instruments. Assuming $\epsilon_r = 4$ for glass, calculate the percentage of the incident light power reflected back by the prism.

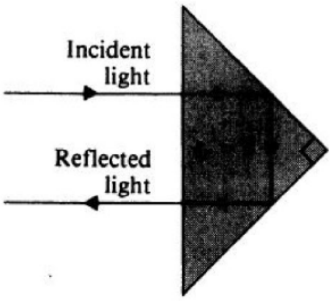

FIGURE 8–25
Light reflection by a right isosceles triangular prism (Problem P.8–40).

P.8–45 By using Snell's law of refraction, (a) express Γ and τ in terms of ϵ_{r1}, ϵ_{r2}, and θ_i; and (b) plot Γ and τ versus θ_i for $\epsilon_{r1}/\epsilon_{r2} = 2.25$ for both perpendicular and parallel polarizations.