

**6.14** The plates of a parallel-plate capacitor have areas of  $10 \text{ cm}^2$  each and are separated by 2 cm. The capacitor is filled with a dielectric material with  $\epsilon = 4\epsilon_0$ , and the voltage across it is given by  $V(t) = 30 \cos 2\pi \times 10^6 t$  (V). Find the displacement current.

**Solution:** Since the voltage is of the form given by Eq. (6.46) with  $V_0 = 30 \text{ V}$  and  $\omega = 2\pi \times 10^6 \text{ rad/s}$ , the displacement current is given by Eq. (6.49):

$$\begin{aligned} I_d &= -\frac{\epsilon A}{d} V_0 \omega \sin \omega t \\ &= -\frac{4 \times 8.854 \times 10^{-12} \times 10 \times 10^{-4}}{2 \times 10^{-2}} \times 30 \times 2\pi \times 10^6 \sin(2\pi \times 10^6 t) \\ &= -0.33 \sin(2\pi \times 10^6 t) \quad (\text{mA}). \end{aligned}$$

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