

37. (a) At any instant the displacement current i_d in the gap between the plates equals the conduction current i in the wires. Thus $i_d = i = 2.0 \text{ A}$.

(b) The rate of change of the electric field is

$$\frac{dE}{dt} = \frac{1}{\varepsilon_0 A} \left(\varepsilon_0 \frac{d\Phi_E}{dt} \right) = \frac{i_d}{\varepsilon_0 A} = \frac{2.0 \text{ A}}{(8.85 \times 10^{-12} \text{ F/m})(1.0 \text{ m})^2} = 2.3 \times 10^{11} \frac{\text{V}}{\text{m} \cdot \text{s}} .$$

(c) The displacement current through the indicated path is

$$i'_d = i_d \times \left(\frac{\text{area enclosed by the path}}{\text{area of each plate}} \right) = (2.0 \text{ A}) \left(\frac{0.50 \text{ m}}{1.0 \text{ m}} \right)^2 = 0.50 \text{ A} .$$

(d) The integral of the field around the indicated path is

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 i'_d = (1.26 \times 10^{-6} \text{ H/m})(0.50 \text{ A}) = 6.3 \times 10^{-7} \text{ T} \cdot \text{m} .$$