29-38. (a)

$$\begin{aligned} Q &= it = 1.8\times10^{-3}\cdot .5\times10^{-6} = 0.9\times10^{-9}\ \text{C} \\ E &= \frac{\sigma}{\epsilon_0} = \frac{Q}{A\epsilon_0} = \frac{0.9\times10^{-9}}{5\times10^{-4}\cdot 8.8542\times10^{-12}} = 2.03\times10^{5}\ \text{V/m} \\ V &= Ed = 2.03\times10^{5}\cdot 0.002 = 407\ \text{V} \end{aligned}$$

(b) Since the current is constant so is dE/dt.

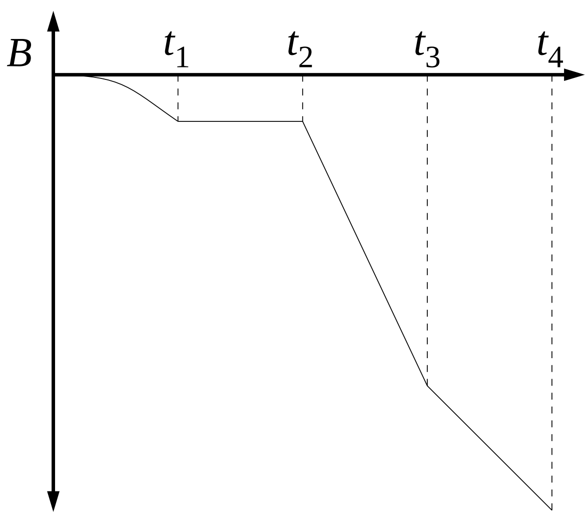
$$\frac{dE}{dt} = \frac{i}{A\epsilon_0} = \frac{1.8\times10^{-3}}{5\times10^{-4}\cdot 8.8542\times10^{-12}} = 4.07\times10^{11}\ \text{V/m}\cdot\text{s}$$

(c)

$$j_D = \epsilon_0\frac{dE}{dt} = \frac{i}{A} = \frac{1.8\times10^{-3}}{5\times10^{-4}} = 3.6\ \text{A/m}^2$$

$$i_D = j_D A = i = 1.8\times10^{-3}\ \text{A}$$

29-48. $\mathcal{E} = -A\ dB/dt$. If $\mathcal{E}=$ positive const, B has a constant (negative) slope; if $\mathcal{E}=0$, B is constant. In general, $B \propto -\int \mathcal{E}\ dt$.



old exam #15 For uniform rotation the angle between $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ increases linearly: $\theta = \omega t = 2\pi f t$. The magnetic flux is:

$$\Phi_B = \vec{\mathbf{B}}\cdot\vec{\mathbf{A}} = BA\cos\theta = BNs^2\cos(2\pi f t)$$

Faraday's law gives the emf:

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = BNs^2 2\pi f\sin(2\pi f t) = \mathcal{E}_0\sin(2\pi f t)$$

Thus: $\mathcal{E}_0 = BNs^2 2\pi f = .75\cdot 150\cdot 0.1^2\cdot 2\pi 60 = 424$ V