Homework #9 Solutions

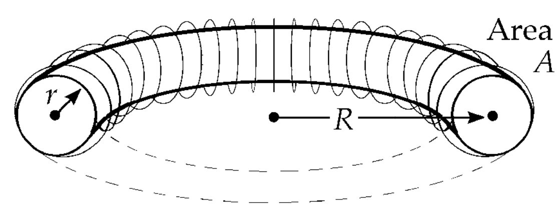
32.11 $|\mathcal{E}| = L\frac{dI}{dt} = (90.0 \infty 10^{-3})\frac{d}{dt}(t^2 - 6t)$ V

(a) At $t = 1.00$ s, $\mathcal{E} = \boxed{360 \text{ mV}}$

(b) At $t = 4.00$ s, $\mathcal{E} = \boxed{180 \text{ mV}}$

(c) $\mathcal{E} = (90.0 \infty 10^{-3})(2t - 6) = 0$ when $\boxed{t = 3.00 \text{ s}}$

32.14 $L = \frac{N\Phi_B}{I} = \frac{NBA}{I} \sim \frac{NA}{I} \cdot \frac{\mu_0 NI}{2\pi R} = \boxed{\frac{\mu_0 N^2 A}{2\pi R}}$



32.48 At different times, $(U_C)_{max} = (U_L)_{max}$ so $\left[\frac{1}{2}C(\Delta V)^2\right]_{max} = \left(\frac{1}{2}LI^2\right)_{max}$

$$I_{max} = \sqrt{\frac{C}{L}}(\Delta V)_{max} = \sqrt{\frac{1.00 \times 10^{-6} \text{ F}}{10.0 \times 10^{-3} \text{ H}}}(40.0 \text{ V}) = \boxed{0.400 \text{ A}}$$

34.7 (a) $B = \dfrac{E}{c} = \dfrac{100 \text{ V/m}}{3.00 \infty 10^{8} \text{ m/s}} = 3.33 \infty 10^{-7} \text{ T} = \boxed{0.333\ \mu\text{T}}$

(b) $\lambda = \dfrac{2\pi}{k} = \dfrac{2\pi}{1.00 \infty 10^{7} \text{ m}^{-1}} = \boxed{0.628\ \mu\text{m}}$

(c) $f = \dfrac{c}{\lambda} = \dfrac{3.00 \infty 10^{8} \text{ m/s}}{6.28 \infty 10^{-7} \text{ m}} = \boxed{4.77 \infty 10^{14} \text{ Hz}}$

34.8 $E = E_{\max} \cos(kx - \omega t)$

$\dfrac{\Box E}{\Box x} = -E_{\max} \sin(kx - \omega t)(k)$ $\qquad$ $\dfrac{\Box E}{\Box t} = -E_{\max} \sin(kx - \omega t)(-\omega)$

$\dfrac{\Box^2 E}{\Box x^2} = -E_{\max} \cos(kx - \omega t)(k^2)$ $\qquad$ $\dfrac{\Box^2 E}{\Box t^2} = -E_{\max} \cos(kx - \omega t)(-\omega)^2$

We must show: $\dfrac{\partial E}{\partial x^2} = \mu_0 \text{e}_0 \dfrac{\partial^2 E}{\partial t^2}$

That is, $-\left(k^2\right) E_{\max} \cos\left(kx - \omega t\right) = -\mu_0 \text{e}_0 (-\omega)^2 E_{\max} \cos\left(kx - \omega t\right)$

But this is true, because $\dfrac{k^2}{\omega^2} = \left(\dfrac{1}{f\lambda}\right)^2 = \dfrac{1}{c^2} = \mu_0 \text{e}_0$

The proof for the wave of magnetic field is precisely similar.

***34.10** $d_{\text{A to A}} = 6\ \text{cm}\ \pm\ 5\% = \dfrac{\lambda}{2}$

$\lambda = 12\ \text{cm}\ \pm\ 5\%$

$v = \lambda f = (0.12\ \text{m}\ \pm\ 5\%)\left(2.45 \times 10^{9}\ \text{s}^{-1}\right) = \boxed{2.9 \times 10^{8}\ \text{m/s}\ \pm\ 5\%}$