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$$A = \frac{\mu_0 l}{4\pi r} I_0 \sin(\omega(t - r/c)) \rightarrow \begin{cases} A_r = \frac{\mu_0 l}{4\pi r} \cos\theta \, I_0 \sin(\omega(t - r/c)) \\ A_\theta = -\frac{\mu_0 l}{4\pi r} \sin\theta \, I_0 \sin(\omega(t - r/c)) \\ A_\phi = 0 \end{cases}$$

$$\phi = \frac{l r \cos\theta}{4\pi\varepsilon_0 r^2} \left(\frac{q_0 \cos(\omega(t - r/c))}{r} + \frac{I_0 \sin(\omega(t - r/c))}{c} \right)$$

$$B = \vec{\nabla} \times \vec{A} = \frac{1}{r^2 \sin\theta} \begin{vmatrix} \hat{r} & r\hat{\theta} & r\sin\theta \, \hat{\phi} \\ \partial/\partial r & \partial/\partial\theta & \frac{\partial}{\partial\phi} \\ A_r & rA_\theta & r\sin\theta \, A_\phi \end{vmatrix} \rightarrow \begin{cases} B_r = 0 \; \checkmark\checkmark \\ B_\theta = 0 \; \checkmark\checkmark \\ B_\phi \neq 0 \end{cases}$$

$$\rightarrow B_\phi = \frac{1}{r^2 \sin\theta} r \sin\theta \left(\frac{\partial}{\partial r}(rA_\theta) - \partial/\partial\theta \, A_r \right) = \frac{1}{r} \left(\frac{\partial}{\partial r}(rA_\theta) - \frac{\partial A_r}{\partial\theta} \right)$$

$$\frac{1}{r} \left\{ -\frac{\mu_0 l}{4\pi} \left(-\frac{\omega}{c}\right) I_0 \cos(\omega(t - r/c)) \sin\theta - \left(-\frac{\mu_0 l}{4\pi r}\right) \sin\theta \, I_0 \sin(\omega(t - r/c)) \right\}$$

$$= \frac{\mu_0 l I_0 \sin\theta}{4\pi r} \left\{ \frac{\omega}{c} \cos(\omega(t - r/c)) + \frac{\sin(\omega(t - r/c))}{r} \right\} \; \checkmark\checkmark$$

$$E_\theta = -\frac{1}{r} \frac{\partial\phi}{\partial\theta} - \frac{\partial A_\theta}{\partial t}$$

$$\frac{1}{r} \frac{\partial\phi}{\partial\theta} = \frac{1}{r} \frac{\partial}{\partial\theta} \left(\frac{l \cos\theta}{4\pi\varepsilon_0 r} \left(\frac{q_0 \cos(\omega(t - r/c))}{r} + \frac{I_0 \sin(\omega(t - r/c))}{c} \right) \right)$$

$$= -\frac{l \sin\theta}{4\pi\varepsilon_0 r^2} \left(\frac{\left(-\frac{I_0}{\omega}\right) \cos(\omega(t - r/c))}{r} + \frac{I_0 \sin(\omega(t - r/c))}{c} \right)$$

$$= \frac{l I_0 \sin\theta}{4\pi\varepsilon_0 r^2} \left(\frac{\cos(\omega(t - r/c))}{r\omega} - \frac{\sin(\omega(t - r/c))}{c} \right)$$

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$$\frac{\partial A_\theta}{\partial t} = -\frac{l I_0 \mu_0}{4\pi r} \sin\theta (\omega) \cos(\omega(t - r/c))$$

$$\Rightarrow E_\theta = \frac{l I_0 \sin\theta}{4\pi\varepsilon_0 r}\left\{ \mu_0\varepsilon_0 \omega \cos(\omega(t-r/c)) - \frac{\cos(\omega(t-r/c))}{r^2\omega} + \frac{\sin(\omega(t-r/c))}{rc} \right\}$$

$$= -\frac{l I_0 \sin\theta}{4\pi\varepsilon_0}\left\{ -\frac{\omega}{rc^2}\cos(\omega(t-r/c)) + \frac{\cos(\omega(t-r/c))}{r^3\omega} - \frac{\sin(\omega(t-r/c))}{r^2 c} \right\}$$ ✓✓

$$E_r = -\frac{\partial \phi}{\partial r} - \frac{\partial A_r}{\partial t}$$

$$-\frac{\partial \phi}{\partial r} = -\frac{\partial}{\partial r}\left\{ \frac{l\cos\theta}{4\pi\varepsilon_0 r}\left(\frac{q_0 \cos(\omega(t-r/c))}{r} + \frac{I_0 \sin(\omega(t-r/c))}{c} \right) \right\}$$

$-I_0/\omega$

$$= \frac{2\cos\theta\, l}{r^3 4\pi\varepsilon_0} q_0 \cos(\omega(t-r/c)) - \frac{l\cos\theta\, q_0}{4\pi\varepsilon_0 r^2}(-\omega/c)(-\sin(\omega(t-r/c))$$

$$+ \frac{l\cos\theta}{4\pi\varepsilon_0 r^2 c} I_0 \sin(\omega(t-r/c)) - \frac{l\cos\theta\, I_0}{4\pi\varepsilon_0 r}\left(-\frac{\omega}{c^2}\right)\cos(\omega(t-r/c))$$

$$-\frac{\partial A_r}{\partial t} = -\frac{I_0 l \mu_0}{4\pi r}\cos\theta(\omega)\cos(\omega(t-r/c))$$

$\rightarrow \frac{1}{c^2\varepsilon_0} = \mu_0 \leftarrow$

$$\Rightarrow E_r = \cos(\omega(t-r/c))\left\{ -\frac{2 I_0 l\cos\theta}{r^3 4\pi\varepsilon_0\omega} + \frac{l I_0 \omega\cos\theta}{4\pi\varepsilon_0 r c^2} - \frac{I_0 l \mu_0 \omega\cos\theta}{4\pi r} \right\}$$

$$+ \sin(\omega(t-r/c))\left\{ \frac{l I_0 \cos\theta}{4\pi\varepsilon_0 c r^2} + \frac{l I_0 \cos\theta}{4\pi\varepsilon_0 r^2 c} \right\}$$

$$\Rightarrow E_r = \frac{2 l I_0 \cos\theta}{4\pi\varepsilon_0}\left\{ \frac{\sin(\omega(t-r/c))}{c r^2} - \frac{\cos(\omega(t-r/c))}{\omega r^3} \right\}$$ ✓✓

$$E_\phi = -\frac{1}{r\sin\theta}\frac{\partial\phi}{\partial\phi} - \frac{\partial A_\phi}{\partial t} = 0$$ ✓✓