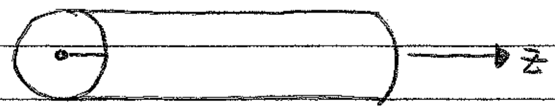
8/21/13
R.P. Woodard

Solution to Problem 7.16

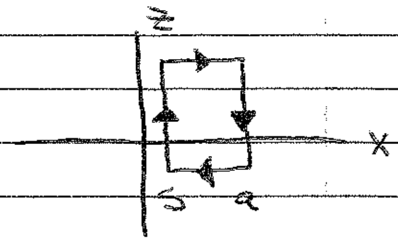
(a) * the E-field is **longitudinal**
 – ie parallel to the wire



(b) * for $0<s<a \rightarrow \vec{B} = \frac{\mu_0 I(t)}{2\pi s}\hat{\phi}$

* for $a<s<\infty \rightarrow \vec{B} = 0$

* choose the surface in the x-z plane



* for $0<s<a \rightarrow \Phi(t) = \frac{\mu_0 l_1 I(t)}{2\pi}\ln\left(\frac{a}{s}\right)$

* for $a<s<\infty \rightarrow \Phi(t) = 0$

$$\mathcal{E} = l_1\left[E(s) - E(a)\right]$$

* assuming $\vec{E} = 0$ for $s \rightarrow \infty \rightarrow E(a) = 0$ (because $\mathcal{E} = 0$ for $a<s<\infty$)

* for $0<s<a$

$$\mathcal{E} = -\frac{\partial \Phi}{\partial t} = \frac{\mu_0 \omega l_1 I_0 \sin(\omega t)}{2\pi}\ln\left(\frac{a}{s}\right) = l_1 E(s)$$

$$\therefore \vec{E}_{inside} = \frac{\mu_0 \omega I_0}{2\pi}\sin(\omega t)\ln\left(\frac{a}{s}\right)\hat{z}$$