8/21/13
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Solution to 7.8

(a) * First compute $\vec{B}$ using Ampere's law &

$$\left.\begin{array}{l} (1)\ \vec{B} = B(s)\,\vec{\phi} \\ (2)\ \oint d\vec{c}\cdot\vec{B} = 2\pi s \cdot B(s) \\ (3)\ \int d\vec{a}\cdot\vec{j} = I \end{array}\right\} \rightarrow \vec{B} = \frac{\mu_0 I}{2\pi s}\,\vec{\phi}$$

* Flux (out of page) through square $= a\int_s^{s+a} ds' \frac{\mu_0 I}{2\pi s'} = \frac{\mu_0 a I}{2\pi} \ln\left(1+\frac{a}{s}\right)$

(b) * just change "s" to $s+vt$

* $\Phi(t) = \frac{\mu_0 a I}{2\pi} \ln\left(1+\frac{a}{s+vt}\right)$

* $\mathcal{E} = -\frac{\partial \Phi}{\partial t} = \frac{\mu_0 a v I}{2\pi}\left\{\frac{1}{s+vt} - \frac{1}{a+s+vt}\right\}$

(c) * $\frac{\partial \Phi}{\partial t} = 0 \rightarrow \mathcal{E} = 0$

* NB the Lorentz force law gives the same result