9.3

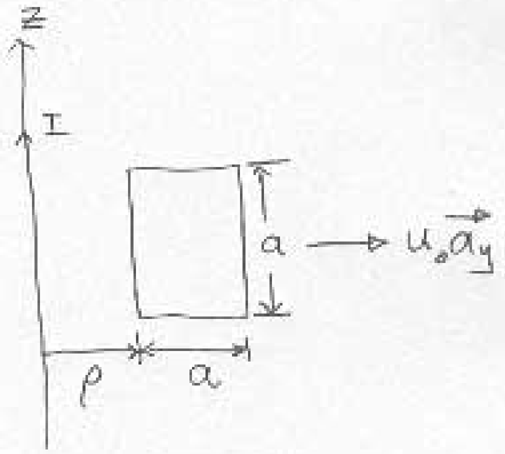
$$\Psi = B_0 S \cos\omega t$$

$$emf = -N\frac{d\Psi}{dt} = N B_0 S \omega \sin\omega t$$

$$= 50 \times 0.06 \times 0.3 \times 0.4 \times 130 \sin 130t$$

$$= 46.8 \sin 130t$$

9.6



$$\vec{B} = \frac{\mu_0 I}{2\pi\rho}\vec{a}_\phi$$

$$\Psi = \int \vec{B}\cdot\vec{ds}$$

$$= \int_{\rho=\rho_0+u_0t}^{\rho_0+u_0t+a}\int_{z=0}^{a} \frac{\mu_0 I}{2\pi\rho}\, d\rho\, dz$$

$$= \frac{a\mu_0 I}{2\pi}\ln\rho \Big|_{\rho_0+u_0t}^{\rho_0+u_0t+a}$$

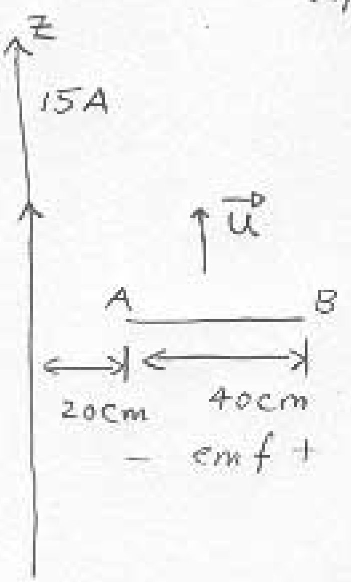
$$= \frac{a\mu_0 I}{2\pi}\ln\left(\frac{\rho_0+u_0t+a}{\rho_0+u_0t}\right)$$

$$emf = -\frac{d\Psi}{dt} = \frac{a\mu_0 I}{2\pi}\frac{(\rho_0+u_0t)}{(\rho_0+u_0t+a)}\left[a(-1)(\rho_0+u_0t)^{-2}u_0\right]$$

$$= -\frac{a^2\mu_0 I u_0}{2\pi(\rho_0+u_0t)(\rho_0+u_0t+a)} = -\frac{a^2\mu_0 I u_0}{2\pi\rho(\rho+a)}$$

sign of emf depends on definition.

9.7



$$\vec{B} = \frac{\mu_0 I}{2\pi\rho}\vec{a}_\phi$$

$$emf = \oint(\vec{u}\times\vec{B})\cdot\vec{dl}$$

$$= \int_{\rho=0.2}^{0.6}\left(3\vec{a}_z \times \frac{\mu_0 I}{2\pi\rho}\vec{a}_\phi\right)\cdot d\rho\,\vec{a}_\rho$$

$$= \int_{0.2}^{0.6} -\frac{3\mu_0 I}{2\pi\rho}\,d\rho$$

$$= -\frac{3\mu_0 I}{2\pi}\ln 3 = -9.89\mu V$$

∴ Point A is at a higher potential than B.

9.16

Conduction current density is $\vec{J}$

displacement " " " $\frac{\partial\vec{D}}{\partial t}$

both appear in the second equation of Maxwell:

$$\nabla\times\vec{H} = \vec{J} + \frac{\partial\vec{D}}{\partial t}$$

$$J = \frac{I}{S} = \frac{(0.2\sin 10^9 t)\times 10^{-3}A}{10\times10^{-4}} = 0.2\sin 10^9 t\left[\frac{A}{m^2}\right]$$

$$E = J/\sigma = \frac{0.2\sin 10^9 t}{2.5\times10^6} = 80\times10^{-9}\sin 10^9 t\ [V/m]$$

$$\frac{\partial D}{\partial t} = \epsilon\frac{\partial E}{\partial t} = 6\epsilon_0(80)\cos 10^9 t$$, Magnitude $= 4.24\times10^{-9}$ [A/m²]