Infinite length cilinder of radius R

$\vec{k}(t) = k(t)\,\hat{\phi}$ (superficial density of current)

$k(t) = \frac{I}{L}$ (1)

L = length of cilinder

$$B = \begin{cases} \mu_0 \cdot k(t)\,\hat{z} , & r < R \\ \vec{0} , & r > R \end{cases} \qquad E = \begin{cases} -\frac{\mu_0 \cdot \dot{k}(t)\, r}{2} , & r < R \\ -\frac{\mu_0 \cdot \dot{k}(t) \cdot R^2}{2r} \end{cases}$$

PROVE displacement current can be ignored, in calculation of magnetic field, by proving (2) $\left| \frac{\ddot{k}(t)}{k(t)} \ll \left(\frac{c}{R}\right)^2 \right|$ (inside of the cylinder)

$$\oint B\,dl = \mu_0 \cdot I + \mu_0 \cdot \varepsilon_0 \cdot \frac{d}{dt} \cdot \int_S E\,dS$$

πr^2 (area of surface of current)

$$B.L = \underbrace{\mu_0 \cdot k(t) \cdot L}_{\text{Equation (1)}} + \mu_0 \cdot \varepsilon_0 \cdot \frac{d}{dt}\left(-\frac{\mu_0 \cdot \dot{k}(t)\, r}{2}\right)(\pi r^2)$$

$$BL = \mu_0 \cdot k(t) \cdot L - \mu_0 \cdot \varepsilon_0 \cdot \left(\frac{\mu_0 \cdot \ddot{k}(t)\, \pi r^3}{2}\right) \qquad \frac{1}{c} = \mu_0 \cdot \varepsilon_0$$

QUESTIONS;

(1) $dS = \pi r^2$ or $2\pi r$

(2) It is asked to prove inside the cylinder, but that equation doesn't have term R, so I can't prove equation (2)