Physics 172
Winter Quarter 1986
March 17, 1986
George Williams

students : 293
Ave : 20.6

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FINAL EXAM

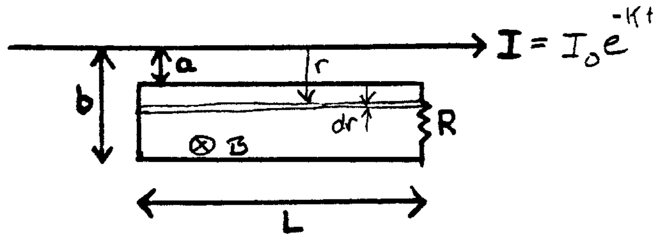
Name (Print) Paulmer Soderberg Name (Signed)__________

Discussion Instructor (Circle One): Brown Chung Pollard Rothman

Discussion Section #:________ Schweizer Soderberg Vaseghi Viohl

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

A long, straight wire carries a current given by $I = I_o e^{-kt}$, where I_o and k are constant. Nearby is a rectangular loop of wire with the dimensions shown. Both the straight wire and the rectangular loop are in the plane of the paper.



(a) Calculate an expression for the flux through the rectangular loop as a function of time.
(b) Calculate the current through the resistor as a function of time.

The B field due to a long straight wire is, by Ampére,

$$B = \frac{\mu_0 I}{2\pi r} \quad (3)$$

a) By definition, flux $\Phi = \int B \cdot dA \Rightarrow$ in this case

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$$\Phi = \int_a^b \left(\frac{\mu_0 I}{2\pi r}\right)(L\,dr) \; (5) = \frac{\mu_0 I L}{2\pi}\int_a^b \frac{dr}{r} \; (4) = \frac{\mu_0 I L}{2\pi} \ln(b/a) \; (3)$$

$$\therefore \quad \boxed{\Phi = \frac{\mu_0 I_o L}{2\pi} \ln(b/a) \cdot e^{-Kt}}$$

b) By Ohm's law, $I_R = \mathcal{E}_{in}/R$ (2) where $\mathcal{E}_{in}$ is induced Emf.

By Faraday's law, $\mathcal{E}_{in} = -\frac{d\Phi}{dt}$ (1) $= -\frac{\mu_0 I_o L \ln(b/a)}{2\pi} \cdot (-K) e^{-Kt}$ (5)

$$\therefore \quad \boxed{I_R = \frac{\mu_0 I_o L K \ln(b/a)}{2\pi R} e^{-Kt}} \quad (3)$$

clockwise