...nter Quarter 1992
March 17, 1994
George Williams

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FINAL EXAM

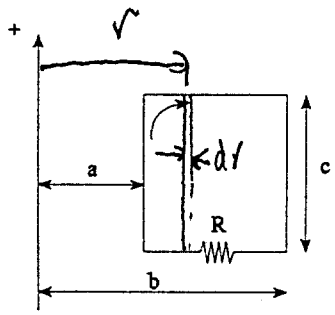
Name (print)_____ Name (signed)_____

Discussion Instructor (circle): Basko Chakhbazian DiCarlo Gundlach Romer Wei

Discussion Section # _____

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

A long straight wire carrying a current is in the same plane as a rectangular loop of wire with the dimensions shown. The wire has a resistance, R, as shown.



(a) If the current in the wire is given by $I = I_0 \sin \omega t$, calculate the current through R as a function of time. Assume the positive direction of the current in the wire is as shown by the arrow, and that the positive current in the rectangle is clockwise.

(b) Now the current in the long wire has a constant value I (new situation), and the shape of the rectangle is changed by changing the value of c at a steady rate of dc/dt = A m/s. Calculate the current in the resistor, including its sign, using the convention in (a).

(a) $d\Phi_B = \frac{\mu_0 I(t)}{2\pi r} c\,dr$ ∴ $\Phi_B(t) = \int_a^b \frac{\mu_0 I(t)}{2\pi r} c\,dr = \frac{\mu_0 I(t) c}{2\pi} \ln\left(\frac{b}{a}\right)$ ∴ $\mathcal{E}_{ind} = -\frac{\partial \Phi_B(t)}{\partial t} =$

$\frac{\mu_0 c}{2\pi} \omega I_0 \ln\left(\frac{b}{a}\right) \cos\omega t$ ∴ Since $I(t)$ increases at $t = 0$ $\vec{B}_{loop}$ into page from wire

⇒ $i_{induced}$ ⇒ counterclockwise

⇒ $i(t) = \frac{\mathcal{E}_{ind}(t)}{R} = \boxed{-\frac{\mu_0 c \omega I_0}{R 2\pi} \ln\left(\frac{b}{a}\right) \cos\omega t}$

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6
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(b) $\Phi_B(t) = \frac{\mu_0 I}{2\pi}(c + At) \ln\left(\frac{b}{a}\right)$ ∴ $c_{new} = c + At$

⇒ $\mathcal{E}_{ind}(t) = -\frac{\partial \Phi_B(t)}{\partial t} \boxed{= -\frac{A \mu_0 I}{R 2\pi} \ln\left(\frac{b}{a}\right)}$ Constant!

∴ ⊖ Due to same Argument as above!

∴ Flat
3 →
3 Sign