Physics 2220
Spring 2001
George A. Williams

SIXTH MIDTERM

5

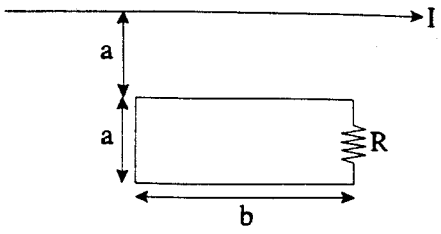
Name: Josh Kennedy

Discussion Instructor (circle): Billeter Diwekar Kennedy Murray Whitaker

Discussion Section # _____ Student ID #: _____

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

The wire shown has a current I given by $I = I_o \cos \omega t$.



10 (a) At t = 0, calculate the flux through the rectangle shown. The wire and the rectangle are both in the plane of the paper.

10 (b) Determine the magnitude of the voltage across the resistor R as a function of time.

10 (c) At a time given by $\omega t = \pi/2$ is the current in the loop clockwise or counterclockwise? Clearly state your reason (no credit will be given for guessing).

a) $I(t=0) = I_o$

+4 $\Phi = \int \vec{B} \cdot d\vec{A}$ $B(r) = \frac{\mu_o I}{2\pi r}$ (into the page inside the circuit) at $t=0$

+2 dA for our rectangular circuit is $b \cdot dr$

+2 $\Phi = \int_a^{2a} \frac{\mu_o I}{2\pi r} b\, dr = \frac{\mu_o I b}{2\pi} \ln 2$

+2 $\Phi(t=0) = \frac{\mu_o I_o b}{2\pi} \ln 2$

b) +5 $\mathcal{E} = -\frac{d\Phi}{dt}$ $\Phi(t) = \frac{\mu_o b I(t)}{2\pi} \ln 2 = \frac{\mu_o b \ln 2}{2\pi} I_o \cos \omega t$

+5 $\frac{d\Phi(t)}{dt} = -\frac{\mu_o b \omega \ln 2}{2\pi} I_o \sin \omega t$

$\mathcal{E}(t) = \frac{\mu_o b \omega \ln 2}{2\pi} I_o \sin \omega t$

+10 c) at $\omega t = \frac{\pi}{2}$ $I(t) = 0$, but $\frac{dI(t)}{dt} < 0$, so current is changing from flowing right to flowing left. The flux into the paper is decreasing, so the induced flux is into the paper. Thus, the induced current is clockwise.