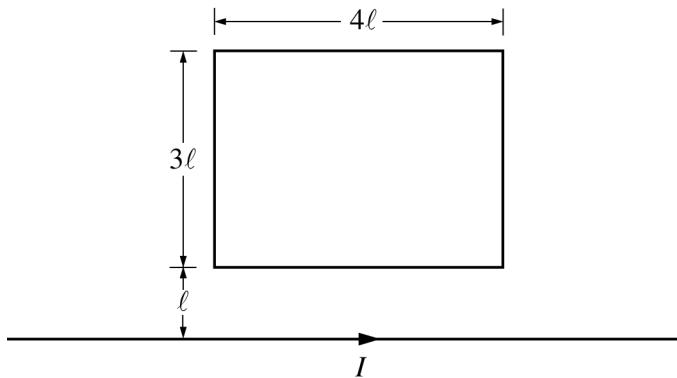


**2004 AP<sup>®</sup> PHYSICS C: ELECTRICITY AND MAGNETISM  
FREE-RESPONSE QUESTIONS**



E&M. 3.

A rectangular loop of dimensions  $3\ell$  and  $4\ell$  lies in the plane of the page as shown above. A long straight wire also in the plane of the page carries a current  $I$ .

- (a) Calculate the magnetic flux through the rectangular loop in terms of  $I$ ,  $\ell$ , and fundamental constants.

Starting at time  $t = 0$ , the current in the long straight wire is given as a function of time  $t$  by

$$I(t) = I_0 e^{-kt}, \text{ where } I_0 \text{ and } k \text{ are constants.}$$

- (b) The current induced in the loop is in which direction?

Clockwise       Counterclockwise

Justify your answer.

The loop has a resistance  $R$ . Calculate each of the following in terms of  $R$ ,  $I_0$ ,  $k$ ,  $\ell$ , and fundamental constants.

- (c) The current in the loop as a function of time  $t$

- (d) The total energy dissipated in the loop from  $t = 0$  to  $t = \infty$

**END OF SECTION II, ELECTRICITY AND MAGNETISM**