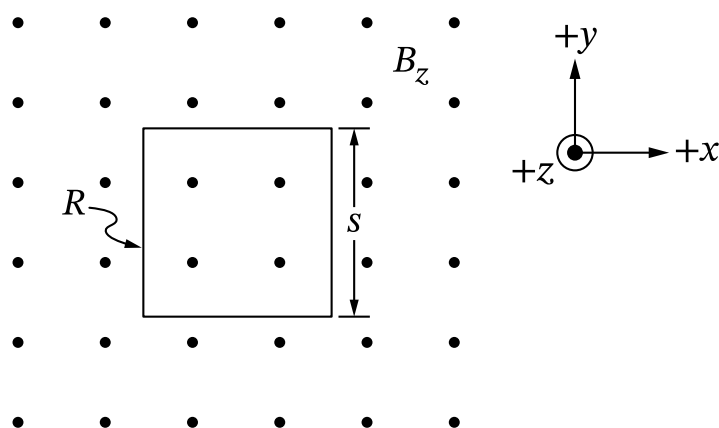


Question 4

4. In Scenario 1, a square conducting loop with side length s has total resistance R . The loop is held fixed in the xy -plane in an external, uniform, time-varying magnetic field that is initially directed in the $+z$ -direction, as shown. The z -component of the magnetic field changes as a function of time t as described by $B_z = B_0 \cos\left(2\pi\frac{t}{t_1}\right)$, where B_0 and t_1 are positive constants.



Part A

Indicate whether the induced current I in the loop is clockwise, counterclockwise, or zero during the time interval $0 < t < \frac{t_1}{4}$ by writing one of the following.

- I is clockwise.
- I is counterclockwise.
- I is zero.

Justify your answer without only manipulating equations.

Part B

Derive an expression for I as a function of t in terms of s , R , B_0 , t_1 , t , and physical constants, as appropriate. Begin your derivation by writing a fundamental physics principle or an equation from the reference information.

Part C

In Scenario 2, a new square conducting loop with side length $2s$ and total resistance $2R$ is placed in the same external, uniform, time-varying magnetic field as in Scenario 1.

Indicate whether the maximum induced current I_2 in Scenario 2 is greater than, less than, or equal to the maximum induced current I_1 in Scenario 1 by writing one of the following.

- $I_2 > I_1$
- $I_2 < I_1$
- $I_2 = I_1$

Briefly **justify** your answer by referencing the expression you derived in part B.