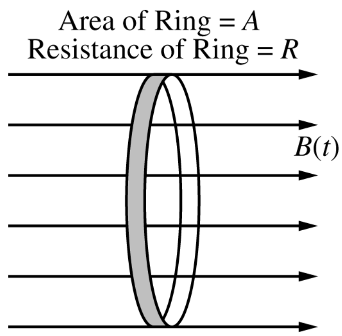
Begin your response to **QUESTION 3** on this page.



3. A thin, conducting ring of area A and resistance R is aligned in a uniform magnetic field directed to the right and perpendicular to the plane of the ring, as shown. At time $t = 0$, the magnitude of the magnetic field is B_0. At $t = 1$ s, the magnitude of the magnetic field begins to decrease according to the equation $B(t) = \frac{\beta}{t}$, where β has units of T·s.

(a) Derive an equation for the magnitude of the induced current I in the ring as a function of t for $t > 1$ s. Express your answer in terms of β, A, R, t, and physical constants, as appropriate.

Assume $A = 0.50\,\text{m}^2$, $R = 2.0\,\Omega$, and $\beta = 0.50\,\text{T}\cdot\text{s}$.

(b) Calculate the electrical energy dissipated in the ring from $t = 1$ s to $t = 2$ s.

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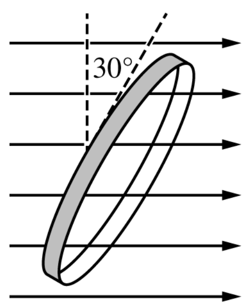
Continue your response to **QUESTION 3** on this page.



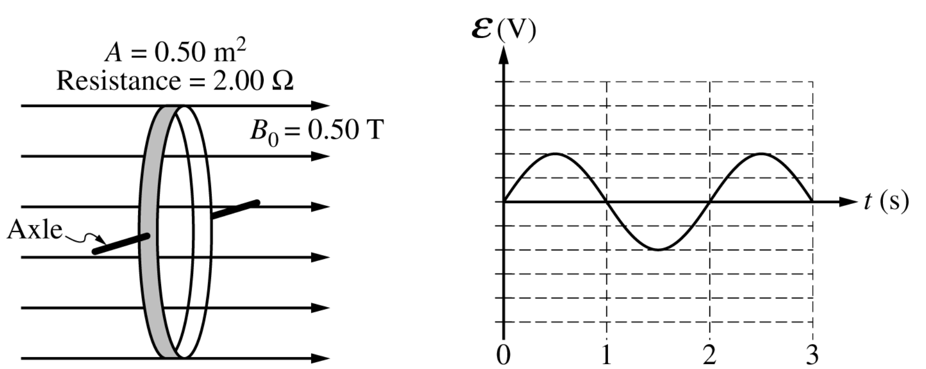
The ring is then rotated so that the plane of the ring is aligned at a 30° angle to the magnetic field, as shown.

The magnitude of the magnetic field is reset to a magnitude of B_0 at a new time $t = 0$ and again begins to decrease at $t = 1\text{ s}$ according to the equation $B(t) = \dfrac{\beta}{t}$, where β has units of T·s.

(c) Will the amount of energy dissipated in the ring from $t = 1\text{ s}$ to $t = 2\text{ s}$ be greater than, less than, or equal to the energy dissipated in part (b) ?

_____ Greater than _____ Less than _____ Equal to

Justify your answer.



The ring is now mounted on an axle that is perpendicular to the magnetic field. The magnitude of the magnetic field is now held at a constant $B_0 = 0.50\text{ T}$, as shown. The ring rotates about the axle, and the emf ε induced in the ring as a function of time t is shown on the graph.

(d) Calculate the angular speed ω of the rotating ring in rad/s.

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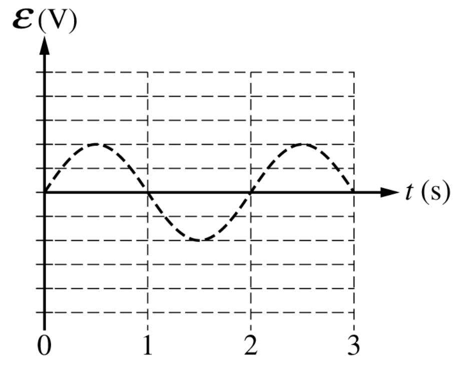
Use a pencil or pen with black or dark blue ink only. Do NOT write your name. Do NOT write outside the box.

Continue your response to **QUESTION 3** on this page.

(e) Calculate the magnitude of the maximum emf ε_{MAX} induced in the ring.

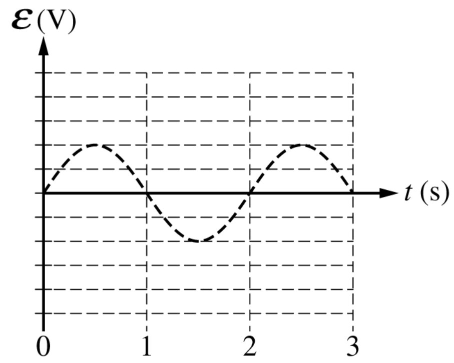
The ring now begins to rotate at an angular speed 2ω.

(f) On the graph below, draw a curve to indicate the new induced emf ε in the ring. The dashed curve shows the emf induced under the original conditions.



Justify your sketch, specifically identifying and addressing any similarities or differences between the sketch and the original graph.

PRACTICE GRAPH - Use the graph below to practice your sketch for part (f). Any work shown on the graph below will NOT be graded.



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