AP® Physics B
2004 Sample Student Responses
Form B

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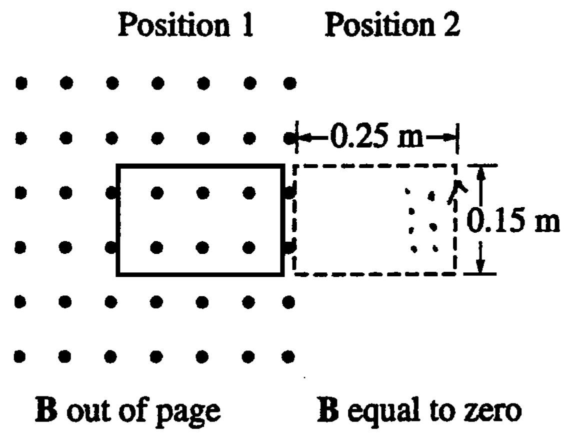
A1



4. (15 points)

A 20-turn wire coil in the shape of a rectangle, 0.25 m by 0.15 m, has a resistance of 5.0 Ω. In position 1 shown above, the loop is in a uniform magnetic field **B** of 0.20 T. The field is directed out of the page, perpendicular to the plane of the loop. The loop is pulled to the right at a constant velocity, reaching position 2 in 0.50 s, where **B** is equal to zero.

(a) Calculate the average emf induced in the 20-turn coil during this period.

$$emf = n\left|\frac{\Delta\Phi}{\Delta t}\right| = n\left|\frac{\Delta(BA)}{0.50s}\right| = n\left|\frac{0 - 0.25m \times 0.15m \times 0.20\,T}{0.50s}\right|$$

$$= 20(0.015)$$

$$= 0.3V$$

(b) Calculate the magnitude of the current induced in the 20-turn coil and state its direction.

$$V = IR$$

$$I = \frac{V}{R}$$

$$= \frac{0.3V}{5.0\Omega}$$

$= 0.06A$, in counter clockwise direction.

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A2

(c) Calculate the power dissipated in the 20-turn coil.

$P = IV$
$= 0.06(0.3)$
$= 0.018\ W$ //

(d) Calculate the magnitude of the average force necessary to remove the 20-turn coil from the magnetic field.

$\frac{Fd}{t} = 0.018$

$F = \frac{0.018(t)}{d}$
$= \frac{0.018(0.5)}{0.25}$
$= 0.036N$ //

(e) Identical wire is used to add 20 more turns of wire to the original coil. How does this affect the current in the coil? Justify your answer.

The emf induced doubles, but $R = \rho \frac{l}{A}$ thus R doubles as well.

$I_0 = \frac{V_0}{R_0}$ $\quad$ $I = \frac{2V_0}{2R_0} = \frac{V_0}{R_0} = I_0$

Thus the current in the coil remains the same.

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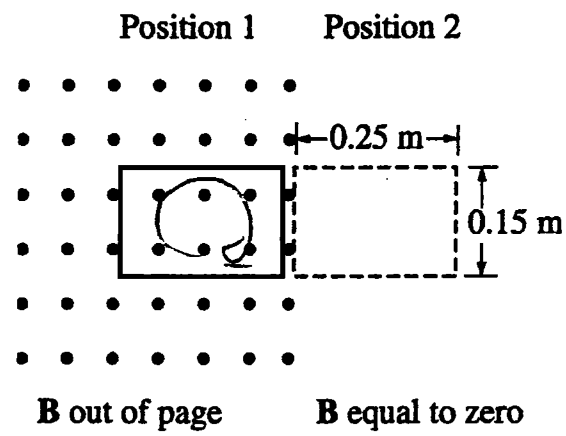
B1



4. (15 points)

A 20-turn wire coil in the shape of a rectangle, 0.25 m by 0.15 m, has a resistance of $5.0\ \Omega$. In position 1 shown above, the loop is in a uniform magnetic field **B** of 0.20 T. The field is directed out of the page, perpendicular to the plane of the loop. The loop is pulled to the right at a constant velocity, reaching position 2 in 0.50 s, where **B** is equal to zero.

(a) Calculate the average emf induced in the 20-turn coil during this period.

$\mathcal{E}_{avg} = -\frac{\Delta \Phi}{\Delta t} \quad \frac{(\Delta B) A}{\Delta t} \quad \frac{.2T(.0375)}{(.5s)}$

.015 V

(b) Calculate the magnitude of the current induced in the 20-turn coil <u>and</u> state its direction.

Clockwise

$V = IR$

$.015 = I(5)$

.003 a

B2

(c) Calculate the power dissipated in the 20-turn coil.

$P = IV$

$P = (.003)(.015)$

4.5×10^{-5} W

(d) Calculate the magnitude of the average force necessary to remove the 20-turn coil from the magnetic field.

$BIl = F_B$

$(.2)(.003)(.25) = F_B$

1.5×10^{-4} N

(e) Identical wire is used to add 20 more turns of wire to the original coil. How does this affect the current in the coil? Justify your answer.

Since $V = IR$, doubling the Resistance would cut the current in half assuming the voltage/field were constant.

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