

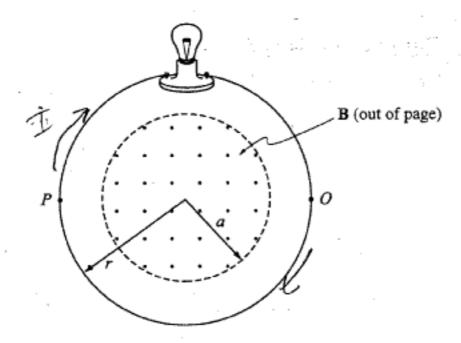
#### AP® Physics C: Electricity & Magnetism 1999 Sample Student Responses

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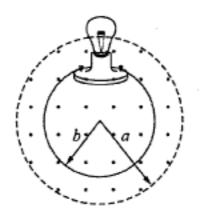
# -18- EEEEEEEEEEEEEEEEEE



- E&M 2. A uniform magnetic field B exists in a region of space defined by a circle of radius a = 0.60 m as shown above. The magnetic field is perpendicular to the page and increases out of the page at a constant rate of 0.40 T/s. A single circular loop of wire of negligible resistance and radius r = 0.90 m is connected to a lightbulb with a resistance R = 5.0 Ω, and the assembly is placed concentrically around the region of magnetic field.
  - (a) Determine the emf induced in the loop.

(b) Determine the magnitude of the current in the circuit. On the figure above, indicate the direction of the current in the loop at point O.

(c) Determine the total energy dissipated in the lightbulb during a 15 s interval.

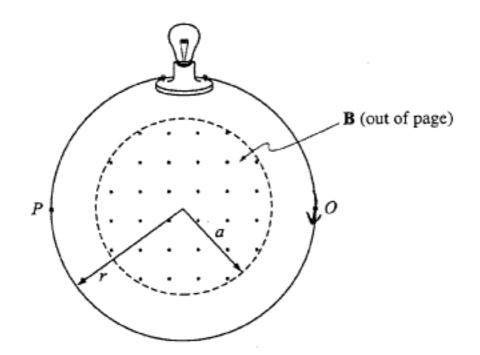


The experiment is repeated with a loop of radius b = 0.40 m placed concentrically in the same magnetic field as before. The same lightbulb is connected to the loop, and the magnetic field again increases out of the page at a rate of 0.40 T/s. Neglect any direct effects of the field on the lightbulb itself.

(d) State whether the brightness of the bulb will be greater than, less than, or equal to the brightness of the bulb in part (a). Justify your answer.

less than the brightness in a because the area inside the wire is less, in the change in flux is less, so the induced EMP is less, so the current is less, so the power dissipated is less which means the lightfulb is less bright.

# -18- EEEEEEEEEEEEEEEEEE



- A uniform magnetic field **B** exists in a region of space defined by a circle of radius a = 0.60 mE&M 2. as shown above. The magnetic field is perpendicular to the page and increases out of the page at a constant rate of 0.40 T/s. A single circular loop of wire of negligible resistance and radius  $r = 0.90 \,\mathrm{m}$  is connected to a lightbulb with a resistance  $R = 5.0 \,\Omega$ , and the assembly is placed concentrically around the region of magnetic field.
  - (a) Determine the emf induced in the loop  $\varepsilon = \frac{aB}{at}$   $\phi = \int B \, dA$   $\varepsilon = \frac{BA}{t}$   $\frac{B}{t} = .40$

$$A = \pi r^2 = \pi (.60)^2 = \pi (.30)$$
  $E = (.40)\pi (.30)$ 

$$E = \frac{BA}{t} = .40$$

$$E = (.40)\pi (.30)$$

$$= (.144)\pi$$

$$= (0.45) \vee$$

(b) Determine the magnitude of the current in the circuit. On the figure above, indicate the direction of the current in the loop at point O.

(c) Determine the total energy dissipated in the lightbulb during a 15 s interval.

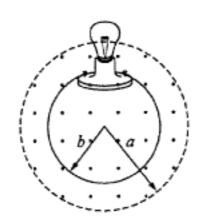
$$L = \frac{A}{A} \qquad \qquad U = \frac{1}{2} L I^{2}$$

$$L = \frac{\pi r^{2}}{2\pi r} \qquad \qquad U = \frac{1}{2} \cdot \frac{r}{2} \cdot (.09)^{2}$$

$$= \frac{r}{2} \qquad \qquad -(.5)(.45)(.0081)$$

$$= \boxed{1.8 \times 10^{-3} \text{ J}}$$

# EEEEEEEEEEEEE-19.

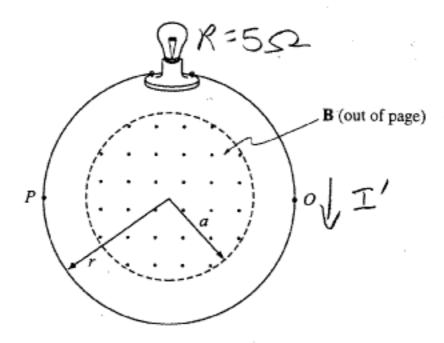


The experiment is repeated with a loop of radius b = 0.40 m placed concentrically in the same magnetic field as before. The same lightbulb is connected to the loop, and the magnetic field again increases out of the page at a rate of 0.40 T/s. Neglect any direct effects of the field on the lightbulb itself.

(d) State whether the brightness of the bulb will be greater than, less than, or equal to the brightness of the bulb in part (a). Justify your answer.

> less because the emf will be less due to the smaller radius and area inside the Magnetic Field circle.

# -18- EEEEEEEEEEEEEEEE



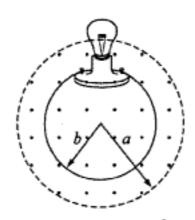
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(a) Determine the emf induced in the loop.

(b) Determine the magnitude of the current in the circuit. On the figure above, indicate the direction of the current in the loop at point O.

Determine the total energy dissipated in the lightbulb during a 15 s interval.

### EEEEEEEEEEEEE



The experiment is repeated with a loop of radius b = 0.40 m placed concentrically in the same magnetic field as before. The same lightbulb is connected to the loop, and the magnetic field again increases out of the page at a rate of 0.40 T/s. Neglect any direct effects of the field on the lightbulb itself

(d) State whether the brightness of the bulb will be greater than, less than, or equal to the brightness of the bulb in part (a). Justify your answer.

Less because the emf, which varries directly with radius, would decrease