PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2016

College of Sciences

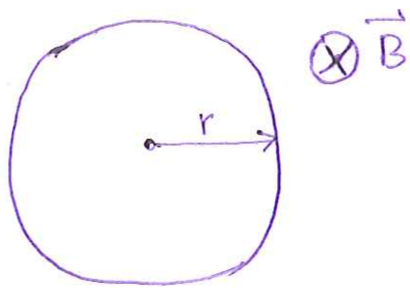
Section 3 **Quiz 9** **28 April 2016**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A circular loop of flexible iron wire has an initial circumference of L, but its circumference is decreasing at a constant rate of A (meters per second). The loop is in a uniform constant, uniform magnetic field oriented perpendicular to the plane of the loop and with magnitude B. Find the *emf* induced in the loop at the instant when time t=2s have passed.

Assume:-

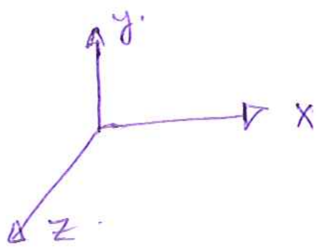


initial Circumference = L

$\Rightarrow \quad 2\pi r = L$

$\Rightarrow \quad r = \frac{L}{2\pi}$

$\overrightarrow{Area} = \pi r^2 = \frac{\pi L^2}{4\pi^2} = \frac{L^2}{4\pi}(-\hat{k})$.



$\Phi_B = \vec{B} \cdot \overrightarrow{Area}$

$= B\frac{L^2}{4\pi}$

$\frac{dArea}{dt} = \frac{dArea}{dL} \cdot \frac{dL}{dt}$.

$= \frac{2L}{2\cdot 4\pi} \cdot A$.

$\frac{d\Phi_B}{dt} = \frac{d}{dt}(\Phi_B) = B \cdot \frac{d}{dt}(Area)$

$= \frac{BLA}{2\pi}$

$|\mathcal{E}| = \left|-N \cdot \frac{d\Phi_B}{dt}\right| = \frac{BLA}{2\pi}$

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Section 4 **Quiz 9** 28 April 2016

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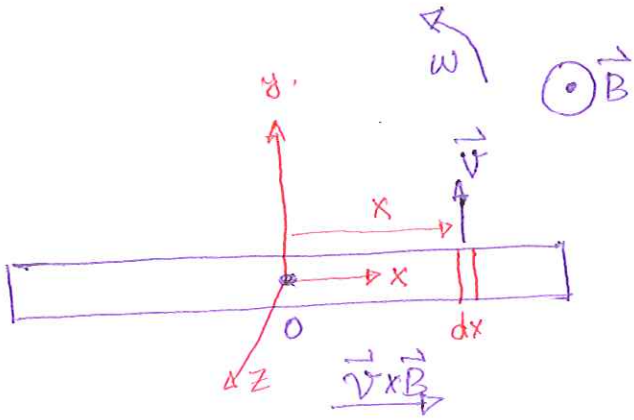
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

An airplane propeller of total length L rotates around its center with a constant angular speed A in a magnetic field B that is perpendicular to the plane of rotation. Modeling the propeller as a thin, uniform bar, find the potential difference between the center and either end of the propeller.



→ Angular velocity of each slice = ω

→ Linear velocity of slice = $\vec{v} = \vec{x} \times \vec{\omega}$

$= x\omega\,\hat{j}$

$= xA\,\hat{j}$ $(\omega = A)$

→ Emf induced in the slice

$d\vec{\mathcal{E}} = (\vec{v} \times \vec{B}) \cdot d\vec{l}$; $d\vec{l} = d\vec{x}\,\hat{i}$.

$= Bv \cdot dx$

$= BAx \cdot dx$.

→ Emf induced in Rod

$|\mathcal{E}| = \int_0^{L/2} BAx \cdot dx = BA \cdot \frac{x^2}{2}\Big|_0^{L/2}$

$= \frac{BA \cdot (L/2)^2}{2} - \frac{BA\,(0)^2}{2}$

$\boxed{|\mathcal{E}| = \frac{BAL^2}{8}}$

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Section 1 Quiz 9 28 April 2016

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Quiz duration: 10 minutes

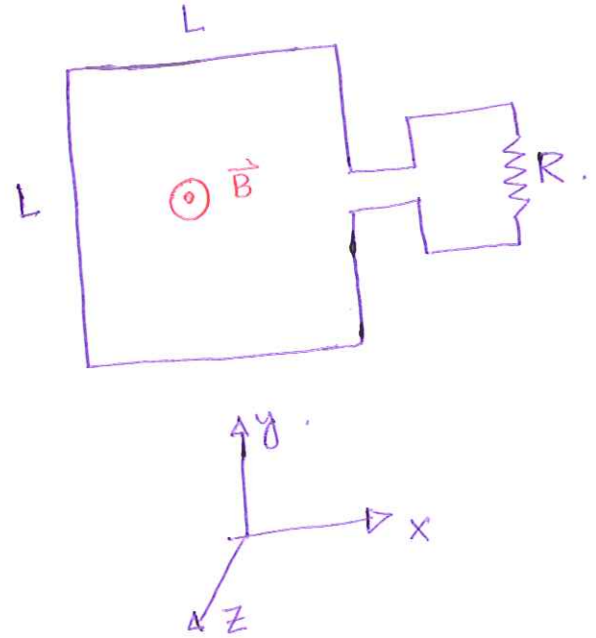
Name: **Student ID:** **Signature:**

A square-shaped coil with side length L, containing N turns, is placed in a uniform magnetic field that varies with time according to $B = At + Ct^4$, where A and C are time-independent constants. The coil is connected to a resistor with resistance R, and its plane is perpendicular to the magnetic field. You can ignore the resistance of the coil. Find the magnitude of the induced *emf* in the coil as a function of time.

Assume:-

$\vec{B} = (At + Ct^4)\hat{k}$

Area $= L^2 \hat{k}$.



$\Phi_B = \vec{B} \cdot \overrightarrow{Area}$

$= L^2 (At + Ct^4)$.

$|\mathcal{E}| = \left| -N \cdot \frac{d\Phi_B}{dt} \right|$

$= NL^2 (A + 4Ct^3)$.

$$|\mathcal{E}| = NL^2 (A + 4Ct^3$$

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Section 2 Quiz 9 28 April 2016

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

A circular coil with radius r is placed in a uniform magnetic field that varies with time according to $B = At^2 + Ct^3$, where A and C are time-independent constants. The coil is connected to a resistor with resistance R, and its plane is perpendicular to the magnetic field. You can ignore the resistance of the coil. What is the current in the resistor at time $t = 2s$?

$B \parallel A$.

$\vec{B} = (At^2 + Ct^3)(-\hat{k})$.

$\overrightarrow{Area} = \pi r^2 (-\hat{k})$.

$\Phi_B = \vec{B} \cdot \overrightarrow{Area}$

$= (At^2 + Ct^3)\pi r^2$.

$|\mathcal{E}| = \left| -N \cdot \frac{d\Phi_B}{dt} \right|$

$= (2At + 3Ct^2)\pi r^2$.

$I = \frac{|\mathcal{E}|}{R} = \frac{\pi r^2}{R}(2At + 3Ct^2)$.

at $t = 2$ sec.

$$I = \frac{\pi r^2}{R}(4A + 12C)$$