PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2012

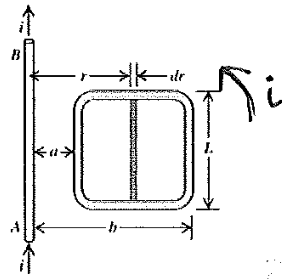
College of Sciences

Section 1 Quiz 10 26 April 2012

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

If the current is increasing steadily at a rate *di/dt*, find the direction and the magnitude of the induced emf in the loop?



$B(t) = \frac{\mu_0 i(t)}{2\pi r}$ (magnetic field due to wire at a distance r)

- Direction of $\vec{B}$: into the page ⊗
- Direction of $\vec{dA}$: (we choose) into the page ⊗

$$\Phi_B = \int_{rectangle} \vec{B}\cdot\vec{dA} = \int B L\,dr = \int_a^b \frac{\mu_0 i(t) L\,dr}{2\pi r} = \frac{\mu_0 i(t) L}{2\pi} \ln(r)\Big|_a^b$$

$$= \frac{\mu_0 i(t) L}{2\pi} \ln(b/a)$$

$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -\frac{\mu_0 L}{2\pi} \ln(b/a) \frac{di(t)}{dt}$$ → positive constant

$$\Rightarrow |\mathcal{E}| = \frac{\mu_0 L}{2\pi} \ln(b/a) \frac{di}{dt}$$

$\mathcal{E} < 0$, by the Lenz law, direction of the induced current is counter clockwise if there is a resistance in the loop.

PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2012**

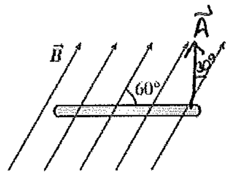
College of Sciences

Section 2 **Quiz 10** **26 April 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

A flat, circular, steel loop of radius R is at rest in a uniform magnetic field, as shown in the edge-on view. If the field is changing with time accordingly $B(t) = a\ exp(-b\ t)$, find the direction and magnitude of the induced emf in the loop.



$B(t) = ae^{-bt}$

$\Phi_B = \vec{B}\cdot\vec{A} = BA\cos 30$

$= ae^{-bt}\pi R^2 \frac{\sqrt{3}}{2} = \frac{\sqrt{3}a\pi R^2 e^{-bt}}{2}$

$\mathcal{E} = \frac{-d\Phi_B}{dt} = \frac{\sqrt{3}}{2}\pi R^2 ab e^{-bt}$

Direction is clockwise when viewed from above.

PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2012

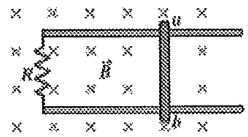
College of Sciences

Section 3 Quiz 10 26 April 2012

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

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

A long metal bar with length L is pulled to the right at a steady v perpendicular to a uniform B field. The bar rides on parallel metal rails connected through a wire with resistance R as shown, so that the apparatus makes a complete circuit. You can ignore the resistance of the bar and the rails. Calculate the direction and magnitude of the induced current through the resistor.



$$\mathcal{E} = -\frac{d\Phi_B}{dt} = +B\frac{dA}{dt} = +BLv$$

if we choose direction of A outward ⊙

$$\mathcal{E} = vBL$$

$$I = \frac{\mathcal{E}}{R} = \frac{vBL}{R}$$ (counterclockwise) ↓ by the Lenz law

PHYS 102: General Physics II **KOÇ UNIVERSITY** **Spring Semester 2012**

College of Sciences

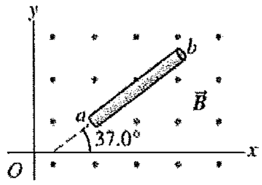
Section 4 **Quiz 10** **26 April 2012**

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

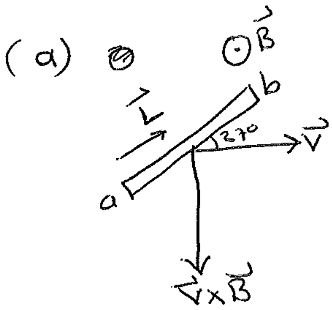
Name: **Student ID:** **Signature:**

A bar with length L moves through a uniform B field. In each case, find the emf induced between the ends of this bar and identify which, if any, end (a or b) is at the higher potential. The bar moves in the direction of

(a) the $+x$ axis.
(b) the $-y$ axis
(c) the $+z$ axis

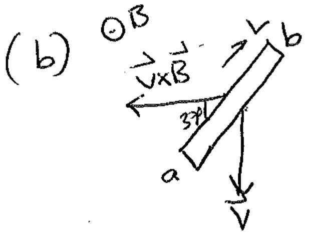


(a)



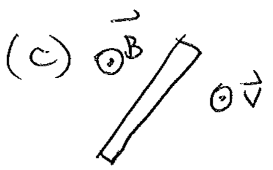
$$\mathcal{E} = (\vec{v}\times\vec{B})\cdot\vec{L}$$
$$= vBL\cos(127) \quad [\cos(127) = -\sin 37]$$
$$= -\frac{3}{5}vBL$$ (a is at higher potential)

(b)



$$\mathcal{E} = (\vec{v}\times\vec{B})\cdot\vec{L}$$
$$= vBL\cos 143$$
$$= -\frac{4}{5}vBL$$ (a is at higher potential)

(c)



$\mathcal{E} = 0$, since $\vec{v}\times\vec{B} = 0$

PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2012

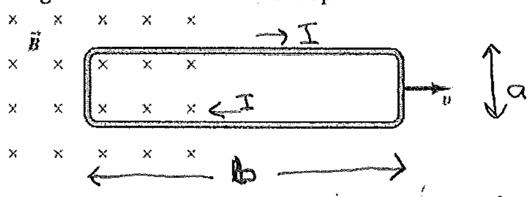
College of Sciences

Section 5 Quiz 10 26 April 2012

Closed book. No calculators are to be used for this quiz.
Quiz duration: 15 minutes

Name: Student ID: Signature:

A rectangular loop of wire with width a, length b and resistance R is being pulled to the right out of a region of uniform magnetic field. The field has strength B and it is directed into the plane of the figure shown. At the instant when the speed of the loop is v, and is still partially in the field region, what force (magnitude and direction) does the magnetic field exert on the loop?



$\Phi_B = \vec{B}\cdot\vec{A} = BA$ (we choose direction of $\vec{A}$ into the page)

→ The magnetic field B is constant, while A is changing with time

$A(t) = ab - avt$

$\Rightarrow \mathcal{E}_{ind} = -\dfrac{d\Phi_B}{dt} = -B\dfrac{dA(t)}{dt} = +Bav$

$I = \dfrac{\mathcal{E}_{ind}}{R} = \dfrac{Bav}{R}$ (direction of current is clockwise)

$\vec{F} = I\vec{l}\times\vec{B}$

$F_{top} = F_{bottom}$ (in opposite directions)
(↑) (↓)

$F_{total} = F_{leftside} = IlB = \left(\dfrac{Bav}{R}\right)(a)(B) = \dfrac{B^2a^2v}{R}$ (direction of F_{total} is opposite to the direction of v)