PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2010**

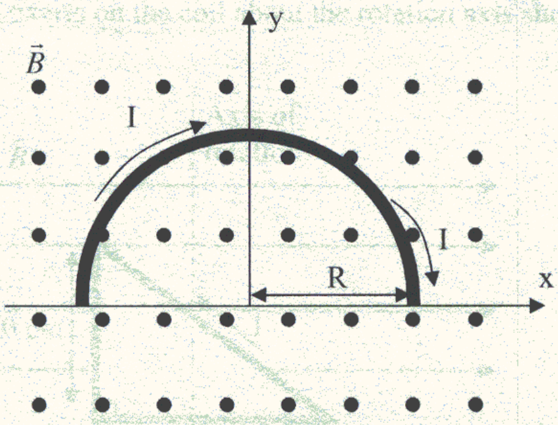
College of Sciences

Section 1 **Quiz 7** **22 April 2010**

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

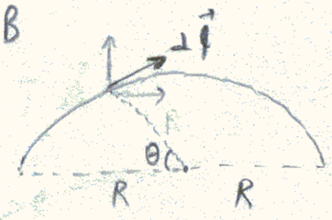
Name: ANSWER **Student ID:** **Signature:**

In figure below the magnetic field $\vec{B}$ is uniform and perpendicular to the plane of the figure, pointing out. The conductor is a semicircle with radius *R*, carrying a current *I*. Find the magnitude and direction of the total magnetic force on the conductor?



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

$\vec{B} = \hat{k} B$



$d\vec{F} = dF_x \hat{i} - dF_y \hat{j}$ $dF_x = I R d\theta B \cos\theta$ $dF_y = I R d\theta B \sin\theta$

$F_x = IRB \int_0^{\pi} \cos\theta \, d\theta = 0$ $F_y = IRB \int_0^{\pi} \sin\theta \, d\theta = 2IRB$

$\vec{F} = -\hat{j}\, 2IRB$

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Section 2 **Quiz 7** **22 April 2010**

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Quiz duration: 10 minutes

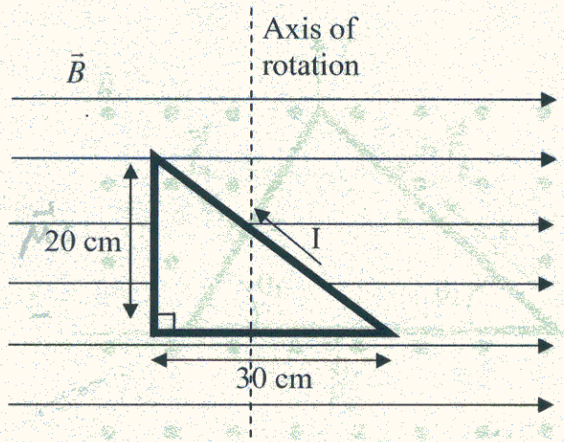
Name: ANSWER **Student ID:** **Signature:**

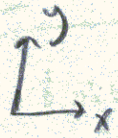
A right triangular coil of wire (dimensions given in the figure below) carrying a current of 1 A (direction counterclockwise as shown in the figure) is oriented with the plane of its loop parallel to a uniform 1.50 T magnetic field. What is the magnitude of the net torque that the magnetic force exerts on the coil about the rotation axis shown in the figure?

$\vec{\tau} = \vec{\mu} \times \vec{B}$

$\vec{\mu} = I\vec{A}$

$\vec{B} = \hat{i}B$





from right hand rule

$\vec{A} = A\hat{k} = \frac{20\,cm \cdot 30\,cm}{2}\hat{k} = \frac{0{,}2 \cdot 0{,}3}{2} m^2 \hat{k} = 0{,}03\, m^2 \hat{k}$

$\vec{\mu} = I\vec{A} = \hat{k} \cdot 1\,\text{Amper} \cdot 0{,}03\,m^2$

$\vec{\tau} = \vec{\mu} \times \vec{B} = 1\,\text{Amper} \cdot 0{,}03\,m^2 \cdot 1{,}5\,\text{Tesla} \cdot (\hat{k} \times \hat{i})$

$|\vec{\tau}| = 0{,}045$ Newton.meter

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Section 3 Quiz 7 22 April 2010

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

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

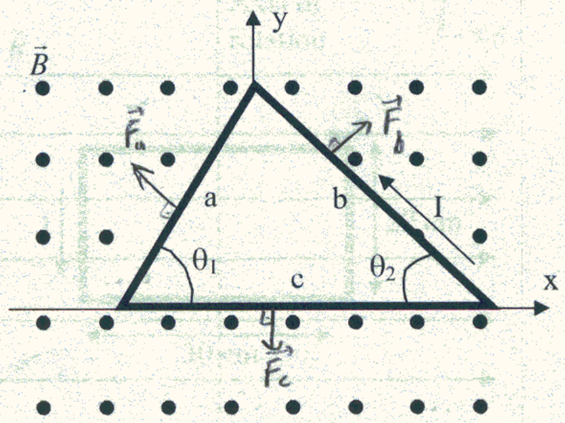
In figure below the magnetic field $\vec{B}$ is uniform and perpendicular to the plane of the figure, pointing out. The conductor is a triangle with edge lengths a, b, and c carrying a current I in the counterclockwise direction. Two angles of the triangle are θ_1 and θ_2 as shown in the figure below. Find the magnitude and direction of the magnetic force on each edge and show that the total magnetic force applied to the triangular conductor is 0.

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

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

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

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

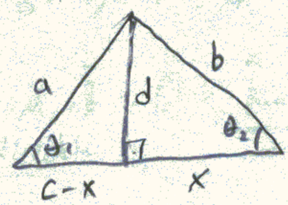


$b.\sin\theta_2 = b.\frac{d}{b} = d$

$a.\sin\theta_1 = a.\frac{d}{a} = d$

$-$

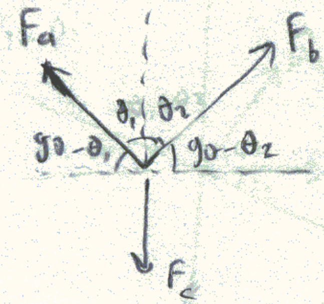
$b.\sin\theta_2 - a.\sin\theta_1 = 0$



$|\vec{F}_a| = IaB$

$|\vec{F}_b| = IbB$

$|\vec{F}_c| = IcB$



$a.\cos\theta_1 = \frac{c-x}{a}.a = c-x$

$b.\cos\theta_2 = b.\frac{x}{b} = x$

$+$

$a.\cos\theta_1 + b.\cos\theta_2 = c$

$F_a.\cos\theta_1 + F_b\cos\theta_2 - F_c = IB(a.\cos\theta_1 + b.\cos\theta_2 - c) = 0$ $\hat{j}$-direction

$F_b.\sin\theta_2 - F_a\sin\theta_1 = IB(b.\sin\theta_2 - a.\sin\theta_1) = 0$ $\hat{i}$-direction

hence $\vec{F}_{net} = \vec{0}$

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Section 4 **Quiz 7** **22 April 2010**

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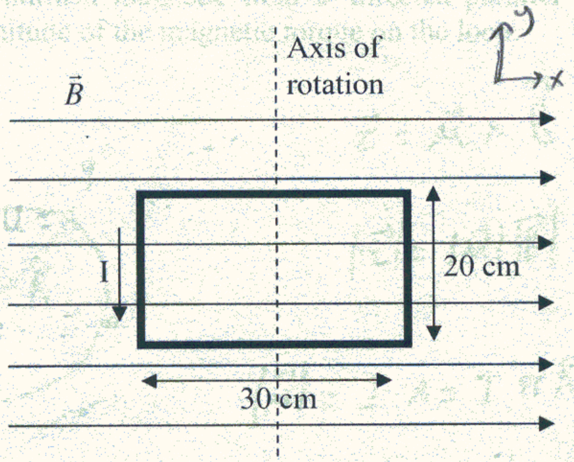
Quiz duration: 10 minutes

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

A rectangular coil of wire, 20 cm by 30 cm, and carrying a current of 1 A (direction counterclockwise as shown in the figure) is initially oriented with the plane of its loop parallel to a uniform 1.50 T magnetic field. What is the work done by the magnetic force when the coil rotates through a 30° angle about the axis of rotation shown below?



$\Delta U = U_2 - U_1$

$U_1 = -\vec{\mu}_1 \cdot \vec{B}$

$U_2 = -\vec{\mu}_2 \cdot \vec{B}$

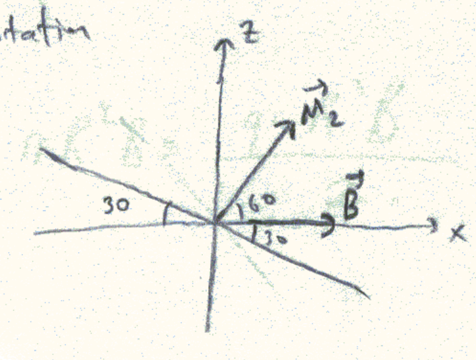
$\vec{\mu}_1 = 0{,}2 . 0{,}3 . 1 \, \hat{k}$

$\vec{\mu}_1 = 0{,}06$ Amper m^2

$\vec{B} = 1{,}5 \, \hat{i}$

$U_1 = -\vec{\mu}_1 \cdot \vec{B} = 0$ $\quad \hat{k} \cdot \hat{i} = 0$

after rotation



$U_2 = -\vec{\mu}_2 \cdot \vec{B} = -0{,}06 . 1{,}5 . \cos 60$

$U_2 = -0{,}045$ joule

$W = |\Delta U| = 0{,}045$ joule

Work done is 0,045 joule, yet this work is NOT done by magnetic force

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Section 5 ANSWER **Quiz 7** **22 April 2010**

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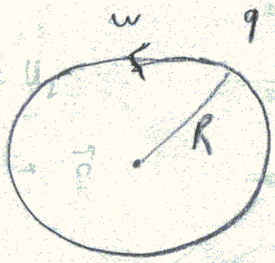
Quiz duration: 10 minutes

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

An insulating circular loop has radius *R*. A positive charge *q* is distributed uniformly around the circumference of the loop. The loop is then rotated around its central axis, perpendicular to the plane of the loop, with angular speed ω. If the loop is in a region where there is a unifirm magnetic field $\vec{B}$ directed parallel to the plane of the loop, calculate the magnitude of the magnetic torque on the loop.



$\vec{\tau} = \vec{\mu} \times \vec{B}$

$|\vec{\tau}| = |\vec{\mu}||\vec{B}| \sin\alpha = |\vec{\mu}||\vec{B}|$ since $\alpha = \frac{\pi}{2}$

$|\vec{\mu}| = I.A = I \pi R^2$

$I = \frac{q}{t} = \frac{q}{T} = \frac{q}{2\pi/w} = \frac{qw}{2\pi}$

$|\vec{\tau}| = IAB = \frac{qw}{2\pi} \pi R^2 B = \frac{qwR^2B}{2}$ unit: Newton. meter