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PHYS 102: General Physics 2 KOÇ UNIVERSITY Fall Semester 2015

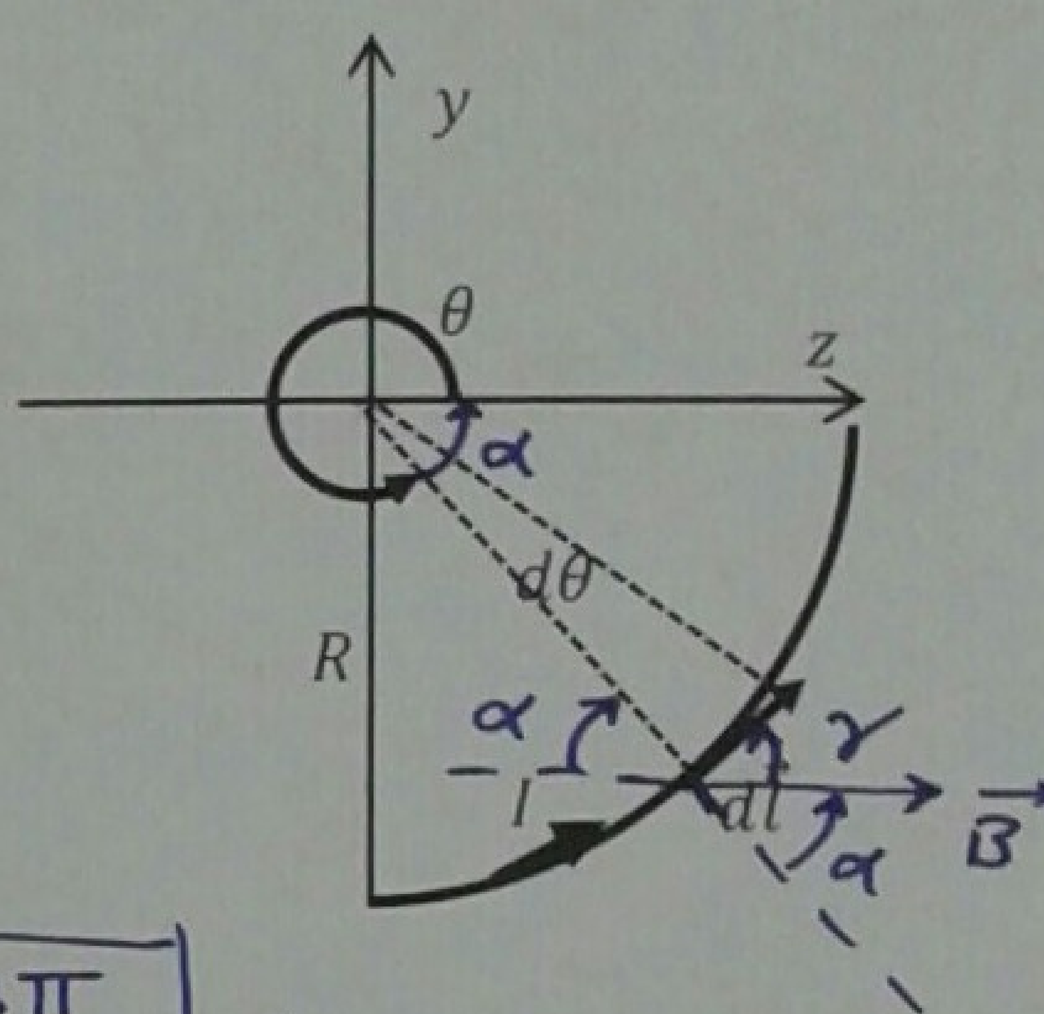
College of Arts and Sciences

Section Quiz November 13, 2015

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

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

The quarter circular arc segment of a wire with current I in counterclockwise direction is placed in a uniform magnetic field $\vec{B} = B\hat{z}$. The radius of arc is R. Using $d\vec{F} = Id\vec{l} \times \vec{B}$ and the polar coordinates, calculate the total force on the wire segment. Hint: First find the direction of $\vec{F}$ by the right hand rule. In finding the magnitude by the integral, express the angle between $d\vec{l}$ and $\vec{B}$ in terms of θ.



$\alpha = 2\pi - \theta$

$\gamma = \frac{\pi}{2} - \alpha = \frac{\pi}{2} - (2\pi - \theta) =$

$= \theta - \frac{3\pi}{2} \Rightarrow \boxed{\gamma = \theta - \frac{3\pi}{2}}$ //

Since $d\vec{F} = Id\vec{\ell} \times \vec{B}$

By the right hand rule the direction of $\vec{F}$ is perpendicular to the plane (into the plane) $\Rightarrow \otimes \vec{F}$

Also, $dF = I\,d\ell\,B\sin\gamma = I\,d\ell\,B\sin\left(\theta - \frac{3\pi}{2}\right) =$

$= -I\,d\ell\,B\sin\left(\frac{3\pi}{2} - \theta\right) = IB\,d\ell\cos\theta$ //

$\Rightarrow F = \int IB\,d\ell\cos\theta = IBR\int_{3\pi/2}^{2\pi}\cos\theta\,d\theta = IBR\sin\theta\Big|_{3\pi/2}^{2\pi} =$

$= IBR$ //

$\Rightarrow \boxed{F = IBR}$ //

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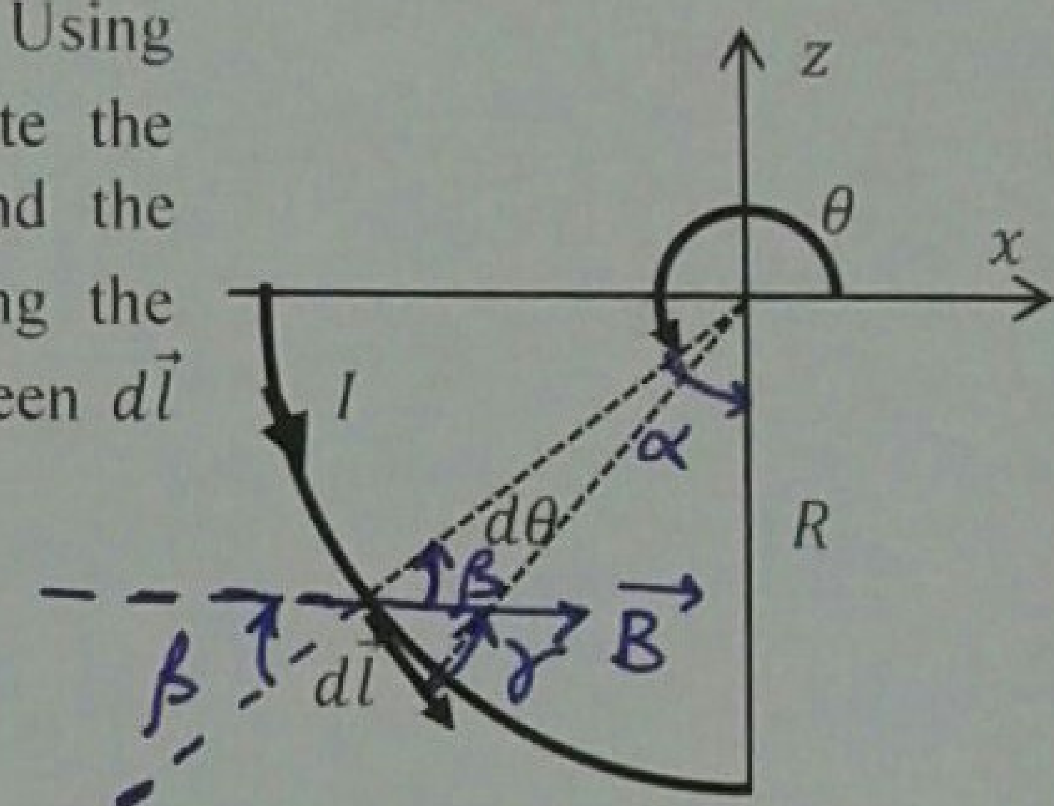
Name: **Student ID:** **Signature:**

The quarter circular arc segment of a wire with current $\boldsymbol{I}$ in counterclockwise direction is placed in a uniform magnetic field $\vec{B} = B\hat{x}$. The radius of arc is $\boldsymbol{R}$. Using $d\vec{F} = Id\vec{l} \times \vec{B}$ and the polar coordinates, calculate the total force on the wire segment. Hint: First find the direction of $\vec{F}$ by the right hand rule. In finding the magnitude by the integral, express the angle between $d\vec{l}$ and $\vec{B}$ in terms of θ.



$\alpha = \frac{3\pi}{2} - \theta$, $\beta = \frac{\pi}{2} - \alpha$

$\gamma = \frac{\pi}{2} - \beta = \frac{\pi}{2} - \left(\frac{\pi}{2} - \alpha\right) = \alpha = \frac{3\pi}{2} - \theta \Rightarrow \boxed{\gamma = \frac{3\pi}{2} - \theta}$

By the right hand rule the direction of $\vec{F}$ is perpendicular to the plane (out of the plane) $\Rightarrow \odot \vec{F}$

Also, $dF = I\,dl\,B \sin\gamma = I\,dl\,B \sin\left(\frac{3\pi}{2} - \theta\right) = -IB\,dl\cos\theta$.

$\Rightarrow F = \int -IB\,dl\cos\theta = -IBR\int_{\pi}^{3\pi/2} \cos\theta\, d\theta = -IBR\sin\theta\Big|_{\pi}^{2\pi} =$

$= IBR$ // $\Rightarrow \boxed{F = IBR}$ //

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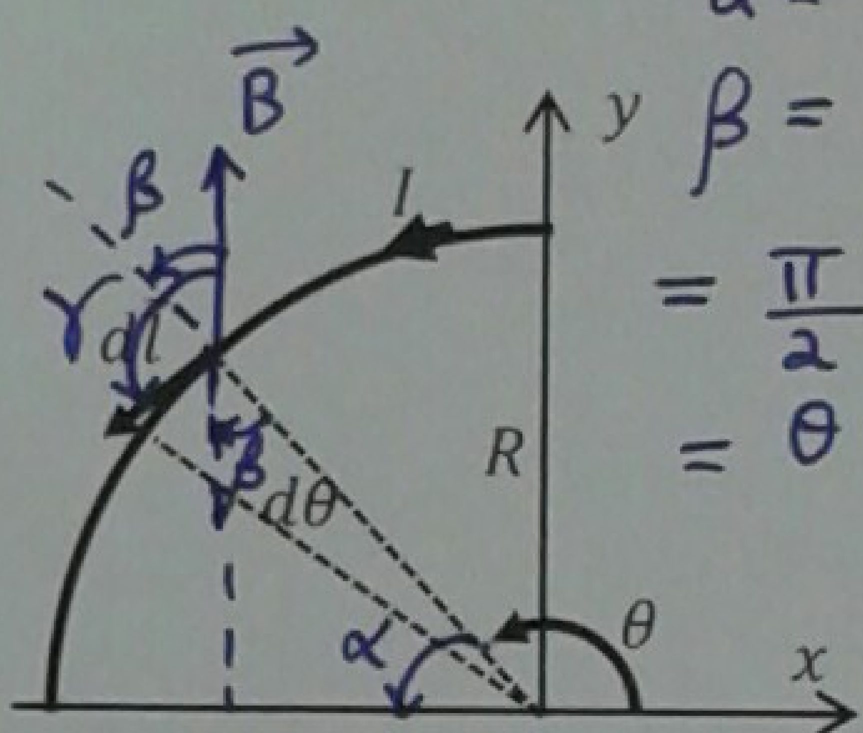
The quarter circular arc segment of a wire with current I in counterclockwise direction is placed in a uniform magnetic field $\vec{B} = B\hat{y}$. The radius of arc is $\boldsymbol{R}$. Using $d\vec{F} = Id\vec{l} \times \vec{B}$ and the polar coordinates, calculate the total force on the wire segment. Hint: First find the direction of $\vec{F}$ by the right hand rule. In finding the magnitude by the integral, express the angle between $d\vec{l}$ and $\vec{B}$ in terms of θ.



$\alpha = \pi - \theta$

$\beta = \frac{\pi}{2} - \beta =$

$= \frac{\pi}{2} - (\pi - \theta) =$

$= \theta - \frac{\pi}{2}$

$\gamma = \beta + \frac{\pi}{2} =$

$= \left(\theta - \frac{\pi}{2}\right) + \frac{\pi}{2} =$

$= \theta$,,

$\boxed{\gamma = \theta}$,,

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

By the right hand rule the direction of $\vec{F}$ is perpendicular to the plane (into the plane) $\Rightarrow \otimes \vec{F}$

Also, $dF = I\,dl\,B \sin\gamma = I\,dl\,B\sin\theta$

$\Rightarrow F = \int IB\sin\theta\, dl = IBR\int_{\pi/2}^{\pi} \sin\theta\, d\theta = IRR(-\cos\theta)\Big|_{\pi/2}^{\pi} =$

$= IBR$,,

where $dl = R\,d\theta$

$\Rightarrow \boxed{F = IBR}$,,