PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semester 2015**

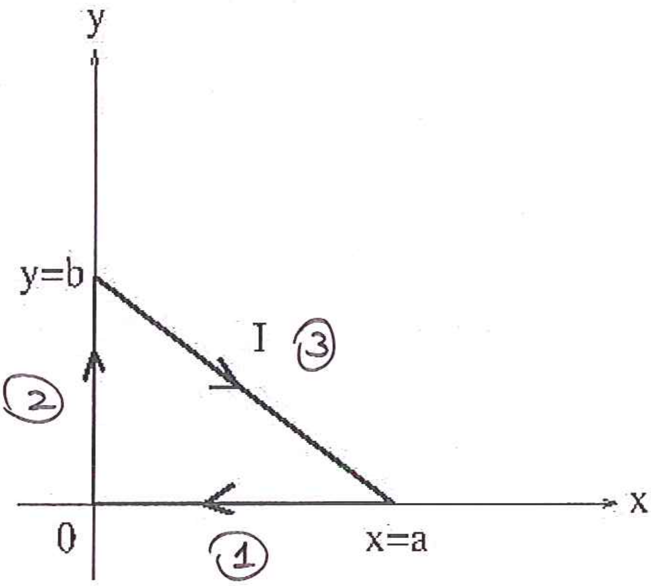
College of Sciences

Section 1 **Quiz 6** **02 April 2015**

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

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

If the current carrying loop shown in the figure is under a varying magnetic field given by $\vec{B} = B_0 xy\hat{j}$, calculate the total magnetic force on the loop.



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

Segment ①: $d\vec{l} = dx\hat{i}$ $\quad \vec{F}_1 = IB_0 \int dx\hat{i} \times (xy\hat{j})$

$y=0 \quad \vec{F}_1 = 0$

Segment ②: $d\vec{l} = dy\hat{j}$ $\quad \vec{F}_2 = IB_0 \int dy\hat{j} \times (xy\hat{j})$ $\quad \hat{j}\times\hat{j} = 0$

$\vec{F}_2 = 0$

Segment ③: $\frac{x}{a} + \frac{y}{b} = 1$ $\quad d\vec{l} = dx\hat{i} + dy\hat{j}$

$x = -\frac{a}{b}y + a$ $\quad d\vec{l} = (-\frac{a}{b}\hat{i} + \hat{j})dy$

$\vec{F}_3 = IB_0 \int (-\frac{a}{b}\hat{i} + \hat{j})dy \times (-\frac{a}{b}y^2 + ay)\hat{j}$

$= IB_0 \left[\frac{a^2}{b^2}\int_b^0 y^2 dy - \frac{a^2}{b}\int_b^0 y\, dy \right] \hat{k}$

$\vec{F}_3 = \frac{IB_0 a^2 b}{6} \hat{k}$

$\vec{F} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$

$\boxed{\vec{F} = \frac{IB_0 a^2 b}{6} \hat{k}}$

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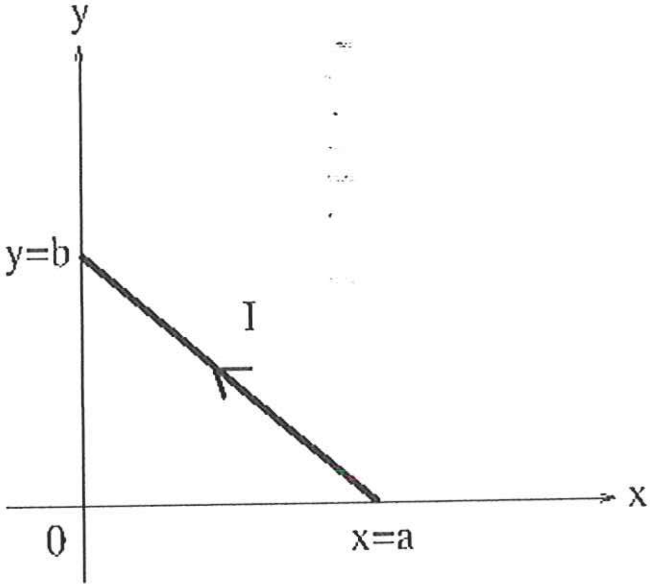
Section 2 **Quiz 6** **02 April 2015**

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

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

If the current carrying loop shown in the figure is under a varying magnetic field given by $\vec{B} = B_0(x\hat{i} + y\hat{j})$, calculate the total magnetic force.



$$\vec{F} = I \int d\vec{\ell} \times \vec{B}$$

$$\frac{x}{a} + \frac{y}{b} = 1 \qquad d\vec{\ell} = dx\,\hat{i} + dy\,\hat{j}$$

$$x = -\frac{a}{b} y + a \qquad d\vec{\ell} = \left(-\frac{a}{b}\hat{i} + \hat{j}\right) dy$$

$$\vec{F} = IB_0 \int \left(-\frac{a}{b}\hat{i} + \hat{j}\right) \times (x\hat{i} + y\hat{j})\, dy$$

$$= -IB_0 \left[\frac{a}{b}\int_0^b y\, dy - IB_0 \int_0^b \left(a - \frac{a}{b} y\right) dy\right] \hat{k}$$

$$\vec{F} = \left(-IB_0 \frac{ab}{2} - IB_0 ab + IB_0 \frac{ab}{2}\right) \hat{k}$$

$$\boxed{\vec{F} = -IB_0 ab\, \hat{k}}$$

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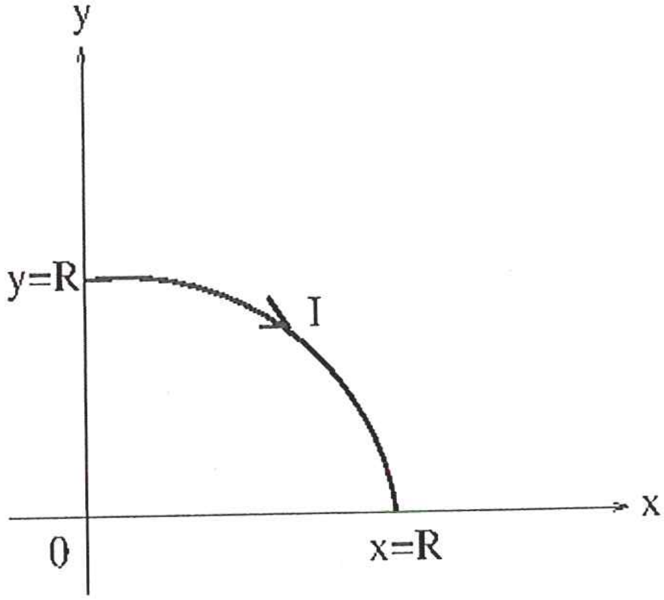
Section 3 **Quiz 6** **02 April 2015**

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

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

If the current carrying wire shown in the figure is under a varying magnetic field given by $\vec{B} = B_0 x\hat{j}$, calculate the total magnetic force.



$\vec{F} = I\int d\vec{l}\times\vec{B}$, $x = R\cos\theta$ $y = R\sin\theta$

$d\vec{l} = R\,d\theta\,(-\sin\theta\,\hat{i} + \cos\theta\,\hat{j})$

$d\vec{F} = I\,d\vec{l}\times\vec{B} = IR\,d\theta\,(-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}) \times (B_0(R\cos\theta))\hat{j}$

$= -IR^2B_0\,(\sin\theta\cos\theta\,\hat{k})\,d\theta$.

$\vec{F} = -\int_{\pi/2}^{0} IR^2B_0(\sin\theta\cos\theta)\,d\theta\,\hat{k} = -IR^2B_0\int u\,du = -IR^2B_0\left(\cos^2\theta\Big|_{\pi/2}^{0}\right)\hat{k}$

let $u = \sin\theta$
$du = \cos\theta\,d\theta$

$$\boxed{\vec{F} = \frac{IR^2B_0}{2}\hat{k}}$$

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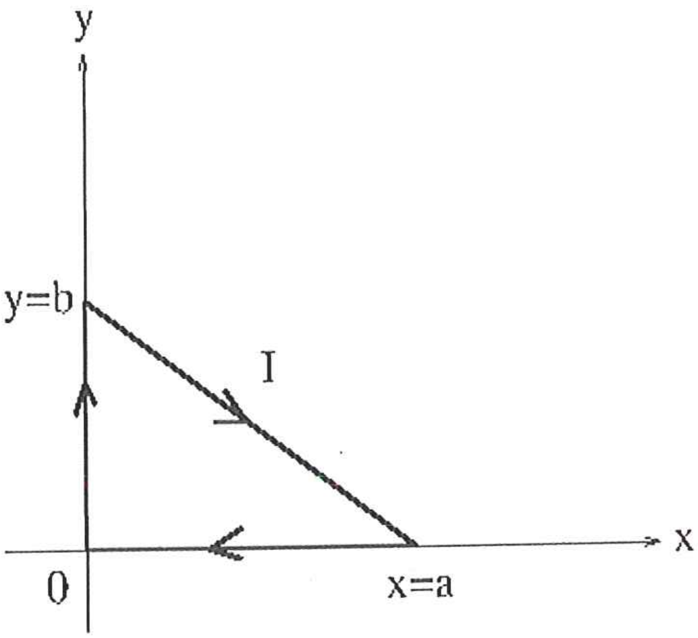
Section 4 Quiz 6 02 April 2015

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

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

If the current carrying loop shown in the figure is under a uniform magnetic field $\vec{B} = B_0(2\hat{i} - \hat{k})$, calculate the total torque caused by the magnetic force.



$\vec{\tau} = \vec{\mu} \times \vec{B}$, $\vec{\mu} = I\vec{A}$

$\vec{\mu} = I \frac{ab}{2} (-\hat{k})$

$\vec{\tau} = I \frac{ab}{2} (-\hat{k}) \times B_0 (2\hat{i} - \hat{k})$

$\boxed{\vec{\tau} = -IB_0 ab \hat{j}}$

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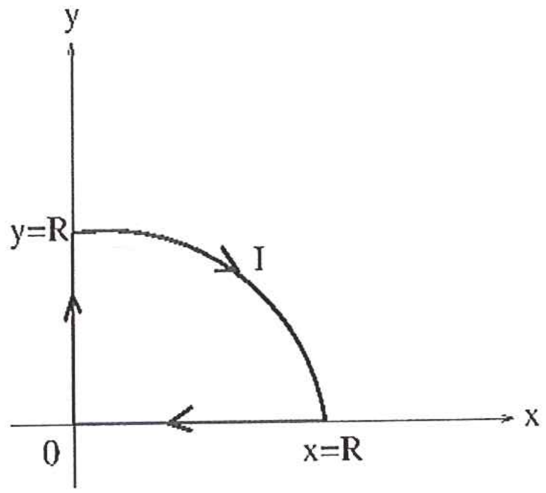
Section 5 Quiz 6 02 April 2015

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

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

If the current carrying loop shown in the figure is under a uniform magnetic field $\vec{B} = B_0(\hat{i} + \hat{j} + \hat{k})$, calculate the total torque caused by the magnetic force.



$\vec{\tau} = \vec{\mu} \times \vec{B}$, $\vec{\mu} = I\vec{A}$

$\vec{\mu} = I \frac{\pi R^2}{4} (-\hat{k})$

$\vec{\tau} = I \frac{\pi R^2}{4} (-\hat{k}) \times B_0 (\hat{i} + \hat{j} + \hat{k})$

$\boxed{\vec{\tau} = I B_0 \frac{\pi R^2}{4} (\hat{i} - \hat{j})}$