PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2016

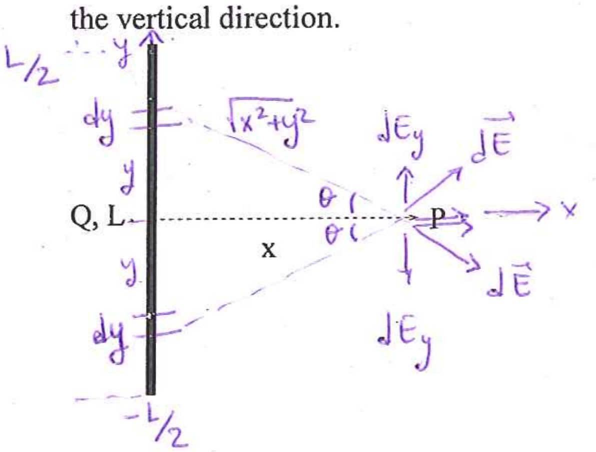
College of Sciences

Section 1 Quiz 1 11 February 2016

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

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

Find the electric field at point P due to the straight wire, where the total charge **Q** is uniformly distributed over the length **L**. The point **P** is symmetrically located (i.e., at the midpoint) in the vertical direction.



y- components of $d\vec{E}$ cancel each other.

$$\lambda = \frac{Q}{L}$$

$$dE = \frac{1}{4\pi\epsilon_0}\frac{dq}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{\lambda\, dy}{x^2+y^2}$$

$$dE_x = dE\cos\theta \qquad \cos\theta = \frac{x}{\sqrt{x^2+y^2}}$$

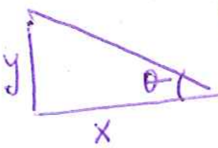
$$dE_x = \frac{1}{4\pi\epsilon_0}\frac{\lambda\, x\, dy}{(x^2+y^2)^{3/2}}$$

$$E_x = \int dE_x = \frac{\lambda}{4\pi\epsilon_0}\int_{-L/2}^{L/2}\frac{x\, dy}{(x^2+y^2)^{3/2}}$$

$$* \quad \boxed{\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{1}{x^2}\frac{y}{\sqrt{x^2+y^2}}}$$

$$E_x = \frac{1}{4\pi\epsilon_0}\frac{2\lambda}{x}\frac{(L/2)}{\sqrt{x^2+(L/2)^2}} \quad ((+x) \text{ direction})$$

*



$$y = x\tan\theta$$
$$dy = x\sec^2\theta\, d\theta$$

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \int \frac{x\sec^2\theta\, d\theta}{(x^2)^{3/2}(1+\tan^2\theta)^{3/2}} = \int \frac{x\sec^2\theta\, d\theta}{x^3\sec^3\theta}$$

$$= \frac{1}{x^2}\int \cos\theta\, d\theta = \frac{\sin\theta}{x^2}$$

$$= \frac{y}{x^2\sqrt{x^2+y^2}}$$

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Section 2 **Quiz 1** **11 February 2016**

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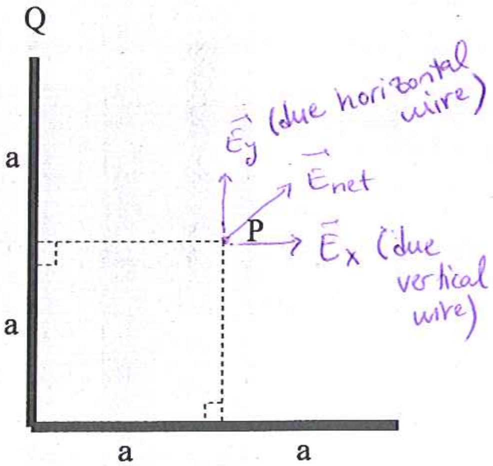
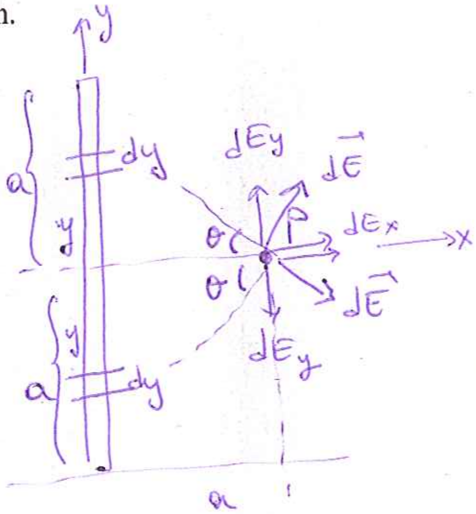
Quiz duration: 10 minutes

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

Find the electric field at point P due to the L-shaped straight wire, where the total charge **Q** is uniformly distributed over its total length.

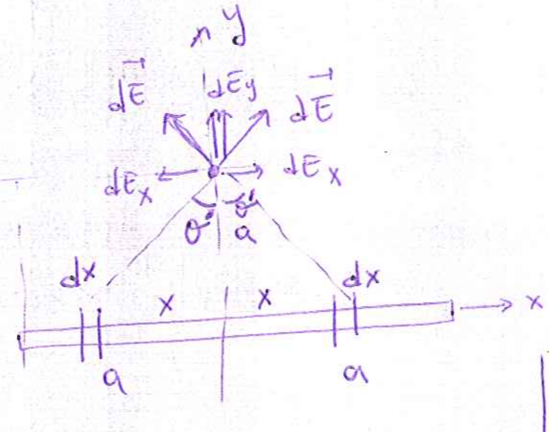




$\lambda = \dfrac{Q}{2a}$

$$E_x = \int dE_x = \int dE\cos\theta = \frac{\lambda x}{4\pi\epsilon_0}\int_{-a}^{a}\frac{dy}{(x^2+y^2)^{3/2}}$$

$$\boxed{E_x = \frac{1}{4\pi\epsilon_0}\,\frac{2\lambda}{x}\,\frac{a}{\sqrt{x^2+a^2}}}$$

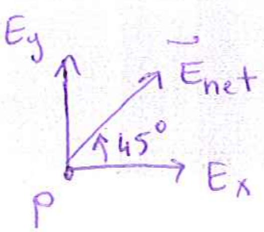


$$E_y = \int dE_y = \int dE\cos\theta' = \frac{\lambda y}{4\pi\epsilon_0}\int_{-a}^{a}\frac{dx}{(x^2+y^2)^{3/2}}$$

$$\boxed{E_y = \frac{1}{4\pi\epsilon_0}\,\frac{2\lambda}{y}\,\frac{a}{\sqrt{y^2+a^2}}}$$

$$x = a \rightarrow E_x = \frac{1}{4\pi\epsilon_0}\,\frac{\sqrt{2}\,\lambda}{a}$$

$$y = a \rightarrow E_y = \frac{1}{4\pi\epsilon_0}\,\frac{\sqrt{2}\,\lambda}{a}$$



$$|\vec{E}_{net}| = \sqrt{E_x^2 + E_y^2} = \frac{2\lambda}{4\pi\epsilon_0 a}$$

PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2016

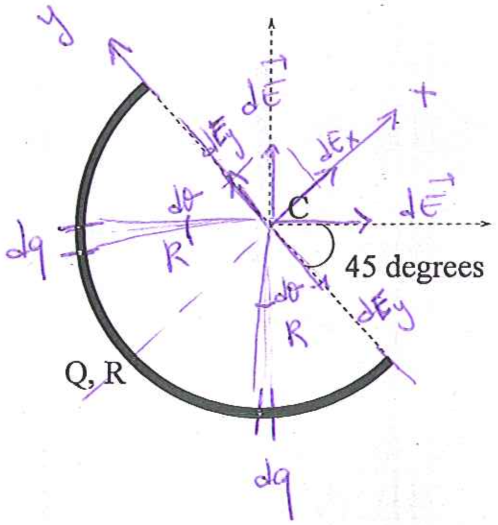
College of Sciences

Section 3 Quiz 1 11 February 2016

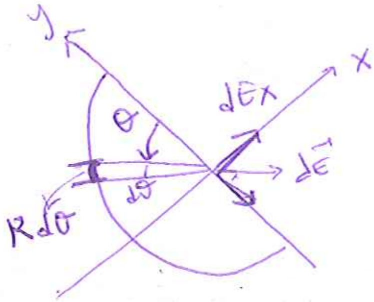
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

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

Find the electric field at point C due to the semi-ring-shaped wire, where the total charge **Q** is uniformly distributed over its length. Here, **R** is the radius of the ring.



dE_y's cancel each other.
$\vec{E}_{net}$ is along $+(x)$ axis.



$\lambda = \dfrac{Q}{\pi R}$

$$dE_x = dE \sin\theta$$
$$= \frac{1}{4\pi\epsilon_0}\frac{dq}{R^2}\sin\theta = \frac{1}{4\pi\epsilon_0}\frac{\lambda(R\,d\theta)}{R^2}\sin\theta = \frac{\lambda}{4\pi\epsilon_0 R}\sin\theta\,d\theta$$

$$E_x = \frac{\lambda}{4\pi\epsilon_0 R}\int_0^{\pi}\sin\theta\,d\theta = \frac{\lambda}{4\pi\epsilon_0 R}(-\cos\theta)\Big|_0^{\pi}$$
$$= \frac{\lambda}{4\pi\epsilon_0 R}(1-(-1)) = \frac{2\lambda}{4\pi\epsilon_0 R}$$

PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2016

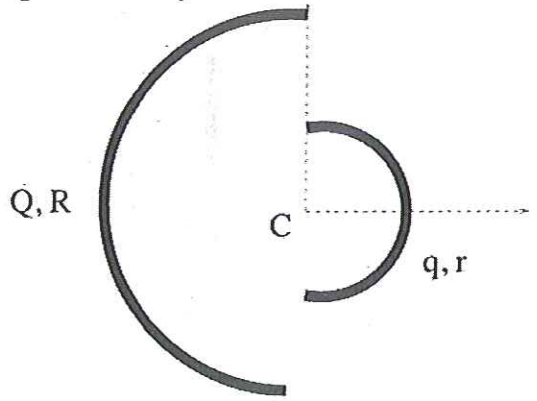
College of Sciences

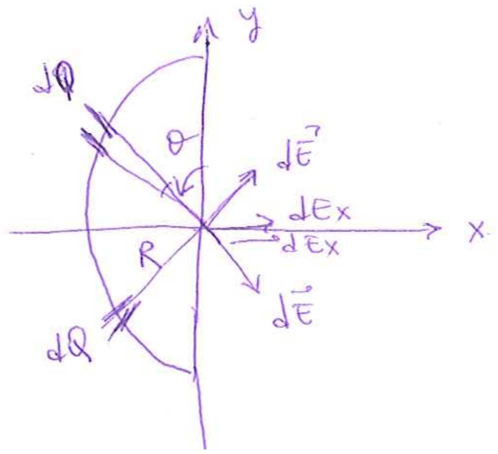
Section 4 Quiz 1 11 February 2016

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

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

Find the electric field at point C due to a combination of co-central semi-ring-shaped wires, where the charge **Q** is uniformly distributed over the bigger ring with radius **R** and the charge **q** is uniformly distributed over the smaller ring with radius **r**.





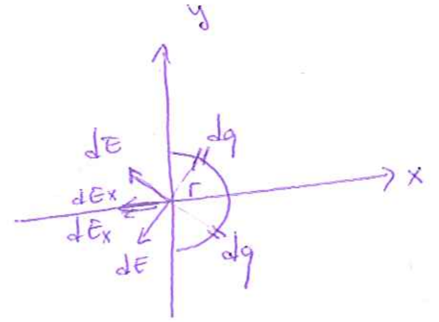
$$dE_{x\,(Q,R)} = \frac{1}{4\pi\epsilon_0}\frac{\lambda R\,d\theta}{R^2}\sin\theta$$

$$\vec{E}_{Q,R} = \frac{2\lambda}{4\pi\epsilon_0 R}\,\hat{\imath} \qquad \left(\lambda = \frac{Q}{\pi R}\right)$$

$$E_{x(Q,R)} = \frac{\lambda}{4\pi\epsilon_0 R}\int_0^{\pi}\sin\theta\,d\theta$$

$$= \frac{2\lambda}{4\pi\epsilon_0 R} \quad (+x \text{ direction})$$

Similarly;



$$\vec{E}_{q,r} = -\frac{2\lambda'}{4\pi\epsilon_0 R}\,\hat{\imath} \qquad \left(\lambda' = \frac{q}{\pi r}\right)$$

$\Rightarrow$ $\vec{E}_{net}$ is the superposition of $\vec{E}_{Q,R}$ and $\vec{E}_{q,r}$

$$\boxed{\begin{aligned}\vec{E}_{net} &= \vec{E}_{Q,R} + \vec{E}_{q,r} \\ &= \left(\frac{2Q}{4\pi^2\epsilon_0 R^2} - \frac{2q}{4\pi^2\epsilon_0 r^2}\right)\hat{\imath}\end{aligned}}$$