PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2015**

College of Sciences

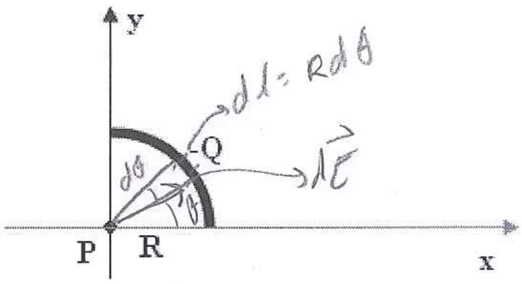
Section 1 **Quiz 1** **26 February 2015**

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

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

Negative electric charge –Q is distributed uniformly around a quarter of a circle of radius R.

What are the components of the electric field E at point P in terms of Q, ε_0 and R.



$$\lambda = Q\Big/\frac{2\pi R}{4} = \frac{2Q}{\pi R}$$

$$dE_x = dE\cos\theta$$

$$dE_y = dE\sin\theta$$

$$dE_x = \cos\theta \frac{1}{4\pi\varepsilon_0}\frac{\lambda R\, d\theta}{R^2}$$

$$\rightarrow E_x = \frac{\lambda}{4\pi\varepsilon_0 R}\int_0^{\pi/2}\cos\theta\, d\theta = \frac{\lambda}{4\pi\varepsilon_0 R} = \frac{Q}{2\pi^2\varepsilon_0 R^2}$$

$$E_y = \frac{\lambda}{4\pi\varepsilon_0 R}\int_0^{\pi/2}\sin\theta\, d\theta = \frac{\lambda}{4\pi\varepsilon_0 R}\cos\theta\Big|_0^{\pi/2} = \frac{Q}{2\pi^2\varepsilon_0 R^2}$$

$$\overline{E} = \frac{Q}{2\pi^2\varepsilon_0 R^2}(\hat{\imath} + \hat{\jmath})$$

PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2015**

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Section 2 **Quiz 1** **26 February 2015**

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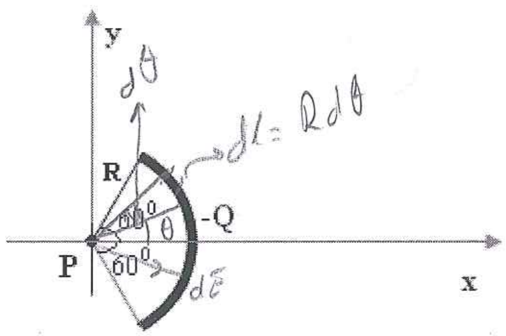
Quiz duration: 15 minutes

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

Negative electric charge –Q is distributed uniformly around a 120 degree circular arc of radius R. What are the components of the electric field E at point P in terms of Q, ε_0 and R.



$$\lambda = \frac{Q}{\frac{2\pi R}{3}} = \frac{3Q}{2\pi R}$$

$E_y = 0$ due to the symmetry

$$d\vec{E}_x = d\vec{E}\cos\theta \,, \quad d\vec{E}_x = \cos\theta \frac{1}{4\pi\varepsilon_0}\frac{\lambda R\, d\theta}{R^2}$$

$$E_x = \int_{-\pi/3}^{\pi/3} \frac{\lambda}{4\pi\varepsilon_0 R}\cos\theta\, d\theta = \frac{3\sqrt{3}\,Q}{8\pi^2 R^2 \varepsilon_0}$$

$$\vec{E} = \frac{3\sqrt{3}\,Q}{8\pi^2 R^2 \varepsilon_0}\,\hat{i}$$

PHYS 102:General PhysicsII KOÇ UNIVERSITY Spring Semester 2015

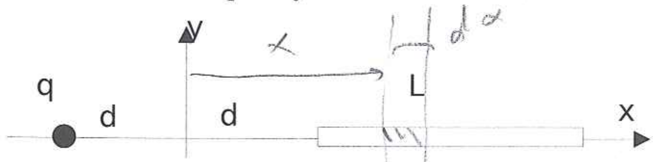
College of Sciences

Section 3 Quiz 1 26 February 2015

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

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

A wire of length L extends from $x=d$ to $x=d+L$. The wire has uniform charge density λ per unit length. Determine the sign and the magnitude of a point charge that must be placed to $x=-d$ such that the electric field at the origin is zero. Determine the magnitude of the point charge when the rod has infinite length in the +x direction. Put $\frac{1}{4\pi\varepsilon_0}=k$ in your calculations for simplicity.



Find $\vec{E}$ of the rod at the origin.

$$dE = \frac{1}{4\pi\varepsilon_0}\frac{\lambda\,dx}{x^2} \rightarrow E = \frac{\lambda}{4\pi\varepsilon_0}\int_d^{d+L}\frac{dx}{x^2} = \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{d}-\frac{1}{d+L}\right)$$

$$\vec{E} = \frac{\lambda}{4\pi\varepsilon_0}\left(\frac{1}{d}-\frac{1}{d+L}\right)(-\hat{i})$$

$\vec{E}$ due to a point charge at $x=-d$, $E_q = \frac{1}{4\pi\varepsilon_0}\frac{q}{d^2}$

point charge must be positive

$$\frac{1}{4\pi\varepsilon_0}\left(\frac{q}{d^2}-\frac{\lambda}{d}+\frac{\lambda}{d+L}\right)=0 \rightarrow q=\lambda d^2\left[\frac{1}{d}-\frac{1}{d+L}\right]$$

if rod has infinite length,

$$E_{rod} = \frac{\lambda}{4\pi\varepsilon_0}\int_d^{\infty}\frac{dx}{x^2} = \frac{\lambda}{4\pi\varepsilon_0 d} \qquad \vec{E}_{rod} = \frac{\lambda}{4\pi\varepsilon_0 d}(-\hat{i}). \qquad E_{rod}+E_q=0$$

$$\rightarrow \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{d^2}-\frac{\lambda}{d}\right)=0$$

PHYS 102:General PhysicsII **KOÇ UNIVERSITY** **Spring Semester 2015**

College of Sciences

Section 4 **Quiz 1** **26 February 2015**

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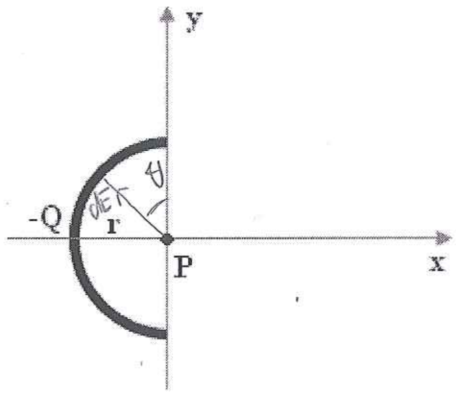
Quiz duration: 15 minutes

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

Negative electric charge –Q is distributed uniformly around a semicircle of radius r. Find the magnitude and direction of the electric field E at point P in terms of Q, ε_0 and r.



E_y cancel due to the symmetry $\Rightarrow \vec{E}_y = 0$.

$$\lambda = Q / \frac{2\pi R}{2} = \frac{Q}{\pi R}$$

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

$$E_x = \int_0^{\pi} \frac{\lambda}{4\pi\epsilon_0 R} \sin\theta \, d\theta = \frac{\lambda}{4\pi\epsilon_0 R} \cdot 2 = \frac{Q}{2\pi^2 \epsilon_0 r^2}$$

$$\vec{E} = \frac{Q}{2\pi^2 \epsilon_0 r^2} \hat{i}$$

PHYS 102:General PhysicsII   KOÇ UNIVERSITY   Spring Semester 2015

College of Sciences

Section 5   Quiz 1   26 February 2015

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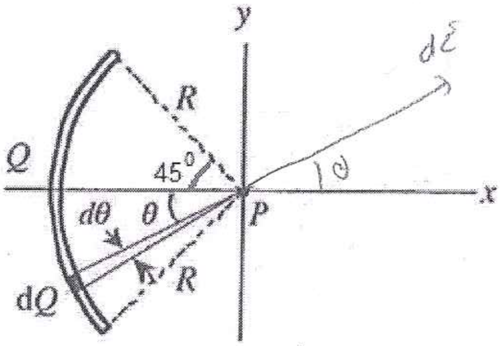
Quiz duration: 15 minutes

Name: Student ID: Signature:

A positive charge Q is uniformly distributed over a quarter circle of radius R. The charged quarter circle is located symmetrically relative to the x axis, as shown in the figure. The point P is at the origin and is the center of the quarter circle.

What are the components of the electric field at point P in terms of Q, ε_0 , R.

$\sin 45^0 = \cos 45^0 = \frac{\sqrt{2}}{2}$



E_y cancel due to the symmetry of the problem.

$\lambda = Q / \frac{2\pi R}{4} = \frac{2Q}{\pi R}$ $dS = R\,d\theta$

$dE_x = dE\cos\theta = \frac{1}{4\pi\varepsilon_0}\frac{R\lambda\,d\theta}{R^2}\cos\theta$

$E_x = \frac{\lambda}{4\pi\varepsilon_0 R}\int_{-\pi/4}^{\pi/4}\cos\theta\,d\theta = \frac{\sqrt{2}\,Q}{2\pi^2 R^2\varepsilon_0}$

$\vec{E}_x = \frac{\sqrt{2}\,Q}{2\pi^2 R^2 \varepsilon_0}$

We are integrating the electric field vector, not the arc