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

College of Sciences

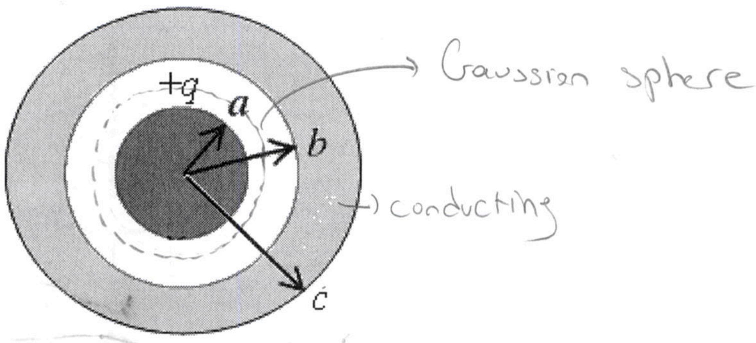
Section 1 **Quiz 2** **09 October 2015**

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

Name: Ongun ARISEV **Student ID:** oarisev14@ku.edu.tr **Signature:** Ongun

A solid conducting sphere carrying charge *q* has radius *a.* It is inside a concentric hollow conducting sphere with inner radius *b* and outer radius *c*. The hollow sphere has no net charge.

(a) Derive expressions for the electric field magnitude in terms of the distance *r* from the center fort he regions $r < a$, $a < r < b$, $b < r < c$, and $r > c$.
(b) Graph the magnitude of the electric field as a function of *r* from $r = 0$ to $r = 2c$.



(a)

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enclosed}}{\varepsilon_0} \quad \text{and} \quad \vec{E} = \vec{0} \text{ in conductors}$$

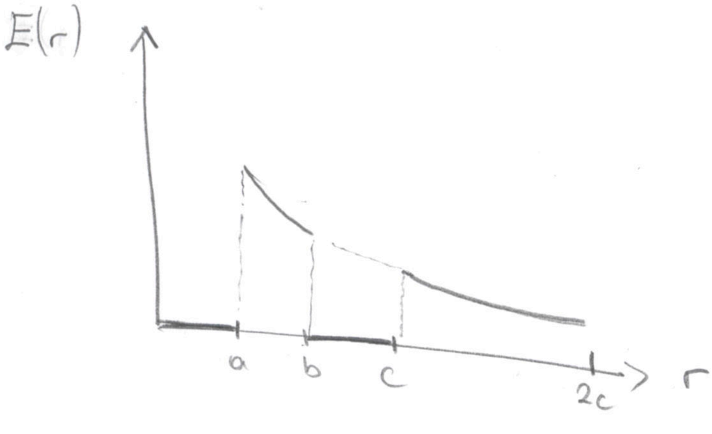
Therefore

$$E(r) = \begin{cases} 0 & r < a \quad \text{(conductor)} \\ \dfrac{q}{4\pi\varepsilon_0 r^2} & a < r < b \quad \left(4\pi r^2 E = \dfrac{q}{\varepsilon_0}\right) \\ 0 & b < r < c \quad \text{(conductor)} \\ \dfrac{q}{4\pi\varepsilon_0 r^2} & r > c \end{cases}$$

(E: spherically symmetric)

$Q_{enc} = +q$ as when $a < r < b$

(b)



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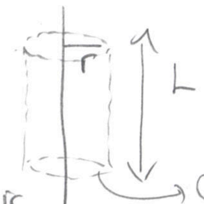
Name: **Student ID:** **Signature:**

A very long conducting tube (hollow cylinder) has inner radius *a* and outer radius *b*. It carries charge per unit length $+\alpha$, where α is the positive constant with units of C/m. A line of charge lies along the axis of the tube. The line of charge has charge per unit length +α.

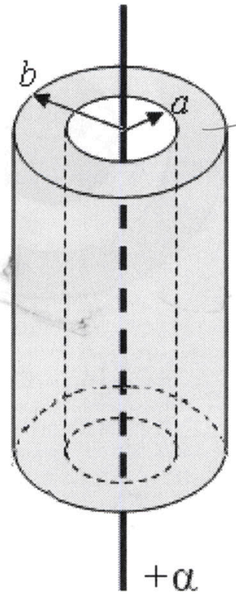
(a) Calculate the electric field in terms of α and the distance *r* from the axis of the tube for $r < a$, $a < r < b$ and $r > b$.

(b) Graph the electric field magnitude as a function of *r* in all the regions?

Gauss' Law for $r<a$



cylindrically symmetric → Gaussian cylinder

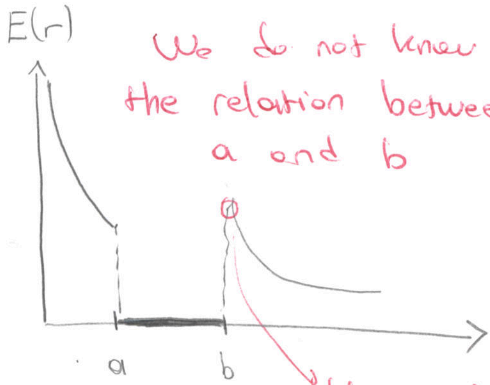


→ conducting

$$\oint \vec{E}\cdot d\vec{A} = E\,2\pi r L = \frac{Q_{enc}}{\varepsilon_0} = \frac{\alpha L}{\varepsilon_0} \quad (1)$$

$$E = \frac{\alpha}{2\pi r \varepsilon_0}$$

b)



We do not know the relation between a and b

Height of this point changes accord. b = 1.5a, b = 2a etc.

(a) Gauss' Law $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enc}}{\varepsilon_0}$

$$E(r) = \begin{cases} \dfrac{\alpha}{2\pi r \varepsilon_0} & r<a \quad Q_{enc} = \alpha L \\ 0 & a<r<b \quad \text{conductor} \\ \dfrac{\alpha}{\pi r \varepsilon_0} & r>b \quad Q_{enc} = 2\alpha L \end{cases}$$

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Section 3 | **Quiz 2** | **09 October 2015**

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Quiz duration: 10 minutes

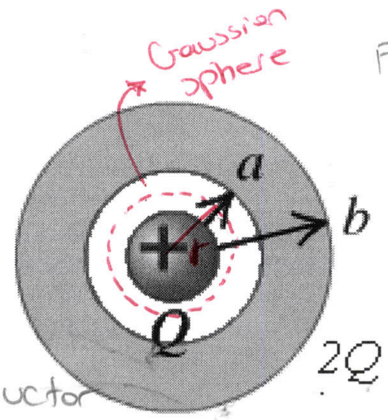
Name: | **Student ID:** | **Signature:**

A conducting spherical shell with inner radius a and outer radius b contains a total charge $2Q$ .A positive point charge Q is located at the center of the spherical shell.

(a) Derive the expression for the electric field magnitude as a function of the distance r from the center for the regions $r < a$, $a < r < b$, and $r > b$.
(b) Graph the electric field magnitude as a function of r.

Gauss' Law

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\varepsilon_0}$$



For the Gaussian sphere

$$\oint \vec{E} \cdot d\vec{A} = E\, 4\pi r^2 = \frac{Q}{\varepsilon_0}$$

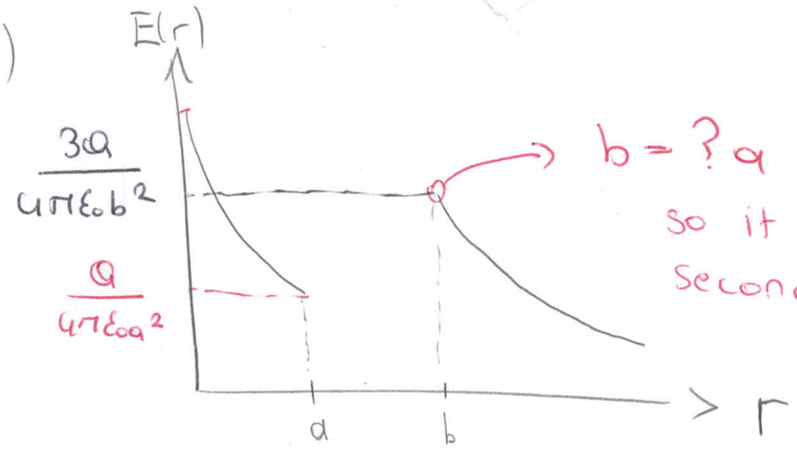
↓ spherically symmetric

E = 0 inside a conductor

a)

$$E(r) = \begin{cases} \dfrac{Q}{4\pi\varepsilon_0 r^2} & 0 < r < a \quad Q_{enc} = +Q \\ 0 & a < r < b \quad \text{(conductor)} \\ \dfrac{3Q}{4\pi\varepsilon_0 r^2} & r > b \quad Q_{enc} = +3Q \end{cases}$$

b)



b = ?a

so it is also possible that the second curve is below the first one