PHYS 102: General Physics 2 **KOÇ UNIVERSITY** **Spring Semestre 2010**

College of Arts and Sciences

Section 1 **Quiz 1** **4 March 2010**

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

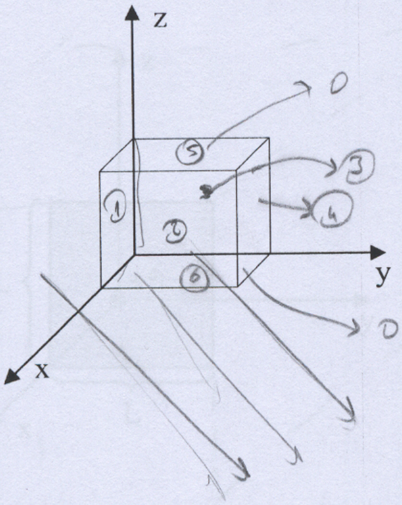
Name: **Student ID:** **Signature:**

A cube has sides of length L. It is placed with one corner at the origin as shown below. The electric field is uniform and given by $\vec{E} = -B\hat{\imath} + C\hat{\jmath}$, where B, and C are positive constants. Find the total outward electric flux through the surface of the cube as a function of L, B, and C.

$\Phi = \vec{E}\cdot\vec{A}$

$\vec{E} = -B\hat{i} + C\hat{j}$

$\vec{A} = A\hat{n}$



(1) $\vec{A}_1 = -L^2\hat{j}$

$\Phi_1 = \vec{E}\cdot\vec{A} = (-B\hat{i} + C\hat{j})\cdot(-L^2\hat{j}) = -CL^2$

(2) $\vec{A}_2 = L^2\hat{i}$

$\Phi_2 = (-B\hat{i} + C\hat{j})\cdot(L^2\hat{i}) = -BL^2$

(3) $\vec{A}_3 = -L^2\hat{i}$

$\Phi_3 = BL^2$

(4) $\vec{A}_4 = L^2\hat{j} \Rightarrow \Phi_4 = CL^2$

(5) $\vec{A}_5 = L^2\hat{k}$, $\vec{A}_6 = -L^2\hat{k} \Rightarrow \Phi_5 = \Phi_6 = 0$

$\Phi_{Total} = -CL^2 - BL^2 + BL^2 + CL^2 = 0$

Total electric flux through all sides is zero.

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Section 2 **Quiz 1** **4 March 2010**

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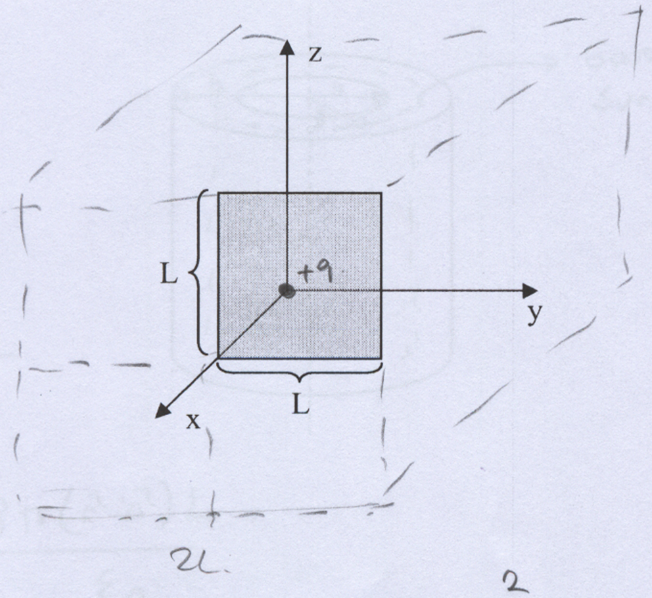
Quiz duration: 10 minutes

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

A flat, square surface with sides of length L (shown below) is described by the equations $x = L$, $0 \leq y \leq L$, and $0 \leq z \leq L$. Find the electric flux through the square due to a positive point charge q located at the origin as a function of q and ε_0. (Hint: Think of the square as part of a cube centered on the origin)



$A_{cube} = 6(2L)^2 = 24L^2$, $A_{square} = L^2 \Rightarrow A_{square} = \frac{A_{cube}}{24}$

for cube ; $\Phi_E = \oint \vec{E} d\vec{A} = E \cdot A_{cube} = \frac{q_{enc}}{\varepsilon_0} = \frac{q}{\varepsilon_0}$

for square; $\Phi_E = E \cdot A_{square} = \frac{q}{\varepsilon_0} \cdot \frac{1}{24} = \frac{q}{24\varepsilon_0}$

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Section 3 **Quiz 1** **4 March 2010**

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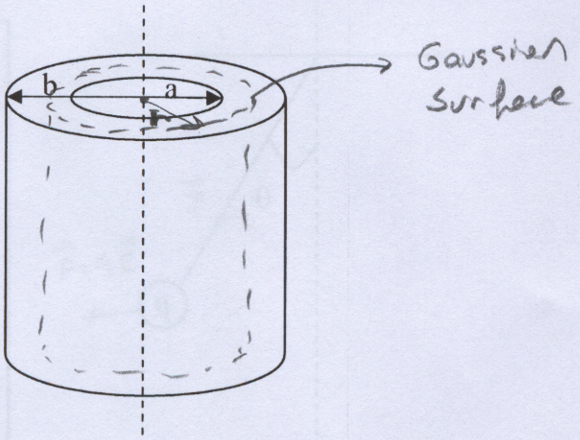
Quiz duration: 10 minutes

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

A very long hollow cylinder with inner radius a and outer radius b has positive charge uniformly distributed throughout it, with charge per unit volume ρ. Derive the expression for the electric field inside the volume at a distance r from the axis of the cylinder ($a < r < b$).



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

$$q_{enc} = \rho\pi(r^2-a^2)L$$

$$E\,2\pi rL = \frac{\rho\pi(r^2-a^2)L}{\varepsilon_0}$$

$$E = \frac{\rho}{2\varepsilon_0 r}(r^2-a^2), \quad \vec{E} = \frac{\rho}{2\varepsilon_0 r}(r^2-a^2)\,\hat{r}$$

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Section 4 **Quiz 1** **4 March 2010**

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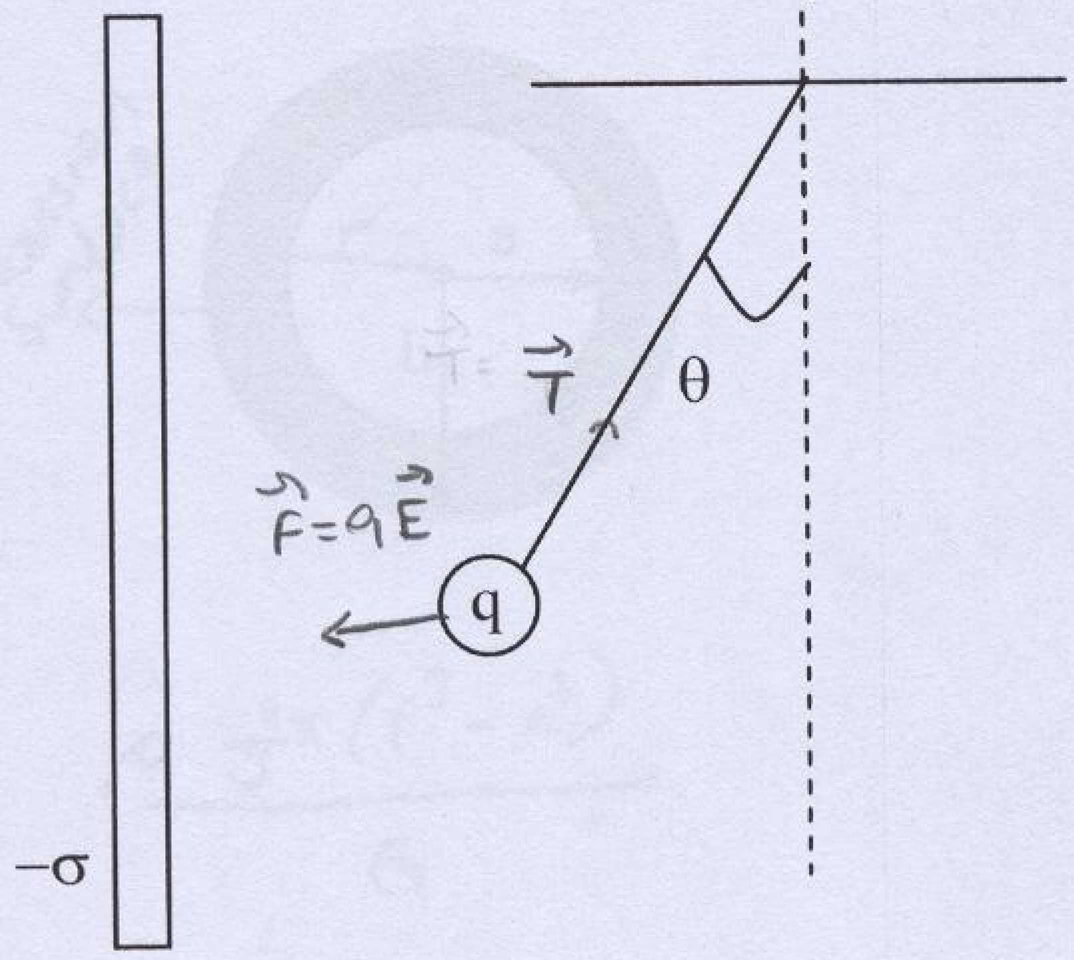
Quiz duration: 10 minutes

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

A small sphere with a mass m and carrying a cahrge q hangs from a thread near a very large, charged conducting sheet as shown below. The charge density on the sheet is $-\sigma$. Find the angle of the thread as a function of m, g, q, σ, and ε_0.



Forces act on the sphere are balanced;

$$\left.\begin{array}{l} qE = T.\sin\theta \\ mg = T.\cos\theta \end{array}\right\} \tan\theta = \frac{qE}{mg} \Rightarrow \theta = \arctan\left(\frac{qE}{mg}\right)$$

Electric field for a sheet of charge;

$$E = \frac{\sigma}{2\varepsilon_0} \Rightarrow \theta = \arctan\left(\frac{q\sigma}{2mg\varepsilon_0}\right)$$

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Section 5 **Quiz 1** **4 March 2010**

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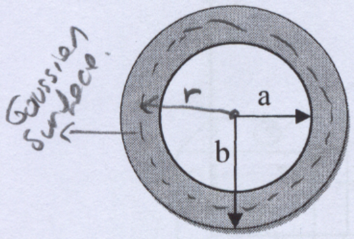
Quiz duration: 10 minutes

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

An insulating spherical shell with inner radius a and outer radius b has positive charge uniformly distributed throughout it, with charge per unit volume ρ. Derive the expression for the electric field inside the volume at a distance r from the center of the sphere ($a < r < b$).



$$\oint \vec{E}\, d\vec{A} = \frac{q}{\varepsilon_0}$$

$$q_{enc} = \rho \frac{4}{3}\pi (r^3 - a^3)$$

$$\Rightarrow \quad E\, 4\pi r^2 = \frac{\rho \frac{4}{3}\pi (r^3 - a^3)}{\varepsilon_0}$$

$$E = \frac{\rho}{3\varepsilon_0 r^2}(r^3 - a^3), \quad \vec{E} = \frac{\rho}{3\varepsilon_0 r^2}(r^3 - a^3)\,\hat{r}$$