Name: .... Section:.................

Physics 208 Quiz 4

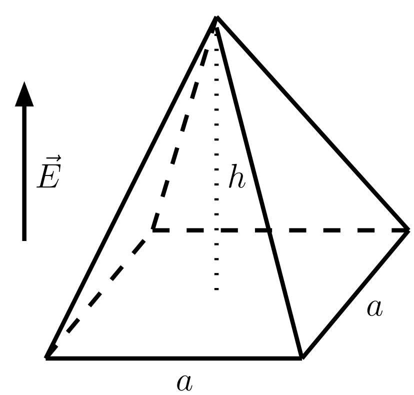
February 13, 2008 (due: February 20, 2008)

Problem 1 (20 points)

A circular loop with a diameter $d = 40$ cm is rotated in a uniform electric field until the position of maximal electric flux is found. The flux in this position is $\Phi = 5.2 \cdot 10^5$ Nm^2/C. What is the magnitude of the electric field?

Problem 2 (20 points)

A pyramid with horizontal square base, $a = 6$ m on each side, and a height, $h = 4$ m is placed in an upward vertical electric field of magnitude $E = 52$ N/C. Calculate the electric flux through the pyramids four slanted surfaces.



Hint: Think about the total flux through the pyramid first, before you do a lot of unnecessary work!

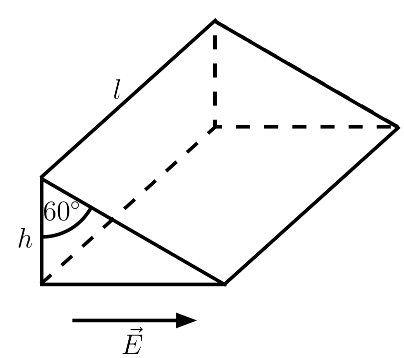
Problem 3 (30 points)

Consider a closed triangular box resting within a horizontal electric field $\vec{E} = 7.8 \cdot 10^4$ N/C$\vec{i}_y$ (see figure). Calculate the electric flux, Φ, through

(a) the vertical rectangular surface,

(b) the slanted surface,

(c) the entire surface of the box.



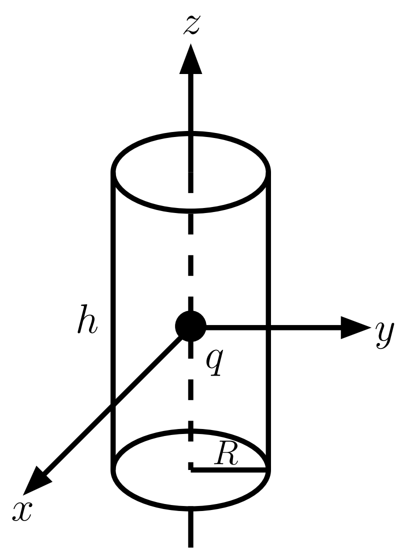
See next page!

Problem 4 (30 Points)

A charge, q, is located in the center of a coordinate system. What is the total electric flux of its electric field through the entire surface of a cylinder with its axis along the z-axis (reaching from $z = -h/2$ to $z = +h/2$ and radius $\rho = R$ (see figure)?

(a) Use Gauss's Law to find the answer!

(b) Do the integrals to verify it!



Hint: Use cylinder coordinates, (ρ, φ, z)! The following integrals are needed to solve the problem:

$$\int \mathrm{d}\rho \frac{\rho}{(\rho^2 + z^2)^{3/2}} = -\frac{1}{\sqrt{\rho^2 + z^2}},$$
$$\int \mathrm{d}z \frac{1}{(\rho^2 + z^2)^{3/2}} = \frac{z}{\rho^2 \sqrt{\rho^2 + z^2}}.$$