Name:

Physics 51
Homework #4
September 12, 2016

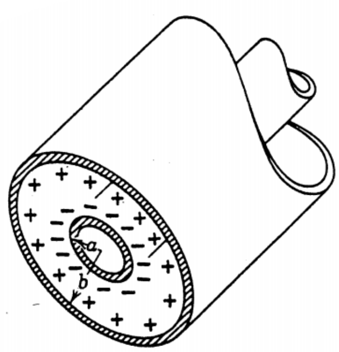
27-P8, 27-P16, 27-P17, SUP1*

27-P8 Figure 35 shows a section through two long thin concentric cylinders of radii a and b. The cylinders carry equal and opposite charges per unit length λ. Using Gauss' Law, prove

(a) that $E = 0$ for $r < a$ and

(b) that between the cylinders E is given by

$$E = \frac{1}{2\pi\epsilon_0}\frac{\lambda}{r}.$$



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27-P16 A plane slab of thickness d has a uniform volume charge density ρ. Find the magnitude of the electric field at all points in space both (a) inside and (b) outside the slab, in terms of x, the distance measured from the median plane of the slab.

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27-P17 A solid nonconducting sphere of radius R carries a nonuniform charge distribution, with charge density $\rho = \rho_s r/R$, where ρ_s is a constant and r is the distance from the center of the sphere. Show that

(a) the total cnharge on the sphere is $Q = \pi \rho_s R^3$ and

(b) the electric field inside the sphere is given by

$$E = \frac{1}{4\pi\epsilon_0} \frac{Q}{R^4} r^2.$$

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SUP1* A nonconducting hemispherical cup of inner radius R has a total charge q spread uniformly over its inner surface. Find the electric field at the center of curvature. (Hint: Consider the cucp as a stack of rings.)

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