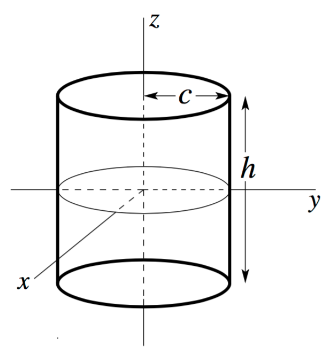
Name ____________________
Physics 51M Section ___ Box # _____
Problem Set 2
16 September 2019

Collaborators:

(10 points)

(a) A cylinder of total height h and cross- sectional radius c (as shown in the figure) carries a charge density per unit volume of $\rho = a\cos(z/h)r^2$. Find the units of a. Calculate the total charge inside this cylinder.

(b) Consider a sphere of radius R with charge density $\rho = \rho_0(r/R)^2$, where r is the radial coordinate measured from the center of the sphere. What are the units of ρ_0? Calculate the average charge density inside this sphere and compare it to ρ_0. Comment on your result.



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Problem 2 Sketch the electric field lines for the electric quadrupole configuration shown in Figure 26-27. Explicitly indicate any points where the field is zero.

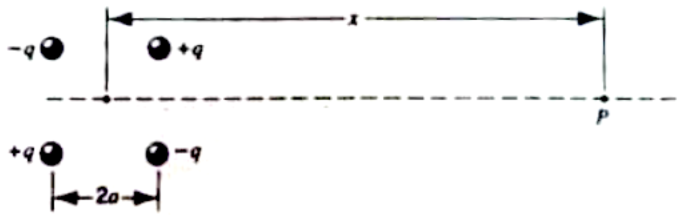

FIGURE 26-27. Exercise 11

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HRK E26.16 A thin glass rod is bent into a semicircle of radius r. A charge $+q$ is uniformly distributed along the upper half and a charge $-q$ is uniformly distributed along the lower half, as shown in Fig. 26-28. Find the electric field $\vec{\mathbf{E}}$ at P, the center of the semicircle.

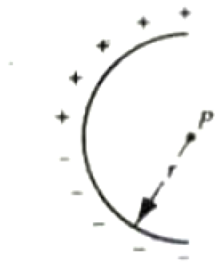

FIGURE 26-28. Exercise 16.

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HRK E26.18* An insulating rod of length L has charge $-q$ uniformly distributed along its length, as shown in Fig. 26-29.

(a) What is the linear charge density of the rod?

(b) Find the electric field at point P a distance a from the end of the rod.

(c) If P were very far from the rod compared to L, the rod would look like a point charge. Show that your answer to (b) reduces to the electric field of a point charge for $a \gg L$.

FIGURE 26-29. Exercise 18

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HRK E36.40 Figure 26-36 shows a Thomson atom model of helium $(Z = 2)$. Two electrons, at rest, are embedded inside a uniform sphere of positive charge $2e$. Find the distance d between the electrons so that the configuration is in static equilibrium.

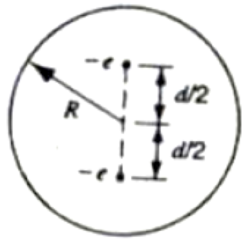

FIGURE 26-36. Exercise 40.

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HRK P26.7 A thin, non-conducting rod of finite length L carries a uniform linear charge density $+\lambda$ on the top half and a uniform charge density $-\lambda$ on the bottom half; compare to Fig 26-6.

(a) Use a symmetry argument to determine the electric field at P due to the rod.

(b) Find $\vec{\mathbf{E}}$ at P.

(c) Take the limit of this expression for large y. How does it depend on y? What does this remind you of?

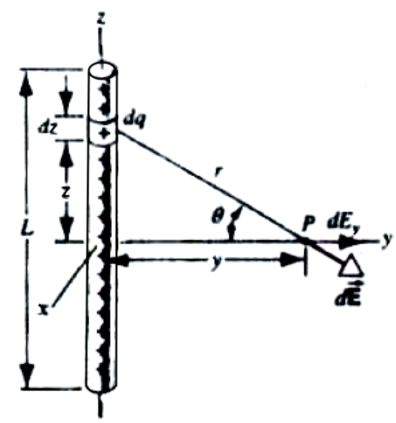

FIGURE 26-6. A uniformly charged rod. The electric field at point P is due to the total effect of all charge elements such as dq.

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