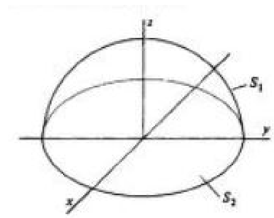
Name ____________________
Physics 51M Section ___ Box # _____
Problem Set 3
23 September 2019

**Collaborators:**

**Schey II-8** An electrostatic force field is given by $\vec{E} = \lambda(\vec{\mathbf{i}}yz + \vec{\mathbf{j}}xz + \vec{\mathbf{k}}xy)$, where $\lambda$ is a constant. Use Gauss' law to find the total charge enclosed by the surface shown in the figure consisting of $S_1$, the hemisphere $z = (R^2 - x^2 - y^2)^{\frac{1}{2}}$, and $S_2$, its circular base in the $xy$-plane.

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**Schey II-10** A solid nonconducting sphere of radius $R$ carries a nonuniform charge distribution, with charge density $\rho = \rho_s r/R$, where $\rho_s$ is a constant and $r$ is the distance from the center of the sphere, Show that a) the total charge on the sphere is $Q = \pi \rho_s R^3$ and b) the electric field inside the sphere is given by $E = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{R^4} \cdot r^2$.
c)Write down the electric field outside the sphere, r ¿ R. You do not need to derive your result, just explain how you know what it is.

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**HRK E27.11** A point charge $q$ is placed at one corner of a cube of edge $a$. What is the flux through each of the cube faces? (Hint: Use Gauss' law and symmetry arguments.)

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**HRK E26.40** 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.

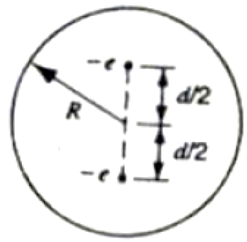


FIGURE 26-36. Exercise 40.

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**HRK P27.17** A solid nonconducting sphere of radius $R$ carries a nonuniform charge distribution, with charge density $\rho = \rho_s r/R$, where $\rho_s$ is a constant and $r$ is the distance from the center of the sphere. Show that

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

(b) the electric field inside the sphere is given by $E = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q}{R^4} \cdot r^2$.

(c) Write down the electric field outside the sphere, $r > R$. You do not need to derive your result, just explain how you know what it is.

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**HRK E27.25**
Charge is distributed uniformly throughout an infinitely long cylinder of radius $R$.

(a) Show that $E$ at a distance $r$ from the cylinder axis ($r < R$) is given by $E = \frac{\rho r}{2\epsilon_0}$, where $\rho$ is the volume charge density.

(b) What result do you obtain for $r > R$?

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