PHY114 S09 Problem Set 3

S. G. Rajeev

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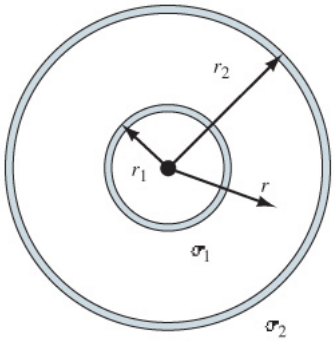
6 Problems Due Monday Feb 9 2008

1. (MCAT Problem) An electron has a mass of $9.1 \times 10^{-31} kg$ and a charge of $-1.6 \times 10^{-19} C$. In a fluorescent lamp, electrons encounter an electric field of 6000 Vm^{-1}. Find the approximate acceleration of an electron in one of these lamps.

2. A uniform electric field of magnitude 6.4 N/Cpasses through a circular disk of radius 14 cm. What is the electric flux through the disk when its face is perpendicular to the field lines?What is the electric flux through the disk when its face is at 45 degrees to the field lines?What is the electric flux through the disk when its face is parallel to the field lines?

3. A 20.0 cm long uniformly charged plastic rod is sealed inside a plastic bag. The total electric flux leaving the bag is 7.0×105 Nm^2C^{-1} . What is the linear charge density on the rod?

4. Two thin concentric spherical shells of radii r_1 and r_2 contain uniform surface charge densities σ_1 and σ_2 , respectively.Determine the electric field in each of the three regions $0 < r < r_1,\ r_1 < r < r_2,\ r_2 < r$. That is, inside the inner shell, in between the two shells and outside both shells.



Neglect the thickness of the shells.

5. A solid ball of radius R has a uniform charge density ρ. What is the electric field $E(r)$ at a distance r from the center of the ball when (i) $r < R$ and (ii) $r > R$? Express your answer in terms of ρ, r, R and ϵ_0.

6. A flat slab of nonconducting material carries a uniform charge ρ per unit volume. The slab has thickness d in the x direction which is small compared to the height and breadth of the slab in the y and z directions (z is out of the plane of the paper). We wish to find the electric field as a function of position, when the values of y and z are very far from the edges of the slab. In this case we can approximate the slab as being infinite in the y and z directions. Using this infinite slab approximation, (i) determine the electric field as a function of x inside the slab. Take the origin at the center of the slab; (ii) determine the electric field as a function of x outside the slab (at distances much less than the slab's height or breadth).