Physics 7b
Spring 2001
Midterm 2
R. Packard

Name:_____ SID_____

Discussion section number_____ Discussion GSI_____

Work all the problems. They are weighted equally. If you don't understand the question ask the proctor for clarification. Do not perform any numerical work until you have a "boxed" algebraic answer. Do a dimension check on you final answer.

$e=1.6\times10^{-19}C$, $m_e=9.1\times10^{-31}kg$, $N_A=6.02\times10^{23}$, $k_B=1.38\times10^{-23}JK^{-1}$, $\varepsilon_o=8.85\times10^{-12}$ $\int\frac{dr}{\sqrt{x^2+r^2}}=\ln\left(r+\sqrt{r^2+x^2}\right)$

1._____

2._____

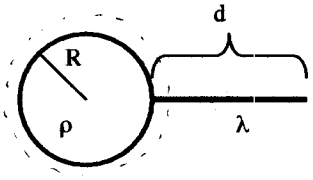
3._____

4._____

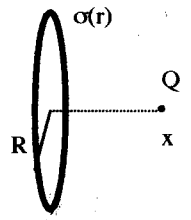
5._____

Total_____

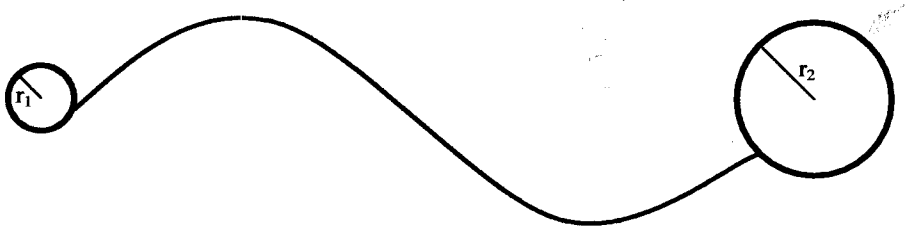
1. A uniformly charged solid sphere of radius R carrying volume charge density ρ is centered at the origin. Find the force on a uniform line charge having a total charge Q. The line is oriented radially with respect to the sphere with its ends at R and R+d.



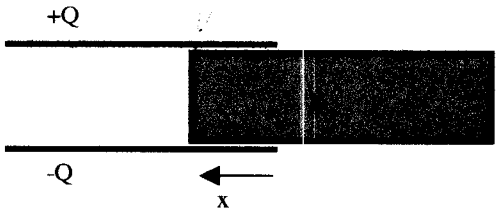
2. A disk of radius R carries a surface charge density $\sigma = \sigma_o \frac{R}{r}$. Find the work required to bring a charge Q from infinity to a point on the axis of the disk a distance x away. (Hint: the potential on the axis of a charged ring of radius r is $\frac{1}{4\pi\varepsilon_0}\frac{q}{\sqrt{x^2+r^2}}$)



3. Charge is placed on two conducting spheres that are very far apart but connected by a thin wire. The radius of the smaller sphere is r_1=5cm and the radius of the larger sphere is r_2=12cm. The electric field at the surface of the larger sphere is $2x10^5$V/m. Find the surface charge density on each sphere.



4. A parallel plate capacitor of area A and separation d is charged to potential V_o and is then disconnected from the charging source. A slab of material of dielectric constant $\kappa=2$, thickness d and area $\frac{1}{2}A$ is inserted between the plates. Find the new potential difference across the plates.



5. A battery of voltage V has an internal resistance R_{in}. The battery is connected to a heater coil of resistance R_L. Find the value of R_L that permits maximum power to be delivered to the heater.