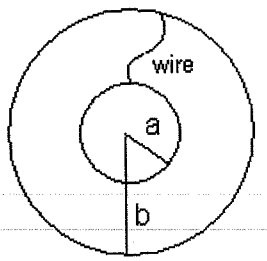
Physics 111 Homework Set #7

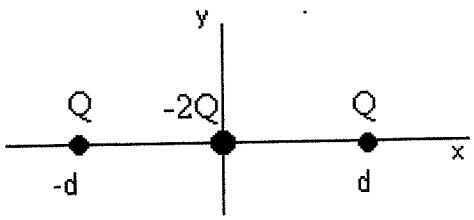
1) Through what potential difference would one need to accelerate an electron in order for it to achieve a velocity of 40% of he speed of light if it starts from rest? (Neglect relativistic effects.)
2) What potential difference is needed to stop an electron with an initial speed of $4.2\text{x}10^5$m/s.
3) Two parallel plates are separated by 0.30mm. If a 20V potential difference is maintained between those plates, calculate the E-field strength in the region between them.
4) At a distance r away form a point charge q, the potential V=900 V and E=150N/C. Determine both q and r.
5) The electrostatic potential due to a set of point charges is

$$V = \frac{36}{\sqrt{(x+1)^2 + y^2}} - \frac{45}{\sqrt{x^2 + (y-2)^2}}$$

where V is in volts. Determine the position and magnitude of the distribution.
6) In Rutherford's experiment that led to the planetary model of the atom, alpha particle (q=+2e, $m=6.6\text{x}10^{-27}$kg) were fired at gold nuclei (q=+79e). Ab alpha initially far from the nucleus is fired at $2\text{x}10^7$m/s directly at the gold. How close does the alpha particle get to the gold?
7) The Bohr model of H states that the electron can exist only in certain allowed orbits. The radius of each is $r=0.0529n^2$ nm. Calculate the electrostatic potential energy for n=1,2 and ∞.
8) If $V=(4xz - 5y + 3z^2)$ Volts, find the **E** and |**E**| at x=2m, y=-1m, z=3m.
9) A rod of length L lies along the x-axis with its left end at the origin and has a ***non-uniform*** linear charge density $\lambda=\alpha x$. (a) What are the units of α? (b) Calculate the electric potential at a point A, a distance d from the left end of the rod.
10) For the arrangement described in problem 9, calculate V at a point B on the perpendicular bisector of the rod a distance b above the rod.
11) Two thin concentric spherical shells of radii a and b are connected by a thin wire as shown. If a total charge Q is placed on the system, how much charge is on each sphere?



12) For the quadrapole charge distribution shown, (a) find the exact expression for the potential at a point on the x axis with x>d. If x>>d, show that $V \approx 2kQd^2/x^3$.



13) Use the exact result from problem 12 to find the E-field at any point along $x>d$. Evaluate E at $x=3d$ if $d=2mm$ and $Q=300\mu C$.

14) Consider two thin concentric conducting spheres. The inner sphere has a radius of 15 cm and a charge of $10\mu C$. The outer sphere has a radius of 30 cm and a charge of $-15\mu C$. Find (a) the electric field and (b) the electric potential in each region if $V=0$ at $r=\infty$.

15) The x-axis is the symmetry axis of a uniformly charged ring of radius R and charge Q. A point charge Q and mass M is located at the center of the ring. When displaced slightly, the point charge accelerates along the x-axis to infinity. Find the ultimate speed of the point charge.