Name : _____
Physics 4B/Exam 1
Winter 2003

MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL! NO CREDIT WILL BE GIVEN IF NO WORK IS SHOWN!!!

1. A point charge +2.0μC is at the origin and a second point charge -3.0μC is at x = 50 cm. (15 pt)
   a) Calculate the potential at x = -50 cm and x = 40 cm.
   b) Find the potential at a general point on the positive y-axis (take +y to be upward on your coordinate system).
   c) Using the result of (b) find the potential at y = 40 cm.
   d) Using the result of (b) find the electric field component along the y-axis.
   e) Determine E_y at y = 40 cm.

2. Consider the following 3-point charge distribution on figure 1 below. (15 pts)

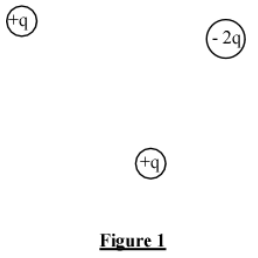


Figure 1

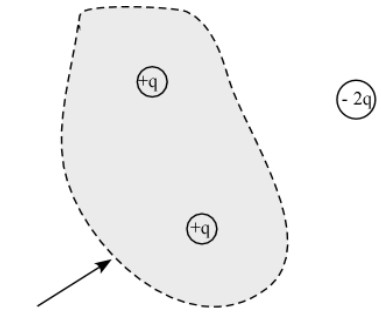


Figure 2

a) Draw the electric field line diagram associated with this charge distribution.

Consider Gauss's Law $\oint \vec{E} \bullet d\vec{A} = \frac{q_{enc}}{\varepsilon_o}$ and the Gaussian Surface shown on Figure 2.

b) In terms of the Gaussian surface shown **EXPLAIN** the meaning of the following terms:

   A. $\vec{E}$

   B. $d\vec{A}$

   C. q_{enc}

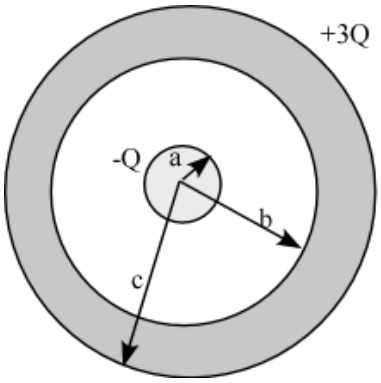
   D. $\frac{q_{enc}}{\varepsilon_o}$

c) Explain qualitatively/quantitatively the flux due to each point charge through the Gaussian Surface.

d) Find the net flux through the Gaussian Surface.

e) Can you determine the electric field $\vec{E}$ on the Gaussian Surface? If yes, what is it? If not, why can't you find it? **Explain your reasoning**.

3. A solid conducting sphere of radius 'a' and charge –Q is concentric with a spherical conducting shell of inner radius 'b' and outer radius 'c'. The net charge on the shell is +3Q. Take the zero of electric potential to be at some point at infinity. (15 pts)



a) Use Gauss's Law to find the charge on the inner and outer surface of the shell.
b) Use Gauss's Law to find the E-field at all points in space.
c) Use the superposition principle for potential to find the potential at all points in space.
d) Using the results of part (c) find the electric field between the sphere and the inner surface of shell.
e) Find the potential difference between the surface of the sphere and the inner surface of the shell. Which point is at a higher potential?
f) If a charge +q is released from rest at the inner surface of the shell, how fast will it be moving when it reaches the surface of the central sphere?

4. A long, straight power line is made from a wire with radius r_A = 1.0 cm and carries a line charge density λ = 2.6 μC/m. Assuming there are no other charges present, calculate the potential difference between the surface of the wire and the ground, a distance of r_B = 22 m below. (10 pts)