Physics 9C-A **Midterm Exam #1** **Winter, 2010**

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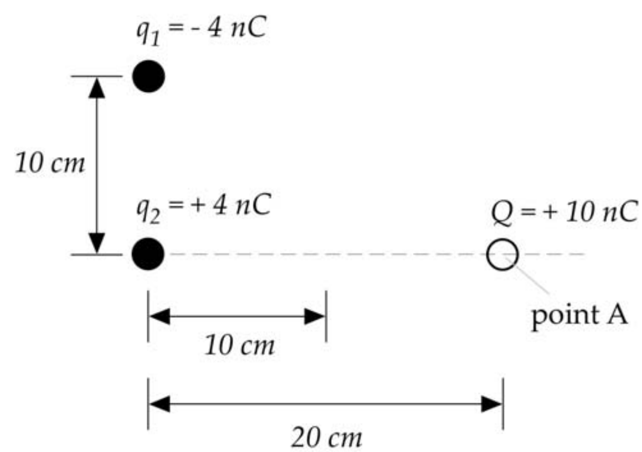
1. Three point charges, q_1, q_2, Q, are separated as shown below. The line connecting q_1 and q_2 is perpendicular to the line connecting q_2 and Q.

(a) (10 points) Find the magnitude and direction of the net electric force on Q. (Hint: choose a convenient coordinate system first).

(b) (10 points) Find the total work done by the electric forces from q_1 and q_2 on Q when Q is moved from its present location (A) to infinity.

(c) (10 points) Find the magnitude and direction of the net electric field produced by q_1 and Q at q_2.

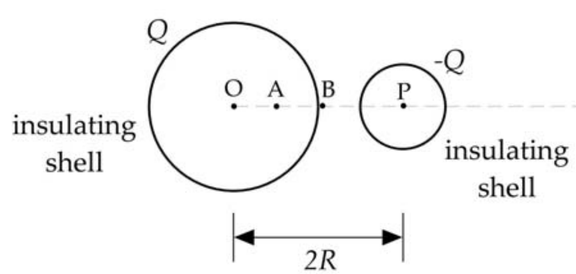


2. A thin, insulating, spherical shell with radius R is uniformly charged with Q. Another thin, insulating, spherical shell with smaller radius R/2 is uniformly charged with – Q. The centers of the shells are separated by 2R.

(a) (10 points) Find the total electric field at point A, (half way between O and the surface of the larger shell) and at point B (just outside the larger shell.)

(b) (10 points) Find the electric potential at point B relative to infinity.

(c) (10 points) Find the electric potential at point P relative to infinity.



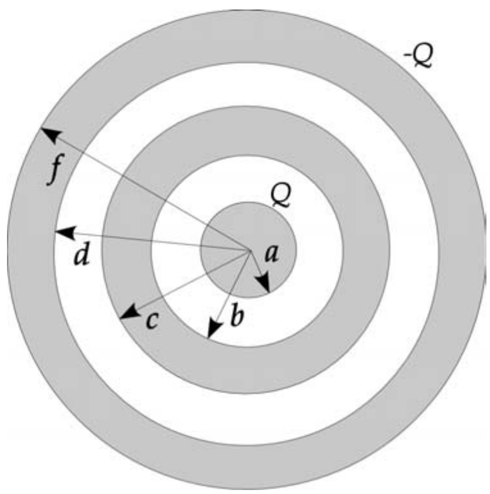
3. A solid conducting sphere of radius *a* carries a positive charge *Q*. It is enclosed by a thick conducting shell with inner radius *b* ($b > a$) and outer radius c that carries no *net* charge. A second thick conducting shell with inner radius *d* ($d > c$) and outer radius *f* encloses the first conducting shell and carries a net charge -Q.

(a) (10 points) Find the charge on *each* of the five surfaces.

(b) (10 points) Find the difference *between* the potential of the solid conducting sphere and the potential of the first (smaller) conducting shell.

(c) (10 points) Find the difference *between* the potential of the first conducting shell and potential of the second (larger) conducting shell.

(d) (10 points) Find the electric field *outside* the second conducting shell.



(Useful constant: $k = 1/4\pi\varepsilon_0 = 8.99\times10^{9}\ \mathrm{Nm^2/C^2}$).