Physics 9C-A **Midterm Exam #1** **Name:**

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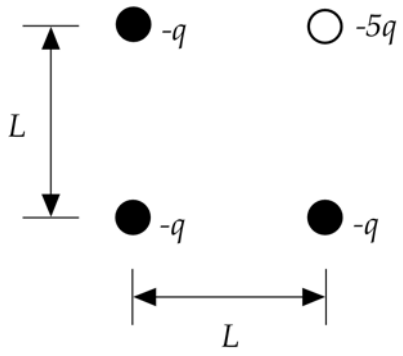
1. Three identical charges - q are placed at each of three corners of a square of side L.

(a) (10 points) Find the magnitude and the direction of the net electric force on a point charge $-5q$ placed at the vacant corner of the square.

(b) (10 points) Find the work done by the electric force to the point charge $-5q$ when it is moved from the center of the square to infinity.

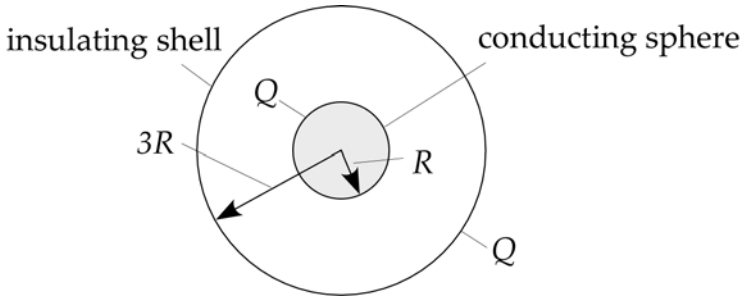


2. A solid conducting sphere with a radius R carries a positive charge Q. A very thin, insulating, concentric spherical shell of radius $3R$ also carries a positive charge Q that spreads uniformly over the shell.

(a) (10 points) Find the magnitude and the direction of the electric field inside the solid conducting sphere, i.e., $0 < r < R$;

(b) (10 points) Find the electric potential between the solid sphere and the thin shell, $R < r < 3R$, when the electric potential at infinity is chosen to be zero;

(c) (15 points) Find the electric potential energy of a positive point charge q placed at $r = 4R$, assuming that its potential energy at infinity is zero.



3. (20 points) Two stationary point charges + 3 nC and + 2nC are separated by a distance of 50 cm. An electron is released from rest at the point midway between the two point charges and moves along the line connecting the two charges. What is the speed of the electron when it is 10 cm away from the +3 nC charge?

(Constants: $e = 1.6\times10^{-19}$ C; $m_e = 9.1\times10^{-31}$ kg; $k = 1/4\pi\varepsilon_0 = 8.99\times10^{9}$ Nm^2/C^2)

4. Four infinitely large, uniformly charged sheets are stacked parallel to each other (with finite distances separating them) in the order of $\sigma_1 = \sigma > 0$ (on the top), $\sigma_2 = -0.8\sigma$, $\sigma_3 = 0.8\sigma$, and $\sigma_4 = -\sigma$ (at the bottom).

(a) (10 points) Find the direction and magnitude of the electric field at point **A** between the second and the third sheets, i.e., between σ_2 and σ_3.

(b) (15 points) Find the direction and magnitude of the electric field at point **B** between the third and the fourth sheets, i.e., σ_3 and σ_4.