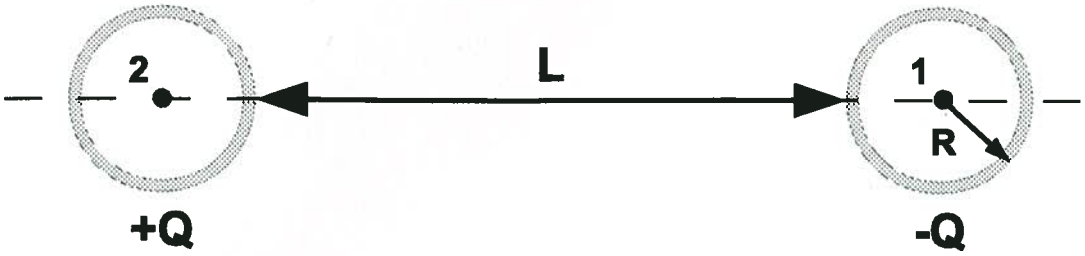
Physics 2212 Fall 2014 Lab Quiz #3

Name: Key Section: ∞

Show all work clearly and in order, and box your final answers.

A thin spherical glass shell of radius R carries a uniformly distributed charge +Q. An identical shell carries a uniformly distributed charge -Q. The distance between the center of each shell is $2R + L$ as indicated in the diagram.



1. (*100 points*) Calculate the potential difference $V_2 - V_1$ between the two shells. Be sure to show all of your work to earn partial credit.

$\Delta V = -\int_i^f \vec{E}\cdot d\vec{l}$ Note: ΔV should be >0

Clerical -5
Minor -15
Major -30
BTN -80

positive shell: $\vec{E}=0$ for $r<R$

$$\Delta V_+ = -\int \vec{E}_+\cdot d\vec{l}$$

$$= -\int_{2R+L}^{R} \frac{Q}{4\pi\epsilon_0 r^2}\,dr$$

$$= -\frac{Q}{4\pi\epsilon_0}\left[\frac{1}{2R+L} - \frac{1}{R}\right]$$

Negative Shell: $\vec{E}=0$ for $r<R$

$$\Delta V_- = -\int \vec{E}_-\cdot d\vec{l}$$

$$= +\int_{R}^{2R+L} \frac{Q}{4\pi\epsilon_0 r^2}\,dr$$

$$= \frac{Q}{4\pi\epsilon_0}\left[\frac{1}{R} - \frac{1}{2R+L}\right]$$

Using superposition:

$$\Delta V = \Delta V_+ + \Delta V_-$$

$$= \frac{-2Q}{4\pi\epsilon_0}\left[\frac{1}{2R+L} - \frac{1}{R}\right]$$

$$= \frac{-Q}{2\pi\epsilon_0}\left[\frac{1}{2R+L} - \frac{1}{R}\right] > 0$$

as anticipated!