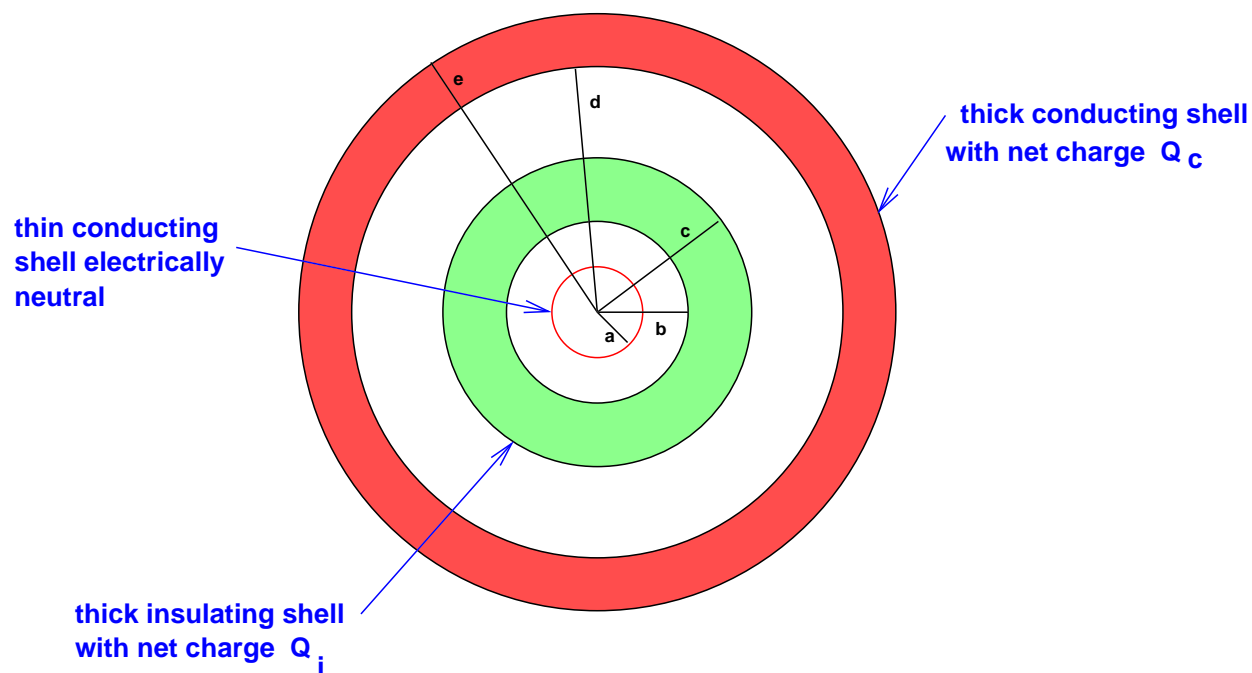


Physics 122: Practice Problem of the Day

Problem #11: Gauss' Law for two thick conducting shells.

Wednesday February 11, 2009



A configuration is constructed of three components as follows:

- A thin shell made of *perfectly conducting* electrically neutral material at radius a .
- A thick shell made of *perfectly insulating* material. The inner radius of the insulating shell is b , the outer radius of the insulating shell is c . Positive charge is *uniformly* deposited in the material of the insulating shell, and the net charge of the insulating shell is Q_i .
- A thick shell made of *perfectly conducting* material. The inner radius of the conducting shell is d , the outer radius of the conducting shell is e . The thick conducting shell has a net charge of Q_c .

Note that the all objects are held fixed and are *concentric*.

Part a) Use **Gauss' Law** to determine the electric field *everywhere*. Note that the five radii divide all space into six regions. Clearly indicate the value of the electric field for each of the six regions. Explain your work.

Part b) What is the *surface charge density* σ_a on the outer surface of the thin conducting shell, and also σ_d and σ_e on the inner and outer surfaces of the thick conducting shell, respectively? Explain your work. Hint: you *must* use **Gauss' Law** here.

Part c) What is the *electric potential* (voltage) at the *outer* surface of the insulating shell relative to the *inner* surface of the conducting shell? Explain how you determined this.

Part d) *Qualitatively* describe what would be the impact of fixing a *large* positive point charge in this system at a position corresponding to a short distance outside the conducting shell? Specifically, how would this change the electric field in each region? Explain.