Physics 1B Midterm 2 Supplementary Practice

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for Dr. Andrea Chaney's class

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Problem 1 Consider a spherically symmetric electric field in the 3-dimensional Euclidean space defined as:

$$E(r) = \begin{cases} E_0 \left(\dfrac{r}{a}\right)^2 \hat{r} & 0 \le r < a \\ 0 & a \le r < b \\ E_0 (r - b)(c - r)\hat{r} & b \le r < c \\ E_0 \left(\dfrac{c}{\sqrt{r - c}}\right) \hat{r} & c \le r < d \\ 0 & d \le r < e \\ E_0 \left(\dfrac{e}{2r}\right)^2 \hat{r} & r \ge e \end{cases}$$

a) Find the electric flux going through a sphere centered at the origin with radius e.

b) Calculate ϕ (the electric potential) everywhere in space.

Problem 2 Answer the following short answer questions.

a) Two conducting spheres of different radii are connected by a fine conducting wire. The spheres and wire together have a net positive charge. Do both spheres have the same amount of charge? If not, which one has less?

b) Let there be two concentric cubes, one of side length r and another of side length $3r$. Given that a point charge exists at the center of the cube, what fraction of the electric flux coming from one side of the smaller cube flows through a square-sized r by r section at the center of the directly adjacent side of the larger cube?