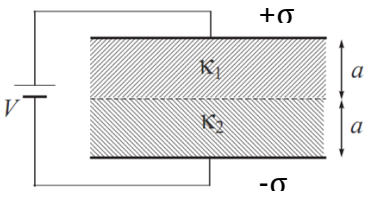
Homework #8 (100 points) - Show all work on the following problems:
(Grading rubric: Solid attempt = 50% credit, Correct approach but errors = 75% credit, Correct original solution = 100% credit, Copy of online solutions = 0% credit)

Problem 1 (30 points): Consider a thick spherical dielectric shell with inner radius a and outer radius b, with a polarization given by $\vec{P}(\vec{r}) = \frac{k}{r}\hat{r}$. Find the electric field for $r < a$, $a < r < b$, and $r > b$ by two different methods.

1a (20 points). Find the surface and volume bound charge densities, and use Gauss's law to calculate the electric field they produce in all three regions.
1b (10 points). Use Eq. 4.23 to find the electric displacement, and then find the electric field from Eq. 4.21.

Problem 2 (30 points): A parallel-plate capacitor is filled with two slabs of linear dielectric, each w/ thickness a. The top slab has a dielectric constant $k_1 = \varepsilon_{r1} = 2$, and the bottom has a dielectric constant $k_2 = \varepsilon_{r2} = 1.5$. There is free charge density $+\sigma$ on the top and $-\sigma$ on the bottom.



2a (5 points). Find the electric displacement in each slab.
2b (5 points). Find the electric field in each slab.
2c (5 points). Find the polarization in each slab.
2d (5 points). Find the electric potential difference V between the plates.
2d (5 points). Find the location and amount of all bound charge.
2f (5 points). Using the free and bound charge, calculate the electric field and verify your answer to 2b.

Problem 3 (40 points): An uncharged conducting sphere of radius a is surrounded by an insulating shell with dielectric constant ε_r that extends from radius a to radius b. This object is placed in a uniform external electric field $\overrightarrow{E_o}$. Utilize a separation of variables solution to find the electric potential and from this the resulting total electric field in the insulator ($a < r < b$).