Special Problem 5-3.5

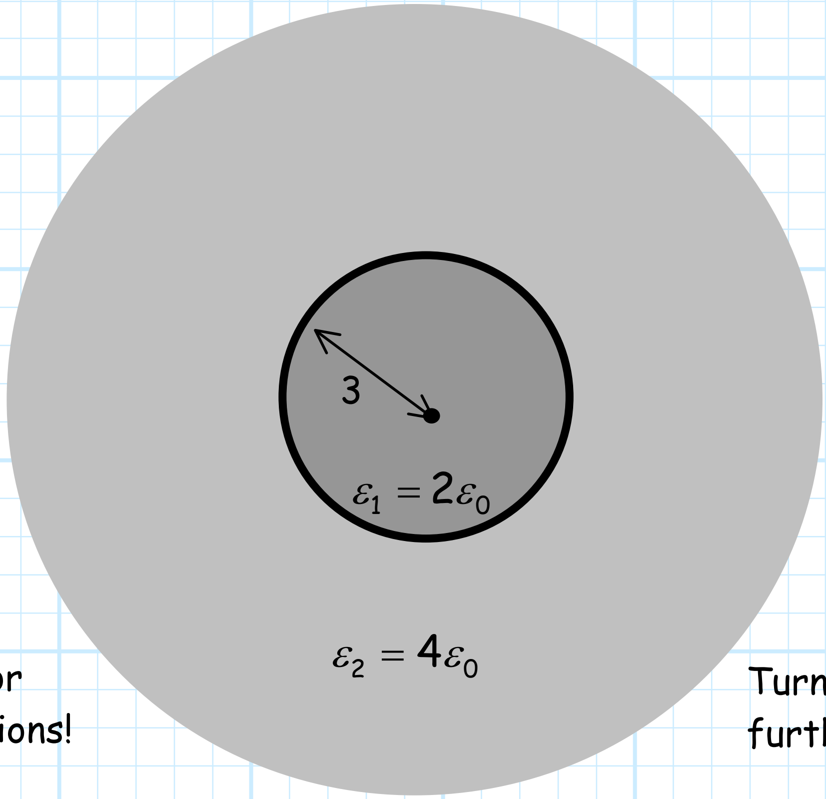
Shown below is the **cross-section** of a spherical structure that is centered at the origin. The center region (region 1) is a **sphere** made of material with $\varepsilon_r = 2$ and has a **radius** of **3 meters**. The electric field in region 1 is known to be (note it's a function of coordinate r!):

$$\mathbf{E}_1(\bar{r}) = \frac{r}{2\varepsilon_0}\,\hat{a}_r \quad \left[V/m\right]$$

Surrounding the sphere of region 1 is material with $\varepsilon_r = 4$. The electric field within this second region is known to have the form (note it's also a function of coordinate r!):

$$\mathbf{E}_2(\bar{r}) = \frac{\alpha}{12\varepsilon_0\, r^2}\,\hat{a}_r \quad \left[V/m\right]$$

where the value α is an unknown numerical **constant** (e.g., 12.4 or -37.6).



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In **region 1**, determine:

1) the **volume polarization charge density** within the inner sphere (i.e., $r < 3$).

For **region 2**, apply the electric **boundary conditions** at the material interface to determine:

2) the **electric field** $\mathbf{E}_2(\bar{r})$ (i.e., determine constant α).

3) the **electric flux density** $\mathbf{D}_2(\bar{r})$.