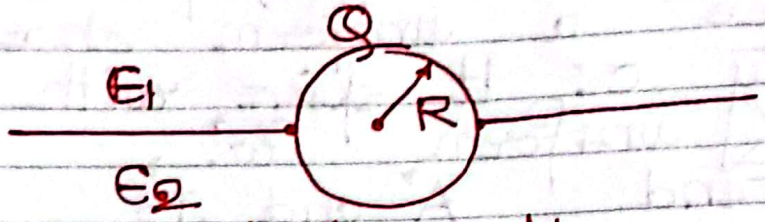
Assignment 5 (Total: 125).

1. A sphere of radius R and dielectric constant ϵ_r is placed in $\vec{E}_0 = E_0 \hat{e}_z$. Find $\varphi(\vec{r})$ and $\vec{E}(\vec{r})$ everywhere. [10 + 10 = 20]

2.

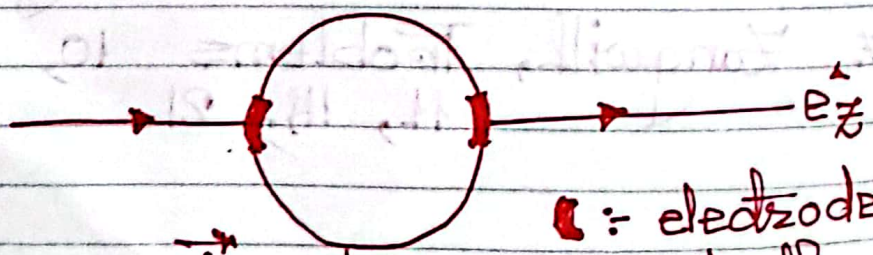


A conducting sphere of radius R has charge Q. Above the $z=0$ plane, there is a dielectric ϵ_1 & below, a dielectric ϵ_2.

(a) Find $\varphi(\vec{r})$ $\forall \vec{r}$ [10]

(b) Find $\rho_p(\vec{r})$, $\sigma_p(\vec{r})$. [10]

3. Zangwill, Problem 9.15 [20]



Assume $\vec{J}$ enters radially through the electrodes.

4. A uniform $\vec{J} = J\hat{e}_x$ flows in a slab of infinite extensions in the x & y directions. The width of the slab along z-axis is 2L. Find $\vec{B}$ everywhere. [5]

5. A spherical shell, of radius R, carries a uniform charge density σ. It spins with a uniform $\vec{\omega}$. Find $\vec{A}$ and $\vec{B}$ everywhere. [5+5]

6. You've a current-carrying wire at z-axis carrying I towards $+\hat{e}_z$. You want to define a ϕ_M s.t. $\vec{B} \propto \vec{\nabla}\phi_M$ everywhere @ $\vec{r} = 0$ i.e., everywhere except z-axis.

Take an Amperian loop circling the wire, and show that ϕ_M cannot be single-valued. [10]

7. Zangwill, Problems 10, 11, 18, 21. [4 × 10 = 40]