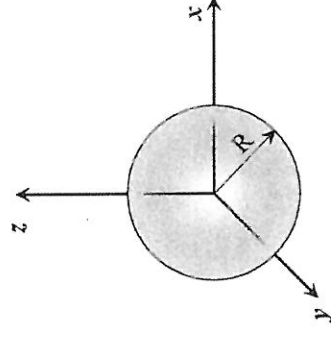


1. As shown in the figure below, a spherical static charge distribution has its center coincide with the origin of the coordinate system. The charge density $\rho(r)$ varies with the distance r from the center, and can be expressed with the following equations (ρ_0 is a constant) (25%):

$$\begin{cases} \rho(r) = \rho_0 \frac{r}{R}, & r \leq R \\ \rho(r) = 0, & r > R \end{cases}$$



- (A) (15 pts) Determine the \mathbf{E} -field of the system for $0 \leq r \leq \infty$.
 (B) (10 pts) Given the electric potential at $V(r = \infty) = 0$, determine the electric potential distribution of the system $V(r)$ for $0 \leq r \leq \infty$.
2. (A) As shown in Fig. (A) below, an infinitely long cylindrical conductor carries a uniform current in $+z$ -direction with current density \mathbf{J} . The axis of the cylinder coincides with the z -axis and its radius is \mathbf{R} . Determine the direction and magnitude of the \mathbf{B} -field of the system on the x -axis for $0 \leq x \leq \infty$. (15 %)
 (B) As shown in Fig. (B) below, now a hollow cylindrical conductor with inner radius $2\mathbf{R}$ and outer radius $3\mathbf{R}$ is added to the system with the axis of symmetry also coincides with the z -axis. If the outer conductor carries a uniform current with density $-\mathbf{J}$, determine the direction and magnitude of the \mathbf{B} -field of the system on the x -axis for $0 \leq x \leq \infty$. (10 %)

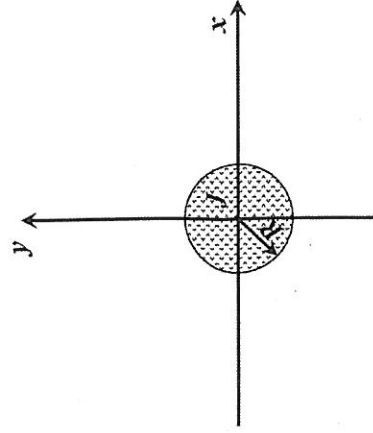


Fig. (A)

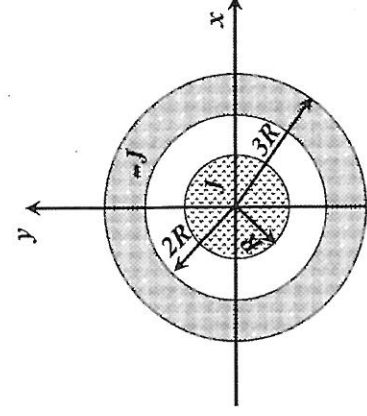


Fig. (B)

3. The four Maxwell's equations, together with the equation of continuity and Lorentz's force equation, form the foundation of electromagnetic theory. Please derive the two divergence equations from the two curl equations and the equation of continuity. (20%)
4. Please describe the physical meaning of the curl of the electrical field vector $\vec{\mathbf{E}}$, and define $\vec{\mathbf{E}}$ to be conservative or non-conservative in the light of this meaning. (10%)
5. Please describe the polarization of light and what the linearly polarized light is. (10%)
6. A parallel-polarized wave is incident from air onto a dielectric with $\epsilon_r = 4$.
- Find the standing wave ratio for a normal incidence. (5%)
 - Find the Brewster angle for the complete transmission. (5%)