**Instructions:** No books or notes allowed. Do not talk to, give help to or receive help from anyone.

\[ d\vec{E} = \frac{k dq}{r^2} \hat{r} \]

\[ \oint \vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_0} \]

\[ \nabla \cdot \vec{B} = 0 \]

\[ \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \]

1. **[25 points]** A spherical ball of radius \( a \) with uniform charge per unit volume \( \rho \) is surrounded by a concentric spherical shell of radius \( b \) having total charge \( Q \) on it. Find the electric field at all points in space. Your answer should be in terms of \( a, b, \varepsilon_0, Q, \rho, \) and \( r \). (Hint: the volume of a sphere or radius \( r \) is \( \frac{4}{3} \pi r^3 \) and its surface area is \( 4\pi r^2 \).) Show all your work.

**Answer:** For \( r < a \), \[ \vec{E} = \text{_________________________} \hat{r} \]

For \( a < r < b \), \[ \vec{E} = \text{_________________________} \hat{r} \]

For \( r > b \), \[ \vec{E} = \text{_________________________} \hat{r} \]