Homework # 14: Gauss's Law.

Textbook problems to solve

28.39, 28.48, 28.53 (4 points each) (***EXPLAIN ALL YOUR STEPS***! *Answers that do not have explanations will get only half the credit)*

Additional problem: (12 points)

1. An infinite non-conducting cylinder of radius *a* has a linear charge density of λ and a volume charge density that depends on radius according to the relation: $\rho(r) = \rho_o r$, and is surrounded by a conducting cylinder of inner radius *b* and outer radius *c* carrying a net charge or -2 λ.
    a. Using gauss' law: $\int \boldsymbol{E}.\boldsymbol{da} = Q_{in}/\epsilon_o$, find the electric field everywhere (i.e., in the regions *0 < r < a, a < r < b, b < r < c, r > c.*). Explain all your steps that you use to simplify the left hand side of gauss' law for the case *0 < r < a.* Explain all the steps used in simplifying the right side of gauss' law in all four cases. (*hint: use* $Q_{in} = \int \rho dV$*, for* spatially varying densities. Express *dV* in the context of a cylinder).
    b. Consider a length L of the inner non-conducting cylinder. The cylinder should have the same charge whether you consider *Q*= λL or $Q = \int \rho dV$. Derive a relationship between the linear charge density λ and ρ_o.
    c. Draw a graph of *E vs r*. Explain the dependence on radius. Make sure to label all important points on your graph. Verify that you get the same electric field at *a* whether you use the expression for *0 < r < a or a < r < b.(*Use the relationship between λ and ρ_o derived in part b for showing this).
    d. Find the linear charge density and the surface charge density on the inner and outer surfaces of the cylinder in terms of λ. (Explain all your steps)