2. A pulsed beam of charged particles is shot into a finite electrically isolated plate of ohmic conductance σ and dielectric coefficient ε. At the end of the pulse (at time $t = 0$) the charge per unit volume in the plate is non-uniform and given at $\mathbf{r}$ by $\rho_0(\mathbf{r})$, where the position vector $\mathbf{r}$ specifies points inside the plate. You may neglect any magnetic fields in the plate.

   a) Show that the final state of static equilibrium is one in which the charge is deposited only on the surface of the plate.

   b) Find the equation governing the charge distribution $\rho_0(\mathbf{r})$ for $t > 0$ as the system approaches static equilibrium.

   c) Solve this equation and show that the interior charge moves to the surface with a characteristic time constant τ. Determine the expression for τ.