Collapsing Bubble

Consider an incompressible fluid of density ρ, at pressure P_0, with a bubble of radius R inside, with no internal pressure. At time $t = 0$, the bubble pops, and fluid can rush in. Let $R(t)$ denote the radius of the bubble as a function of time.

(a) Begin by using mass conservation to find completely the velocity field, up to an undetermined function of time.

(b) Then, use the Navier-Stokes equation, and find a first order differential equation in R for $\dot{R}^2$.

(c) Show that by integrating this equation, and then integrating further the equation for $\dot{R}(R)$, that the time it takes for the bubble to collapse is given by

$$t = cR\sqrt{\frac{\rho}{P_0}}.$$

Evaluate the constant c numerically.