MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 8.13
This problem is from "Advanced Fluid Mechanics Problems" by A.H. Shapiro and A.A. Sonin

Consider a gas bubble of fixed mass and radius $R(t)$ which is expanding or contracting in an infinite sea of incompressible liquid. The speed of the interface is dR/dt. The local Eulerian coordinate in the liquid is r. Let p_R, p, and p_∞ be, respectively the pressure at $r = R$ (on the liquid side of the interface), at $r = r$, and at $r = \infty$.

(a) Determine the viscous contribution to the normal stress τ_{rr} in the liquid.

(b) Show that the dimensionless overpressure, $(p_R - p_\infty)/\rho(dR/dt)^2$, is independent of whether the fluid is viscous or inviscid.

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