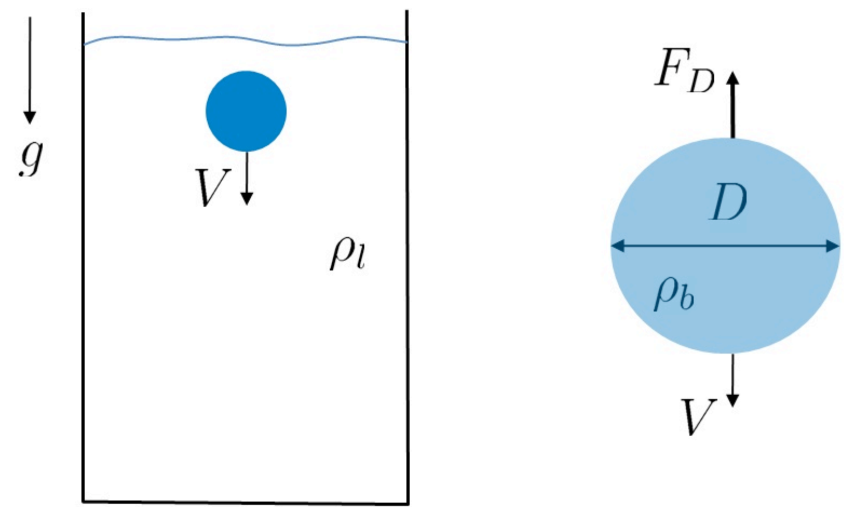
MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 7.03

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

A metal ball falls at steady speed in a large tank containing a viscous liquid. The ball falls so slowly that it is known that the inertia forces may be ignored in the equation of motion compared with the viscous forces.



(a) Perform a dimensional analysis of this problem, with the aim of relating the speed of fall V, to the diameter of the ball D, the mass density of the ball ρ_b, the mass density of the liquid ρ_l, and any other variables which play a role. Note that the "effective weight" of the ball is proportional to $(\rho_b - \rho_l)g$.

(b) Suppose that an iron ball (sp. gr.=7.9, D=0.3 cm) falls through a certain viscous liquid (sp. gr. = 1.5) at a certain steady-state speed. What would be the diameter of an aluminum ball (sp. gr. = 2.7) which would fall through the same liquid at the same speed assuming inertial forces are negligible in both flows?

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