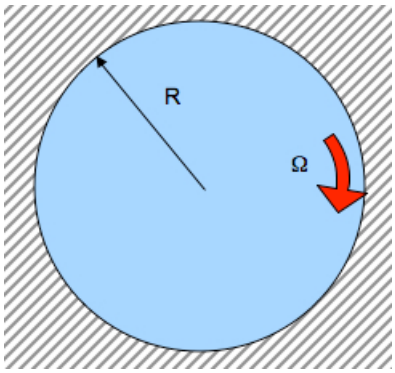
MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Problem 8.02
This problem is from "Advanced Fluid Mechanics Problems" by A.H. Shapiro and A.A. Sonin



An infinitely long, cylindrical container of radius R rotates at the angular speed Ω. It contains water which is also in solid-body rotation with angular speed Ω. At time $t = 0$, the container suddenly stops rotating, and the contained water gradually comes to rest.

In all that follows, the possible effects of turbulence and other instabilities are to be considered absent.

- (a) Sketch curves of V_θ versus r, showing how the circumferential velocity varies with radius for several successive times, $t > 0$.
- (b) What is the order of magnitude of the time, t_R, up to which the Rayleigh's solution for impulsive start of a flat plate would describe the motion near the wall?
- (c) Suppose that $\Omega = 33 - 1/3$ $[rpm]$, $R = 10[cm]$, and that the fluid is water at 20 degrees celcius.

Make a very rough estimate of the time, in seconds required for most of the motion to disappear.

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