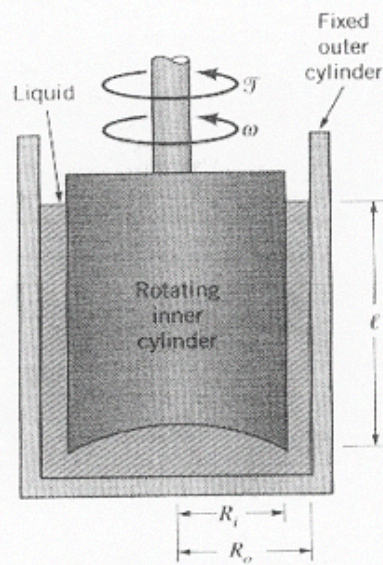


流力考題 (一)

1. (15%) The viscosity of liquids can be measured through the use of a **rotating cylinder viscometer** of the type illustrated in Fig. 1.61. In this device the outer cylinder is fixed and the inner cylinder is rotated with an angular velocity, ω . The torque \mathfrak{T} required to develop ω is measured and the viscosity is calculated from these two measurements. Develop an equation relating μ , ω , \mathfrak{T} , l , R_o , and R_i . Neglect end effects and assume the velocity distribution in the gap is linear.



■ FIGURE P1.61

2. (15%) A small hole develops in the bottom of the stationary rowboat shown in Fig. P3.77. Estimate the amount of time it will take for the boat to sink. List all assumptions and show all calculations.

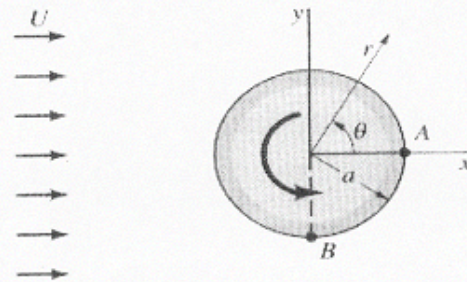


■ FIGURE P3.77

3. (20%) The velocity potential for a cylinder (Fig. P6.63) rotating in a uniform stream of fluid is

$$\phi = U\left(r + \frac{a^2}{r}\right)\cos\theta + \frac{\Gamma}{2\pi}\theta$$

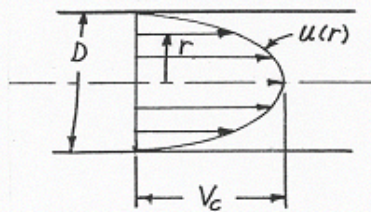
where Γ is the circulation. For what value of the circulation will the stagnation point be located at (a) point A, (b) point B?



■ FIGURE P6.63

Fluid Mechanics (part 2) 2002/4/5

1. Please describe the boundary layer structure and the thickness on a flat plate. Also define the displacement thickness. (10%)
2. Please derive the boundary layer equations and its boundary conditions. (start from 2-D Navier-Stokes equations) (15%)
3. For laminar flow in a round pipe of diameter D , at what distance from the centerline is the actual velocity equal to the average velocity? (15%)



4. A thin rectangular plate having a width w and a height h is located so that it is normal to a moving stream of fluid. Assume the drag, D , that the fluid exerts on the plate is a function of w and h , the fluid viscosity and density, μ and ρ , respectively, and the velocity V of the fluid approaching the plate. Determine a suitable set of pi terms to study this problem experimentally. (10%)