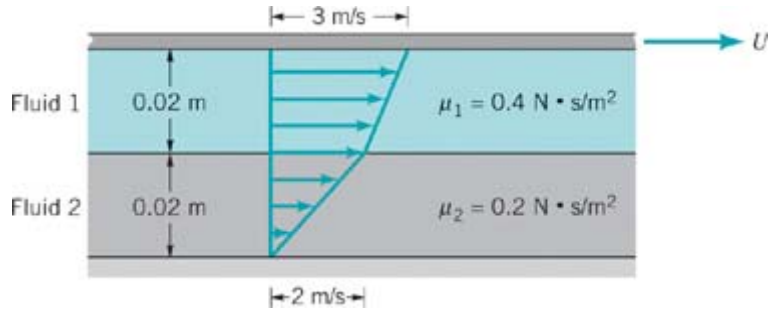
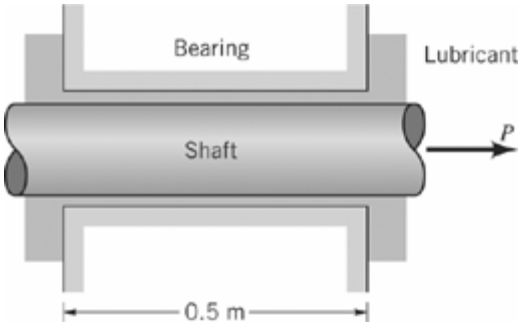
1. The specific gravity of mercury at 80 °C is 13.4. Determine its density and specific weight at this temperature.
2. The viscosity of a certain fluid is 5×10^{-4} poise. Determine its viscosity.
3. For a parallel plate arrangement, it is found that when the distance between plates is 2 mm, a shearing stress of 150 Pa develops at the upper plate when it is pulled at a velocity of 1 m/s. Determine the viscosity of the fluid between the plates.
4. As shown in figure below, the "no-slip" condition means that a fluid "sticks" to a solid surface. This is true for both fixed and moving surfaces. Let two layers of fluid be dragged along by the motion of an upper plate. The bottom plate is stationary. The top fluid puts a shear stress on the upper plate, and the lower fluid puts a shear stress on the bottom plate. Determine the ratio of these two shear stresses

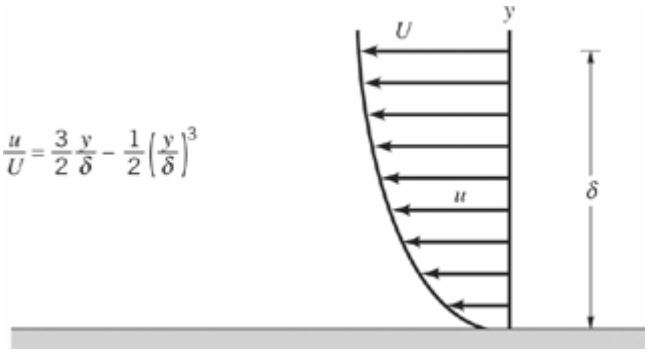


5. 25-mm-diameter shaft is pulled through a cylindrical bearing as shown in figure below. The lubricant that fills the 0.3-mm gap between the shaft and bearing is an oil having a kinematic viscosity of 8.0×10^{-4} m^2/s and a specific gravity of 0.91. Determine the force *P* required to pull the shaft at a velocity of 3 m/s. Assume the velocity distribution in the gap is linear.

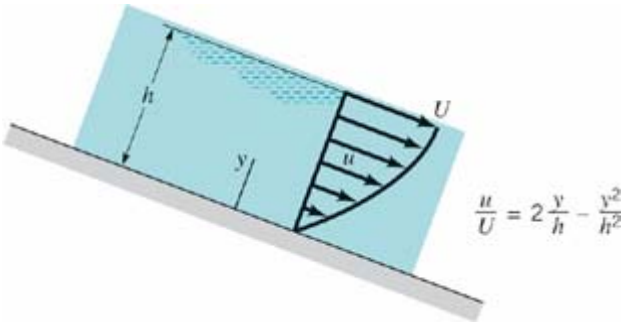


6. A Newtonian fluid having a specific gravity of 0.92 and a kinematic viscosity of 4×10^{-4} m^2/s flows past a fixed surface. Due to the no-slip condition, the velocity at the fixed surface is zero, and the velocity profile near the surface is shown in figure below. Determine the magnitude and direction of the shearing stress developed on the plate. Express your answer in terms of *U* and δ, with *U*

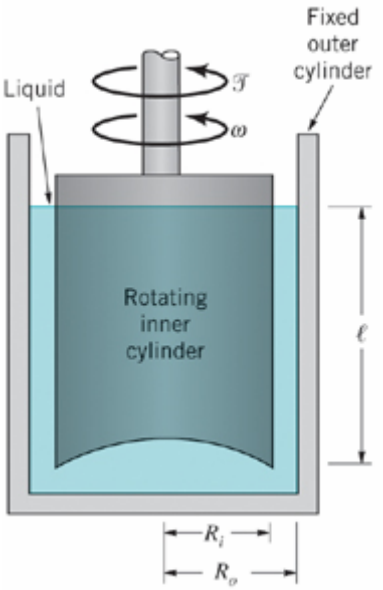
and δ expressed in units of meters per second and meters, respectively.



7. A layer of water flows down an inclined fixed surface with the velocity profile shown in figure below. Determine the magnitude and direction of the shearing stress that the water exerts on the fixed surface for $U = 2$ m/s and $h = 0.1$ m



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



8. A ventrical cylinder of diameter 180mm rotates concentrically inside another cylinder of diameter 181.2 mm. Both the cylinders are 300mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid if a torque of 20Nm is required to rotate the inner cylinder at 120rpm.
9. A circular disc of diameter D is slowly rotated in a liquid of large viscosity at a small distance from a fixed surface. Derive an expression of Torque necessary to maintain an angular velocity.
10. A 120mm disc rotates on a table separated by an oil film of 1.8mm thickness. Find the viscosity of oil if the torque required to rotate the disc at 60rpm is 3.6 $\times 10^{-4}$Nm.
11. Two large fixed parallel planes are 12mm apart. The space between the surfaces is filled with oil of viscosity 0.972Ns/m^2. A flat thin plate 0.25 m^2 area moves through the oil at a velocity of 0.3m/s. Calculate the drag force;
    ① When the plate is equidistant from both the planes
    ② When the thin plate is a distance of 4mm from one of the plane surface
12. In figure below shown a central plate of area 6m^2 being pulled with a force of 160N. If the dynamic viscosities of the two oils are in the ratio of 1:3 and the viscosity of top oil is 0.12Ns/m^2, determine the velocity at which the central

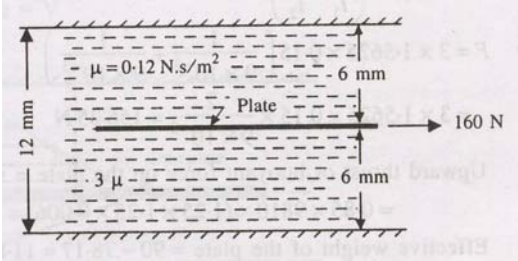
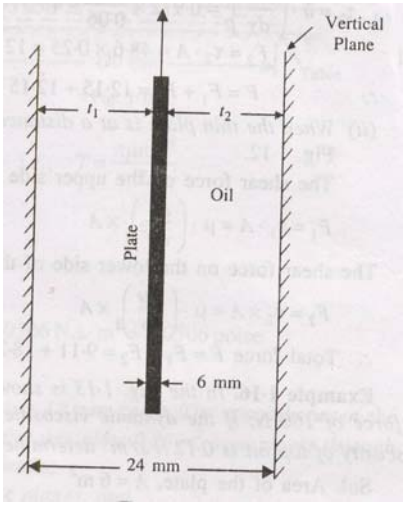


plate will move.

13. A metal plat 1.25m x 1.25m x 6mm thick and weighing 90N is placed midway in the 24mm gap between the two vertical plane surfaces as shown below. The gap is filled with an oil of specific gravity 0.85 and dynamic viscosity 3.0Ns/m^2. Determine the force required to lift the plate with a constant velocity of 0.15m/s

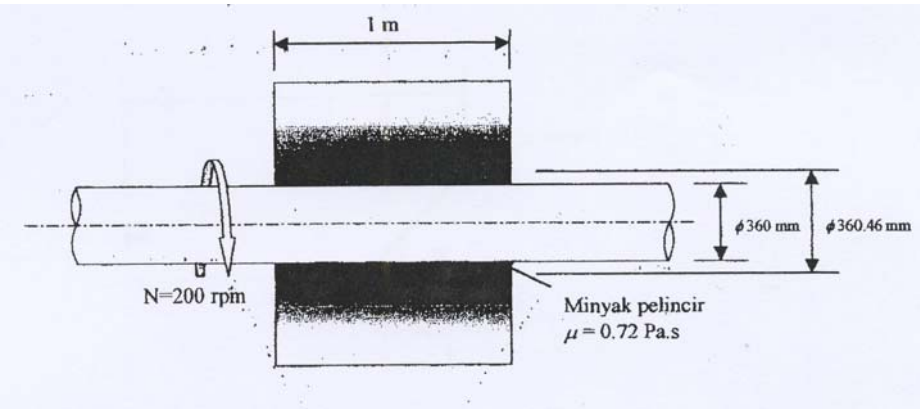


14. A square metal plate 1.8m side and 1.8mm thick weighing 60N is to be lifted through a vertical gap of 30mm of infinite extent. The oil in the gap has a specific gravity of 0.95 and viscosity of 3 Ns/m^2. If the metal plate is to be lifted at a constant speed of 0.12m/s, find the force and power required.

15. A thin plate of a very large area is placed in a gap of height *h* with oils of viscosities μ_1 and μ_2 on the two sides of the plate. The plate is pulled at a constant velocity V. Calculate the position of the plate so that
    ① The shear force on the two sides of the plate is equal
    ② The force required to drag the plate is minimum

16. Apakah yang dimaksudkan dengan bendalir likat dan bendalir tak likat

17. Rajah dibawah menunjukkan aci bergaris pusat 360mm berada di tengah galas yang bergaris pusat 360.46mm. Jika aci berputar dengan halaju 200rpm, tentukan kehilanagn kuasa pada galas. Kelikatan minyak pelincir ialah 0.72Pa.s



18. Apakah yang dimaksudkan dengan bendalir Newtonan dan Tak Newtonan. Beri dua contoh bagi setiap jenis

19. Sekeping cakera berdiameter 30cm dan tebal 5cm diletakkan didalam silinder tetap dengan ruang kelegaan 1mm diisikan dengan glycerin yang berkelikatan 0.6Ns/m^2. Tentukan daya kilas dan kuasa yang diperlukan untuk memutarkan cakera pada kadar 20ppm.

20. sebuah cakera berdiameter 75mm berputar pada kelajuan 4 rad/s dalam sebuah bekas yang berputar pada kelajuan 2 rad/s. Bekas dipenuhi minyak berkelikatan 8 x 10-3Ns/m^2. Dengan mengabaikan kesan kelikatan pada hujung cakera, buktikan bahawa daya kilas yang diperlukan untuk memutarkan satu permukaan cakera ialah

$$T = 4.97 \times 10^{-8} / h$$

Dengan *h* ialah kelegaan antara cakera dengan bekas

Jika kelegaan dibahagian atas cakera ialah 3mm dan dibahagian bawahnya ialah 2mm, tentukan daya kilas yang diperlukan untuk memutarkan cakera tersebut

21. State and explain the Newton's law of viscosity.

22. A viscous clutch is to be made from a pair of closely spaced parallel discs enclosing a thin layer of viscous liquid as shown below. Develop algebraic expression for the torque and the power transmitted by the disc pair, in term of liquid viscosity, disc radius, disc spacing and the angular speed of the input disc and the output disc.