

College of Engineering and Technology
Mechanical Engineering Department
Hydraulics (ME 362)



Sheet 1

1. The density of a certain type of jet fuel is 805 kg/m^3 . Determine its specific gravity and specific weight.
2. A liquid is poured into a graduated cylinder is found to weigh 8 N when occupying a volume of 500 ml. Determine its specific weight, density and specific gravity.
3. The information of a can of juice indicates that the can contains 355 ml. the mass of a full can of juice is 0.369 kg while an empty can weighs 0.153 N. Determine the specific weight, density, and specific gravity of the juice. Express you results in SI units.
4. The kinematic viscosity and specific gravity of a liquid are $3.5 * 10^{-4} \text{ m}^2/\text{s}$ and 0.79; respectively. What is the dynamic viscosity of the liquid in SI units?
5. A 0.3 m-diameter cylindrical tank that is 5 m long weighs 551 N and is filled with a liquid having a specific weight of 8.8 N/m^3 . Determine the vertical force required to give the tank an upward acceleration of 0.6 m/s^2 .
6. A 10 kg block slides down a smooth inclined surface a shown in figure 1. Determine the terminal velocity of the block if the 0.1-mm gap between the block and the surface contains oil having a viscosity of 0.29 N.s/m^2 . Assume the velocity distribution in the gap is linear, and the area of the block in contact with the oil is 0.2 m^2 .

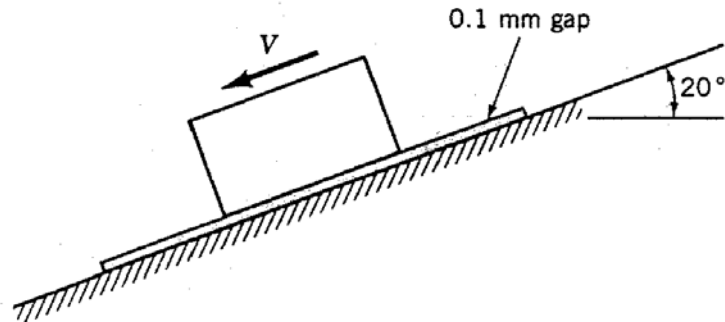


Figure 1

7. A piston having a diameter of 13.9 cm and a length of 24.1 cm slides downward with a velocity V through a vertical pipe. The downward motion is resisted by an oil film between the piston and the pipe wall. The film thickness is 0.05 mm, and the cylinder weighs 2.22 N. Estimate V if the oil viscosity is $0.766 \text{ N}\cdot\text{s}/\text{m}^2$. Assume the velocity distribution is linear.
8. A large movable plate is located between two large fixed plates as shown in figure 2. Two Newtonian fluids having the viscosities indicated are contained between the plates. Determine the magnitude and direction of the shearing stresses that act on the fixed walls and when the moving plate has a velocity of 4 m/s. Assume the velocity distribution between the plates is linear.

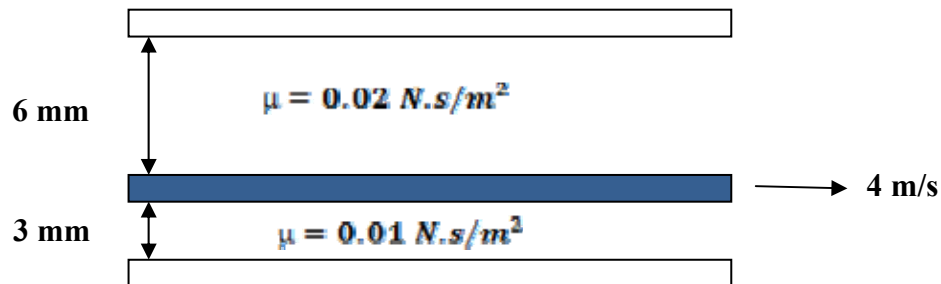


Figure 2

9. Two layers of fluid are dragged along by the motion of an upper plate as shown in figure 3. 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 between these two shear stresses.

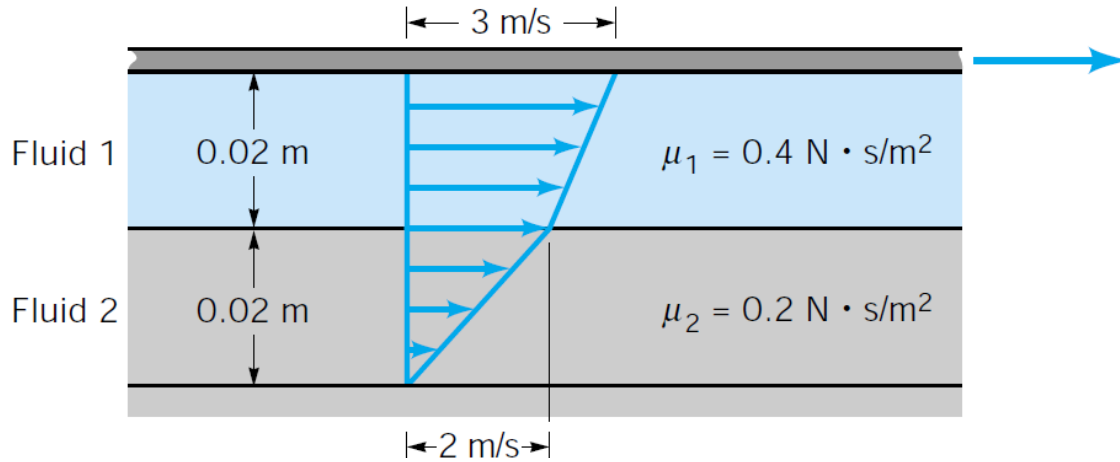


Figure 3

10. A 25 mm diameter plunger is pulled through a cylinder. The lubricant that fills the 0.3 mm gap between the plunger and the cylinder is an oil having a kinematic viscosity of $8 \cdot 10^{-4} \text{ m}^2/\text{s}$ and a specific gravity of 0.91. Determine the force (P) required to pull the plunger at a velocity of 3 m/s. Assume the velocity distribution in the gap is linear.
11. A Newtonian fluid having a specific gravity of 0.92 and a kinematic viscosity of $4 \cdot 10^{-4} \text{ m}^2/\text{s}$ 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 4. 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.

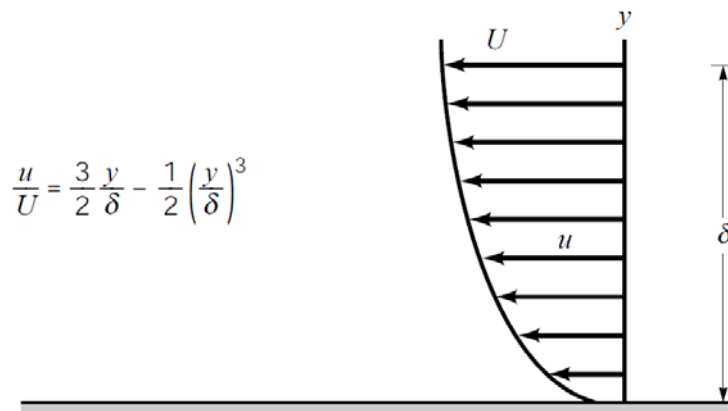


Figure 4

12. Determine the torque required to rotate a 50 mm diameter vertical cylinder a constant angular velocity of 30 rad/s inside a fixed outer cylinder that has a diameter of 50.2 mm. the gap between the cylinders is filled with SAE 10 oil at 20°C. The length of the inner cylinder is 200 mm. Neglect bottom effects and assume the velocity distribution in the gap is linear. If the temperature of the oil increases to 80°C, what will be the percentage change in the torque?

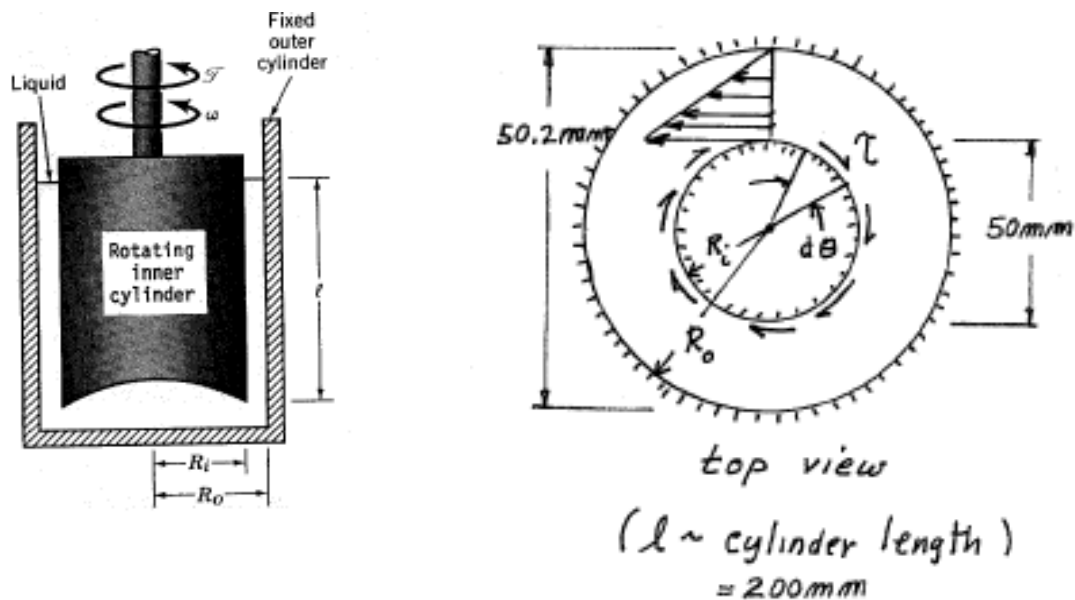


Figure 6

13. A 30.4 cm diameter circular plate is placed over a fixed bottom plate with 3.54 mm gap between the two plates filled with glycerin as shown in figure 7. Determine the torque required to rotate the circular plate slowly at 2 rpm. Assume that the velocity distribution in the gap is linear and that the shear stress on the edge of the rotating plate is negligible.

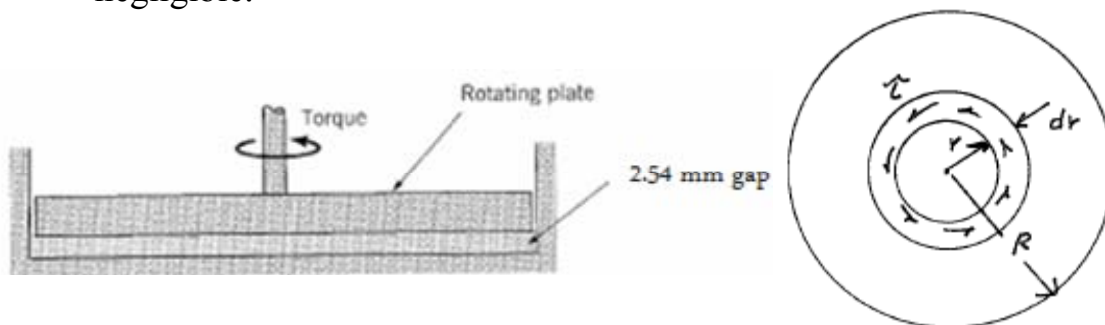


Figure 7