College of Engineering and Technology
Mechanical Engineering Department
Fluid Mechanics (ME 361)

Sheet 1

1. During a study of a certain flow system, the following equation relating p_1 and p_2 at two points was developed:

$$p_2 = p_1 + \frac{flV}{\mathrm{Dg}}$$

In this equation *V* is a velocity, *l* the distance between the two points, *D* a diameter, g the acceleration of gravity, and f a dimensionless coefficient. Is this equation dimensionally consistent?

2. If *V* is a velocity, *l* a length, *W* a weigh, and μ a fluid propriety having dimensions of $FL^{-2}T$, determine the dimensions of*:*

a) VlW/μ
b) $W\,\mu l$
c) $V\,\mu/l$
d) $Vl^2\,\mu/W$.

3. The density of a certain type of jet fuel is 805 kg/m^3. Determine its specific gravity and specific weight.

4. Determine the specific gravity of water at 22 and 89°C. What is the specific volume of water at these two temperatures?

5. 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.

6. 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.

7. The kinematic viscosity and specific gravity of a liquid are $3.5 * 10^{-4}$ m^2/s and 0.79; respectively. What is the dynamic viscosity of the liquid in SI units?

8. Calculate the density and specific weight of air at gauge pressure of 989 kPa of 38°C. Assume standard atmospheric pressure.

9. 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.

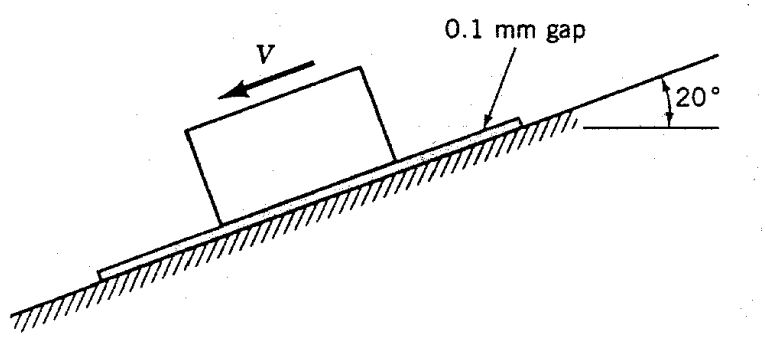

Figure 1

10. 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 N.s/m2. Assume the velocity distribution is linear.

11. Two layers of fluid are dragged along by the motion of an upper plate a shown in figure 2. 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 ration between these two shear stresses.

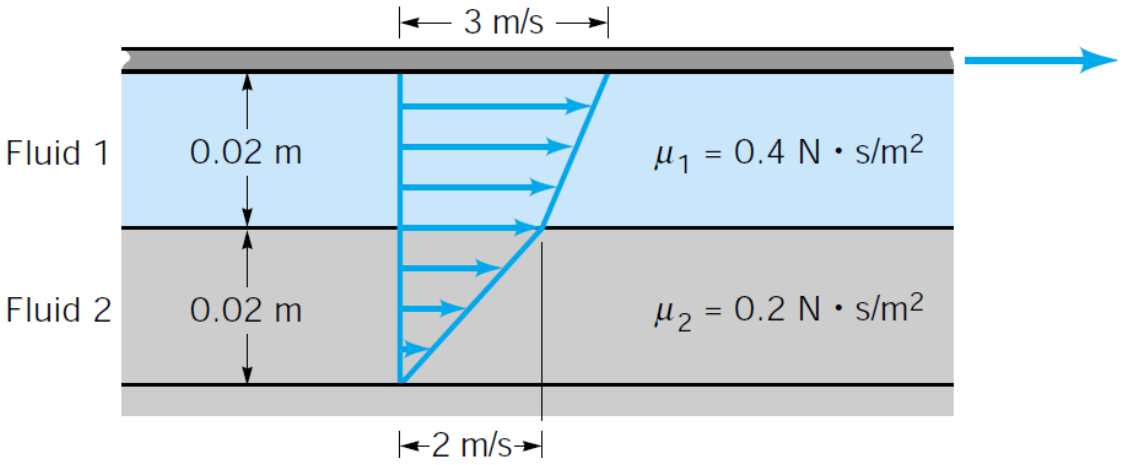

Figure 2

12. 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 and oil having a kinematic viscosity of $8*10^{-4}$ m^2/s and a specific gravity of 0.91. Determine the force (P) required to pull the plunger at velocity of 3 m/s. Assume the velocity distribution in the gap is linear.

13. 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 comdition, the velocity at the fixed surface is zero, and the velocity profile near the surface is shown in figure 3. 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 seconds and meters; respectively.

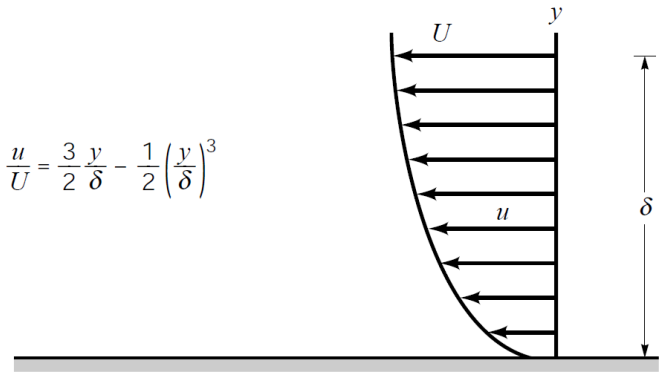

Figure 3