Homework 1 – Recall this must be submitted via Gradescope

Questions 1.8, 1.24, 1.30, 1.44 and 1.62 from the textbook. They are cut and paste below for those who do have a copy of the text.

Do not ignore Question 1 on all assignments– it is worth points and while it is more qualitative in nature it is meant to help you see fluids in the world around you.

1. Take a photo of something you think is fluid mechanics as you walk around your daily life. Include it with HW1.

2. Question 1.8 in text.

1.8 The pressure difference, Δp, across a partial blockage in an artery (called a *stenosis*) is approximated by the equation

$$\Delta p = K_v \frac{\mu V}{D} + K_u \left(\frac{A_0}{A_1} - 1\right)^2 \rho V^2$$

where V is the blood velocity, μ the blood viscosity ($FL^{-2}T$), ρ the blood density (ML^{-3}), D the artery diameter, A_0 the area of the unobstructed artery, and A_1 the area of the stenosis. Determine the dimensions of the constants K_v and K_u. Would this equation be valid in any system of units?

3. Question 1.24 in text

1.24 When poured into a graduated cylinder, a liquid is found to weigh 6 N when occupying a volume of 500 ml (milliliters). Determine its specific weight, density, and specific gravity.

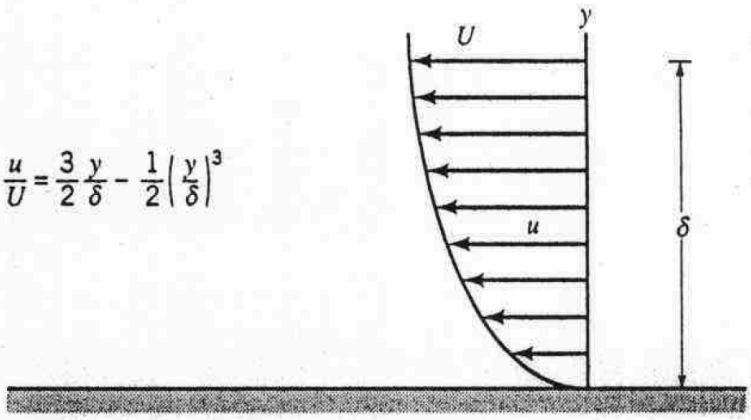
4. Question 1.30 in text

1.30 A closed tank having a volume of 2 ft^3 is filled with 0.30 lb of a gas. A pressure gage attached to the tank reads 12 psi when the gas temperature is 80 °F. There is some question as to whether the gas in the tank is oxygen or helium. Which do you think it is? Explain how you arrived at your answer.

5. Question 1.44 in text

1.44 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 (as shown in Video V1.4), and the velocity profile near the surface is shown in Fig. P1.44. 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.

$$\frac{u}{U} = \frac{3}{2}\frac{y}{\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$$



6. Question 1.62 in text

1.62 Oxygen at 30 °C and 300 kPa absolute pressure expands isothermally to an absolute pressure of 140 kPa. Determine the final density of the gas.