1. (20 points) Water flows steadily downward in a pipe at 45° as shown. The flow is steady and the pipe has a uniform diameter.
   a. For the values given, what is the pressure change between points 1 and 2?
   b. Is this flow inviscid? (You must prove your answer)

\[ L = 1.5 \text{ m} \]
\[ H = 15.0 \text{ cm} \]
\[ \gamma_w = 9.8 \text{ kN/m}^3 \]
\[ \gamma_m = 133.0 \text{ kN/m}^3 \]
2. (20 points) A cylinder slides slowly down a ramp at a constant speed \( U \). The ramp is covered with two thin fluid layers, each with a different dynamic viscosity and thickness. The cylinder has a weight \( W \) and a diameter \( D \). Find an expression for the speed \( U \) in terms of the given variables. Each layer is a Newtonian fluid with a uniform-thickness and negligible weight.
3. (30 points) An open rectangular tank (3m wide and 5m long) contains water at an initial depth of 4m. The tank begins moving with a constant horizontal acceleration of \( a_x = 3.0 \, m/s^2 \). A spherical balloon is anchored to the bottom of the tank by a string. The balloon has a constant diameter of 30.0 cm. Calculate the following:

a. The minimum height of the rear wall if no water is to spill.
b. The water-pressure force on the rear wall.
c. The tension force in the string.
d. At what angle will the balloon lean? Does the balloon lean left or right?

Assume the balloon always remains far beneath the free surface. Neglect the weight of air.
4. (30 points) Air flows steadily through the axisymmetric nozzle shown below. The manometer is filled with oil (SG=0.8). The static pressure difference between section 1 and 2 is 10.0 Pa. When the manometer reading is 10.0 cm, determine the:
   a) Velocity at section 2
   b) Volume flow rate
   c) Velocity at section 1
   d) Diameter of section 1
Assume the flow is one dimensional, steady, inviscid, and incompressible.

\[ \gamma_{\text{air}} = 12.0 \text{ N/m}^3 \]