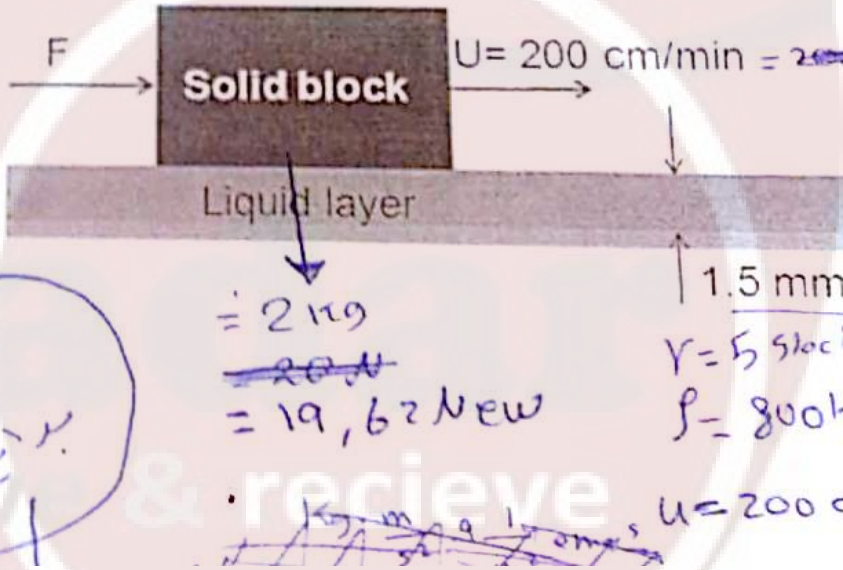
Question 1. The solid block (its mass=2 kg and the its base area = 80 cm × 80 cm) shown in the figure is sliding over a liquid layer (thickness=1.5 mm, liquid kinematic viscosity= 5 stoke, and liquid density=800 kg/m³) with constant velocity of 200 cm/min. The liquid is Newtonian fluid.

Find the force F required to maintain constant sliding velocity of the block.

Calculate the dynamic viscosity in Poise.



Question 2. *In the figure shown below, the flow of water (density=1.94 slug/ft^3) from a reservoir is controlled by L-shaped rigid gate which is 5 ft wide and its weight is 250 lbf. The gate is hinged at point A. If it is desired that the gate will just open when the water height is 12 ft. Determine the mass of the required weight W.*

$R = 0$

$\Sigma M = 0$

$F_1 (L_{p_1} + 3\,ft) + F_2 (L_{p_2}) = 0$

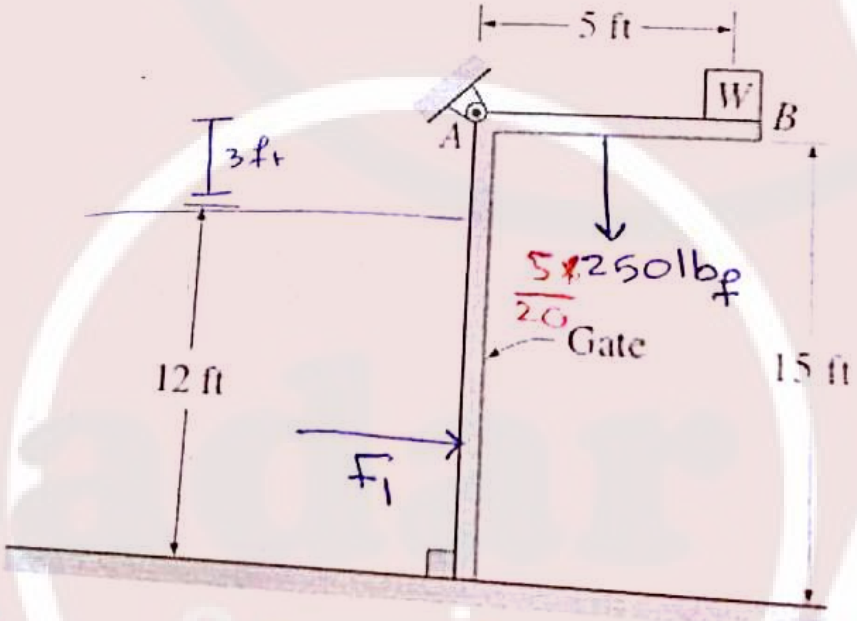
$F_1 = \rho g h_c A$

$= \frac{1.94\ slug}{ft^3} \Big| \frac{32.1\ ft}{s^2} \Big| \frac{12\ ft}{2} =$

$= 373.44\ \frac{slug}{ft.s^2}$

$L_c + \frac{I_c}{A L_c}$ (2)

$6 + \frac{6^3 \cdot 5}{12 \cdot 5 \cdot 6} = 6.25\ ft$



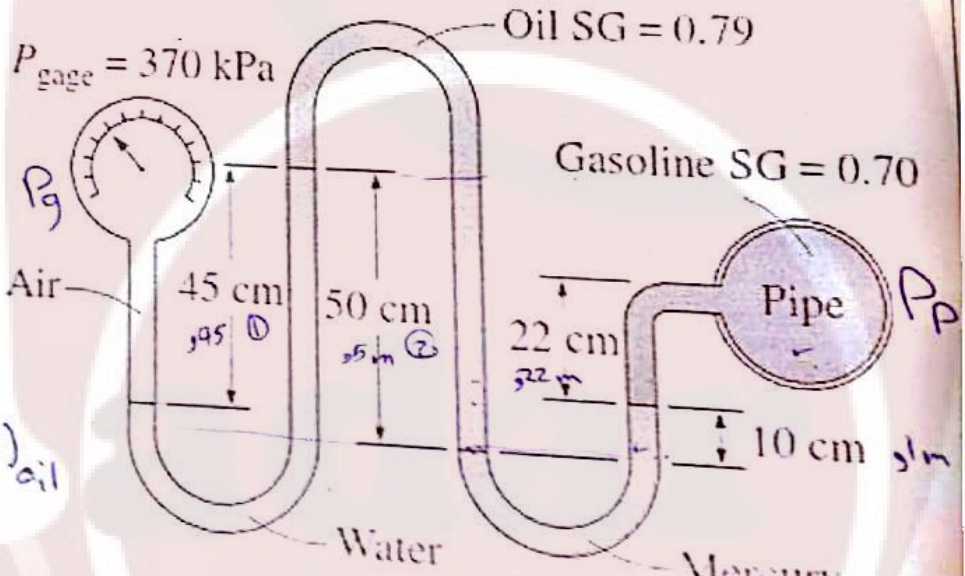
$\rho = 1.94\ slug/ft^3$

Question 3. Gasoline flows in a horizontal pipe line in which double U-shape manometers are connected at one location as shown in the figure below. The length of the pipe, from this location up to the gasoline discharge to atmosphere, is 300 m. Determine the energy losses due to friction over this length of the pipe. Neglect air column in the manometer system.

Energy transform from pressure energy to kinetic energy

$$\frac{\Delta P}{\gamma} + \frac{\Delta v^2}{2} = -w_f$$

$w_p - w_f$



$$P_p + \gamma g(\quad) + \gamma g(.31)_{Hg} - \gamma g(.65)_{oil}$$

$$+ \gamma g(.45)_{water} - P_g = 0$$

(4)

$$P_p - P_g + (700 \times 9.81 \times .22) + (13600 \times 9.81 \times .31)$$

$\gamma_G = G \cdot \gamma_{water@4^\circ C}$

Question 4. Liquid water (density= 980 kg/m^3) is supplied continuously to the tank shown in the figure below to maintain a constant water level. The tank is placed on a horizontal plane which has frictionless surface. Neglect all energy losses to answer the following:

a. What are the main energy transformations for the water flow from the constant water level to the left jet? ~~From potential energy to kinetic~~

b. Find the volumetric flow rate through the left and right jet.

c. Find the volumetric flow rate of water supply.

d. Find the horizontal force F required to hold the tank in place. ~~Force~~

$$\frac{\Delta P}{\rho} + \frac{\Delta u^2}{2} + g\Delta h + \cancel{\Delta} = \cancel{w_p} - \cancel{w_e}$$