

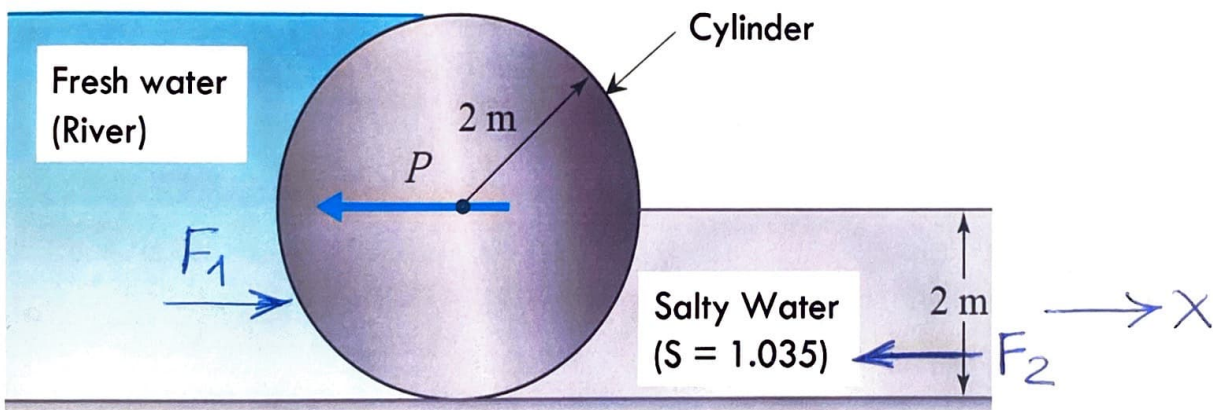
Florida International University
CWR 3201 Fluid Mechanics, Fall 2024
Mid-term # 1

Instructor: Arturo S. Leon, Ph.D., P.E., D.WRE

Student Name: Arturo Leon **Panther ID:** _____

✓ You will have 1 h 15 minutes to complete the exam. The exam is closed book and closed notes.
 Only one page (front and back) with handwritten equations are allowed

1. (35 points). Find the force "P" needed to hold the 10-m-long cylinder in position as shown in the figure below.



At equilibrium $\Sigma F_x = 0$

$$F_1 - P - F_2 = 0 \rightarrow P = F_1 - F_2 \dots \textcircled{1}$$

$$F_1 = \gamma \bar{h}_1 A_1 = 9800 \left(\frac{4}{2} \right) (4 \times 10) = 784,000 \text{ N}$$

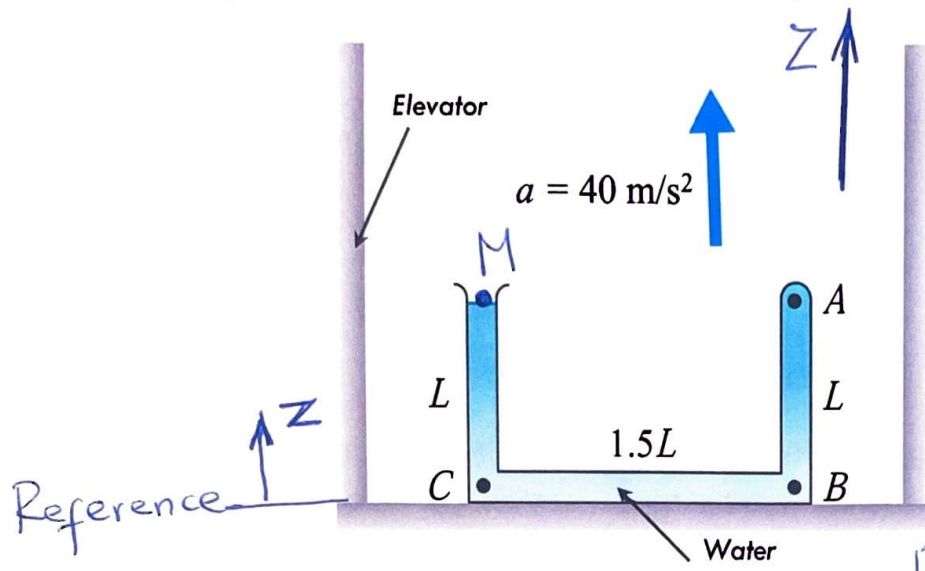
$$F_2 = \gamma \bar{h}_2 A_2 = 1.035 \times 9800 \left(\frac{2}{2} \right) (2 \times 10) = 202,860 \text{ N}$$

In $\textcircled{1}$

$$P = 581,140 \text{ N}$$

$$P = 581.14 \text{ kN}$$

2. (30 points) In the figure below, a U-tube contains water and is placed inside an elevator. If the elevator is accelerated vertically upward with an acceleration of 40 m/s^2 , find the pressures at points A and C ($L = 2 \text{ m}$).



$$dp = -\rho a_x dx$$

$$- \rho (az + g) dz$$

$$dp = -\rho (az + g) dz$$

$$dp = -\rho (+40 + 9.8) dz$$

$$dp = -49.8 \rho dz$$

Between (A) and (M)

$$P_A - P_M = -49.8 (1000) (z_A - z_M)$$

$$P_A = P_M = 0$$

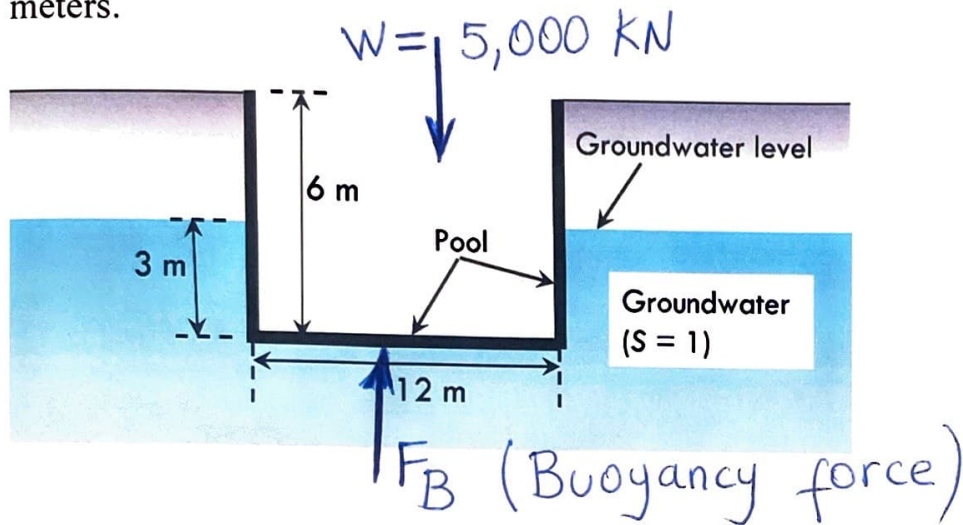
Between (C) and (M)

$$P_C - P_M = -49.8 (1000) (z_C - z_M)$$

$$P_C = -49.8 (1000) (0 - 2)$$

$$P_C = 99,600 \text{ Pa}$$

3. (35 points) The pool, depicted in the cross-section below, has been constructed using a combination of concrete and recyclable plastic materials. The total weight of the pool empty is 5000 kN. If the pool is empty, will the groundwater cause the pool to lift out of the ground? Justify your answer with calculations. The groundwater density is 1000 kg/m^3 ($S = 1.0$). The width of the pool, measured perpendicular to the illustration, is 16 meters.



$$F_B = \gamma V_{\text{submerged}} = 9800 \times 3 \times 12 \times 16$$

$$F_B = \underline{\underline{5,644.8 \text{ kN}}}$$

$F_B > W$ [Thus, the groundwater will cause the empty pool to lift out of the ground.