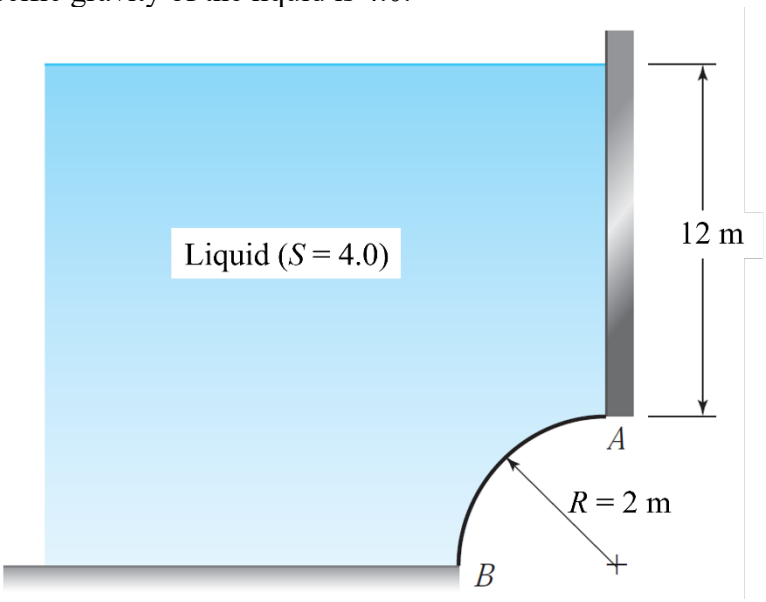
Florida International University
CWR 3201 Fluid Mechanics, Fall 2022
Final Exam

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

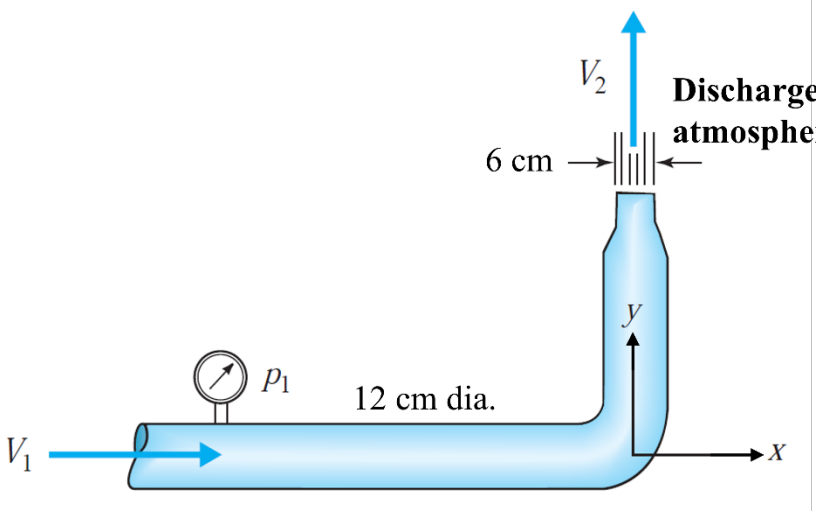
Student Name: _____ **Panther ID:** _____

- ✓ You will have 2 hours to complete the exam. The exam is closed book and closed notes
- ✓ Only two pages with handwritten equations are allowed (no photocopies or artificially reduced text will be allowed)
- ✓ No cell phones or any type of communication device will be allowed.
- ✓ The final exam consists of five questions; however, the **grading will be based on four questions only**. If five problems are solved, the grading will consider the 4 solutions with the highest scores.

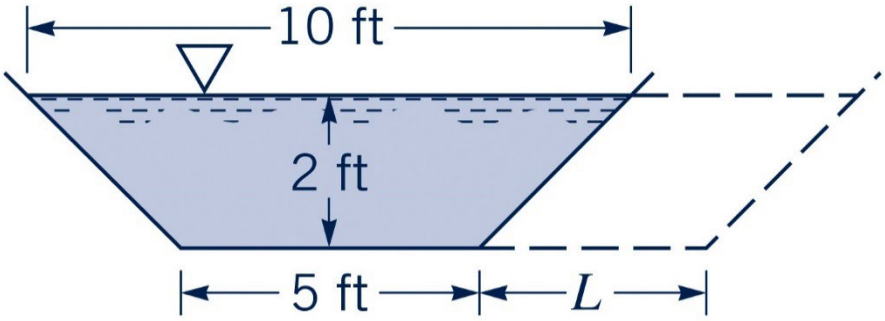
1. **(25 points)** Determine the magnitude of the horizontal and vertical components of the hydrostatic force acting on the curved surface ***AB*** shown in the figure below, which has a radius of 2 m and a **width of 4 m**. The specific gravity of the liquid is 4.0.



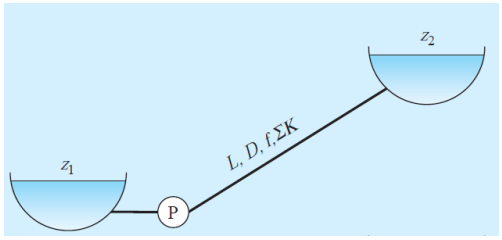
2. **(25 points)** Determine the horizontal force components (***F*** $_x$ and ***F*** $_y$) of the water on the **horizontal** bend shown in the figure below if the pressure P_1 is 450 kPa. Neglect head losses.

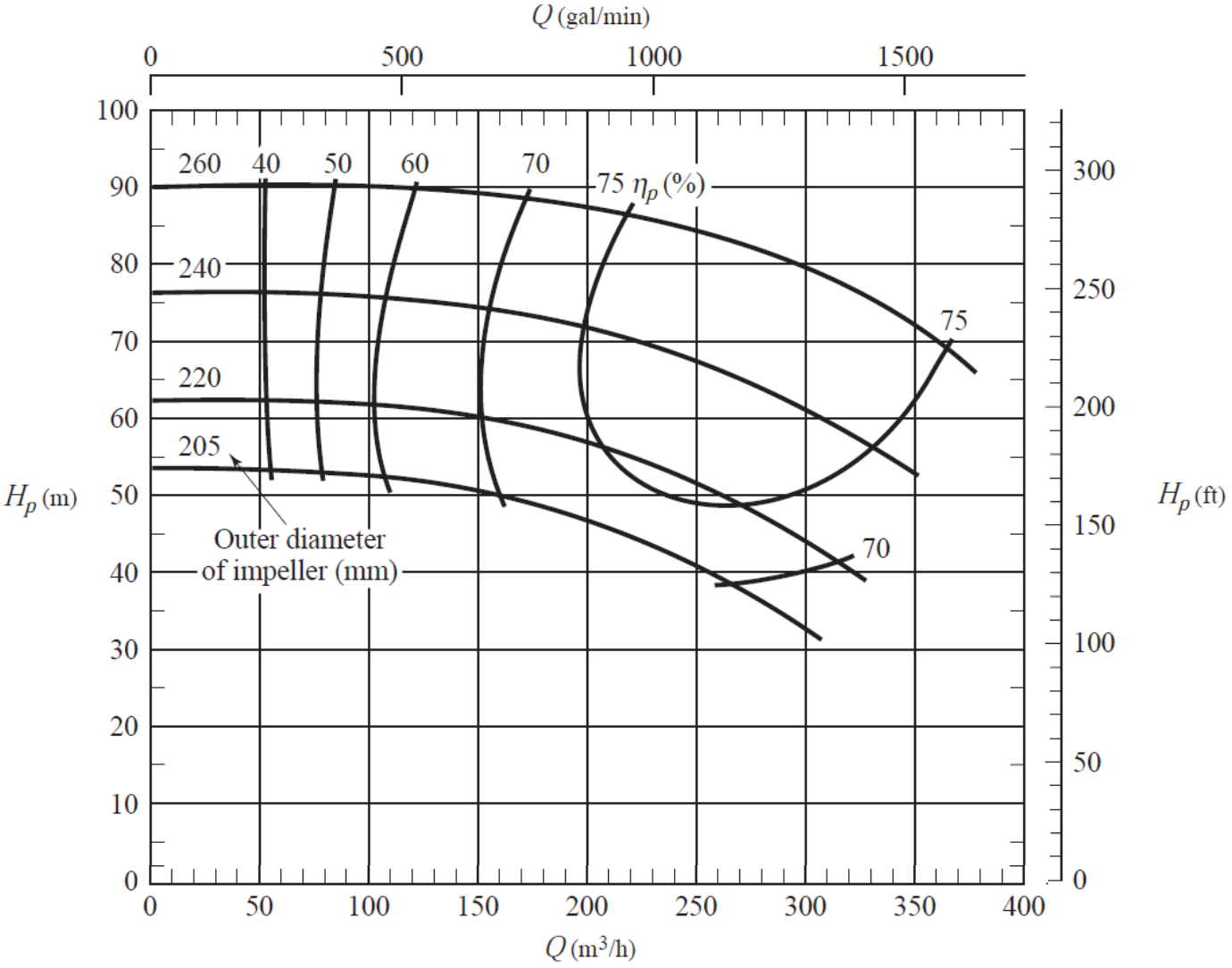


3. **(25 points)**. The canal shown below is to be widened so that the water flow discharge can be increased. If the additional width, ***L,*** is 3 ft, by what percentage will the flow discharge increase with respect to the initial flow discharge. **All other parameters (i.e., flow depth, bottom slope, surface material, side slope) are to remain the same**.



4. **(25 points)** The **205**-mm-outer impeller diameter pump represented in the figure below is used to move **water** in a piping system. The pipeline has the following characteristics: $D = 100$ mm, $L = 50$ m, $f = 0.02$, $\Sigma K = 3.2$. Determine the actual flow discharge (m^3/s) and pump head (m) when **two pumps in series** (**205**-mm-impeller diameter pump) are used. The elevation difference between the reservoirs is 65 m ($z_2 - z_1 = 65$ m).





5. **(25 points)** The channel below carries a discharge of 10 m^3/s of water with a velocity of 1.0 m/s. If the channel is designed for **maximum hydraulic efficiency** conditions, what should be the bottom (***b***) and the side slope (***Z***) of the channel?

Derivative rule for a power function: $\frac{dx^n}{dm} = nx^{n-1}\frac{dx}{dm}$