

Birzeit University
Mechanical & Mechatronics Engineering Department
Fluid Mechanics ENME335

Final Exam
Time two hours

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Closed book exam formula sheet is attached.

Problem 1 (20%)

- Give an example of a manometer, and explain what is used for?
- What is meant by pump operating point/ illustrate using pump curves?
- Write Bernoulli's equation and state assumptions for using the equation?
- Explain Hydraulic Grade Line HGL, illustrate with figure?
- What is meant by fully developed pipe flow? and how it differs from flow in the entrance region?

Problem 2 (25%)

Gasoline ($\rho = 750 \text{ kg/m}^3$) storage tank consisting of a cylinder 3m long and 1m diameter as shown in figure 1. Tank filling pipe extends 2 m above the tank and opens to atmosphere.

- Determine the hydrostatic force (magnitude, direction and location) on the vertical cylinder end
- Determine vertical force component (magnitude, direction and location) on the lower half of the tank?

Problem 3 (30%)

A nozzle is attached to the pipe bend as shown in figure 2. Pipe diameter 5 cm (for all points 1, 2, 3, 4) while nozzle diameter is 3 cm. nozzle exit water velocity $V_1 = 20 \text{ m/s}$. Neglect elevation difference between points 1, 2, 3, and 4 and neglect friction losses in the pipe-nozzle system.

- Calculate water velocity in pipe sections 2, 3, and 4. [5]
- Calculate pressures at sections 2, 3, and 4? [15]
- Calculate force to hold pipe-nozzle assembly 4-1 including horizontal component, vertical components and resultant magnitude and direction) [10]

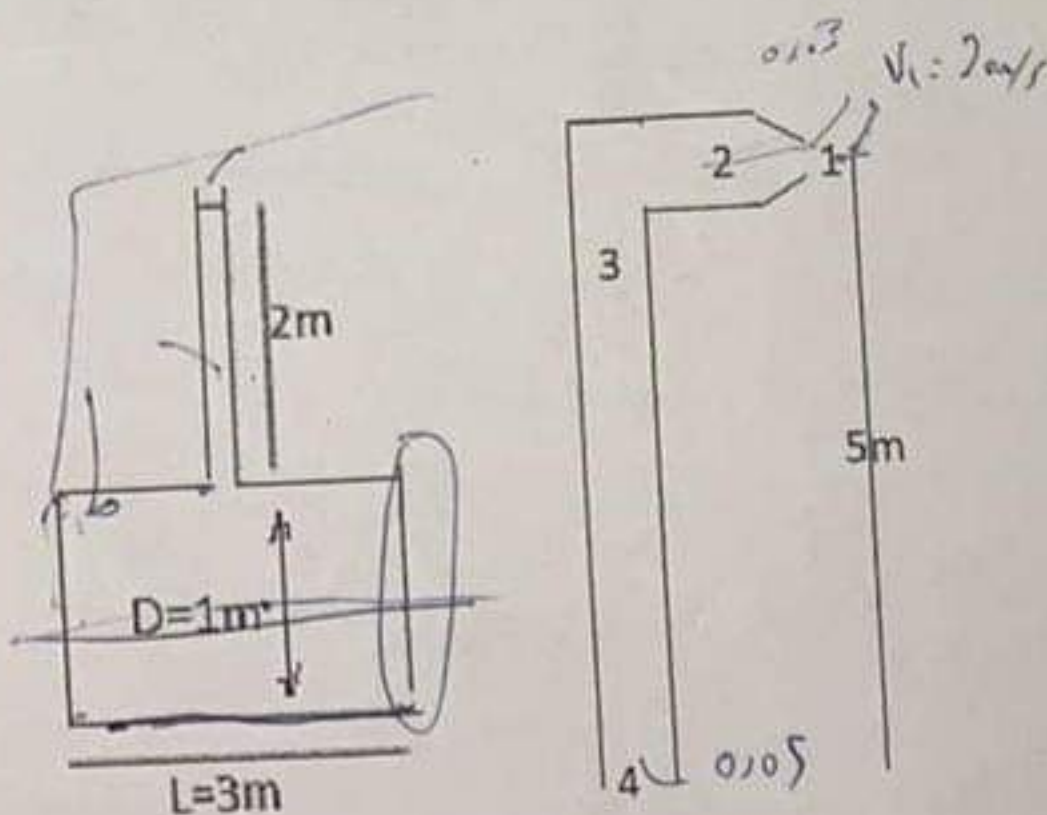


Figure 1

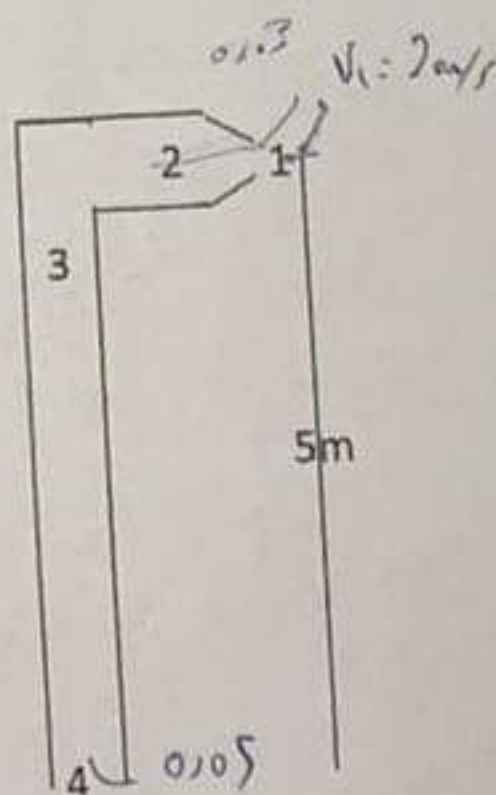


Figure 2