Test 2- Fluids

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Purpose:

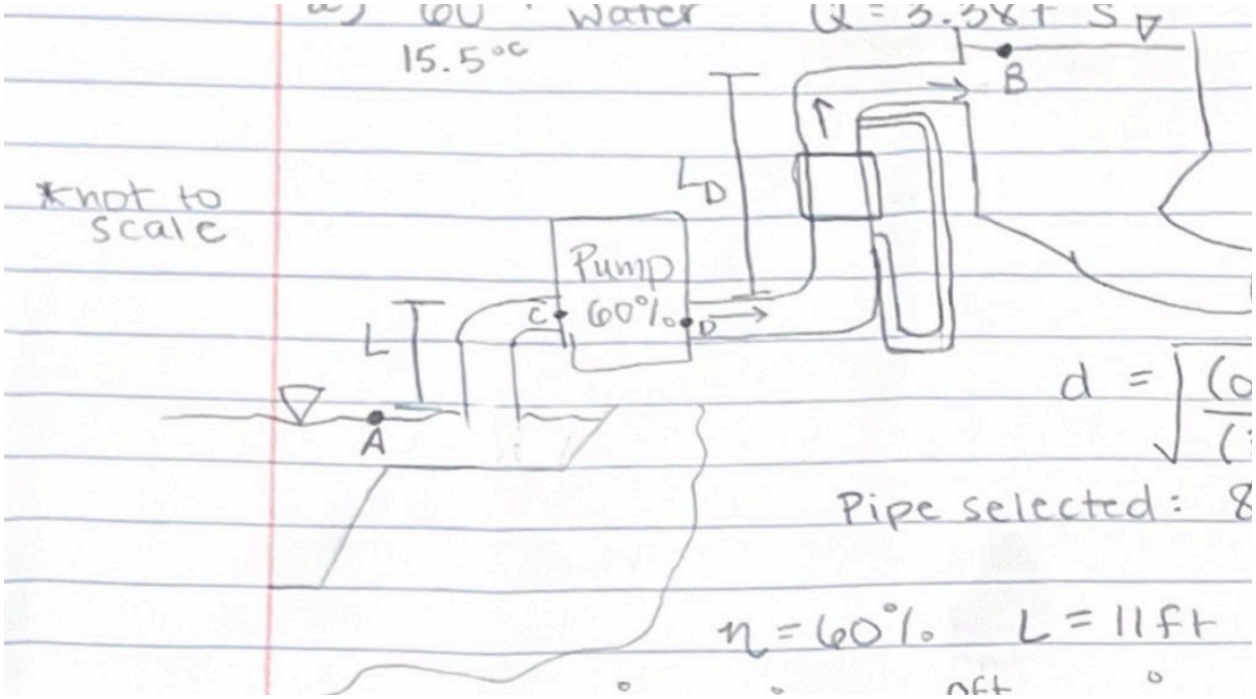
The purpose of the questions asked is to demonstrate our understanding of an open channel system using a pump and applying Bernoulli's equation to solve for the pipe's diameter and pressure at the inlet and outlet of the pump.

The second question was to test our knowledge of a flow nozzle and the application of the instrument given the diameter ratio.

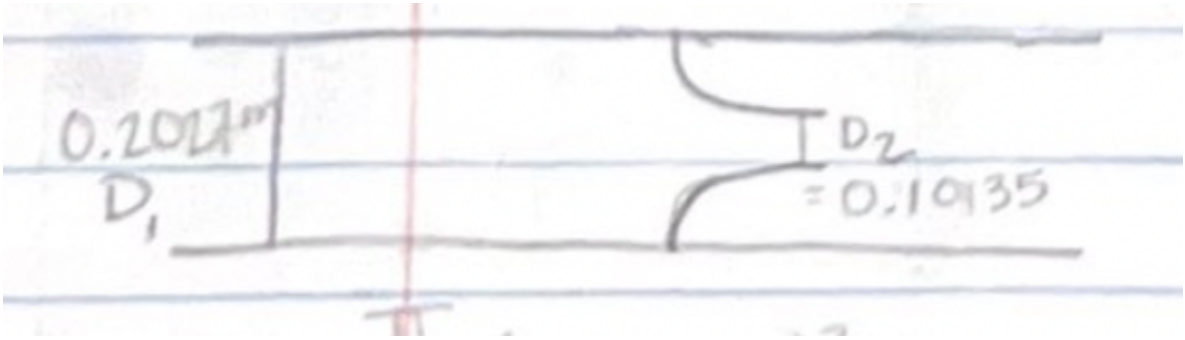
Lastly, the third question was asked to test our knowledge of Manning’s equation for open channels.

Drawings & Diagrams:

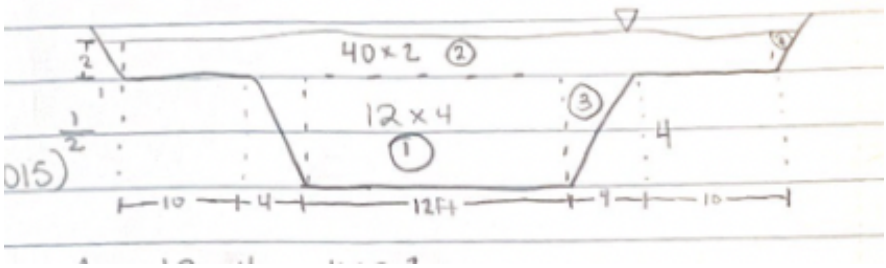
a)



b)



c)



Sources:

- My notes
- Applied Fluid Mechanics 8th Edition, Robert L. Mott & Joseph A. Untener
- Canvas Module slides

Design Considerations:

a) 60F water

   From a large open channel flowing up to upper open channel

   Figure is not to scale

   Q = 3.387 ft^3/s

b) D/d = 0.5

   Added flow nozzle instrument

   All values from question 1 apply

c) Slope = 0.00015

   Natural channel with light brush

Data and Variables:

Volumetric Flow Rate	Q = 3.387 ft^3/s
Velocity	V = 3 m/s
Change in Pressure	ΔP
Density of Water	ρ_w = 9.81 kN/m^2
Area	A
Gravity	g = 9.81 m/s^2
Energy addition due to pump	hP

Energy loss due to friction	hL
Reynolds Number	Re
Friction Factor	f
Length	L
Hydraulic Radius	R
Slope	S

Procedure:

A. First I calculated the diameter of the pipe needed with the given Q and V.
    a. Next I used Bernoulli's equation to calculate the pump power required.
    b. I had to calculate the D/epsilon, Reynolds number, and friction factor to find hL.
    c. Then used hL to find the energy added from the pump (hP).
    d. Then use hP to calculate the power of the pump in kW, then converted into horsepower.
    e. I also used bernoulli's to find the pressure at the inlet and outlet of the pump.
B. First, I picked the correct formula to use for the flow nozzle and solved for P1-P2 (ΔP).
    a. I used an equation from the modules to compute c with Reynolds number and the given diameter ratio.
    b. Then using the derived equation I calculated the ΔP loss.
    c. Using that number, I plugged it into the equation to get power and then divided that by the power I got in the first question to get the percentage of increased pump power.
C. Geometrically, I had to solve for each composite area and find the wetted perimeter of the lower channel in order to find R.