

1. How and why the test demonstrates your work toward one, or more, of the course learning objectives. Be specific on the course objectives you decide to mention.

- a. Module 5 (Friction and Minor Losses): The exam asked me to identify sources of minor losses and work out friction-related energy losses in round pipes. In Problem 1, I used Darcy's equation under fully turbulent flow assumptions. In Problem 2, I worked through the fluid velocity to calculate Reynolds numbers (N_R) and applied the Swamee-Jain equation to find the friction factor (f). I also accounted for minor losses by pulling the right resistance coefficients (K) for the pipe entrance, the 90° standard elbows, a branching tee, an expansion, and a half-open gate valve.
- b. Module 6 (Series Pipeline Systems): Problem 2 had me analyze a recirculating Class II series pipeline for a decorative fountain. I set up the general energy equation across the whole system to solve for the required pump head (h_A). I also worked with non-circular geometry by calculating the annulus energy loss using the hydraulic diameter method ($D_e = 4R_H$).
- c. Module 7 (Parallel & Branching Pipeline Systems): Problem 1 focused on branching pipeline networks. I showed I understood how flow rates and head losses behave in branched systems, specifically how two parallel gravity-fed lines have to balance against a shared downstream restriction, while still satisfying conservation of mass ($Q_3 = Q_1 + Q_2$).

2. How your test compares against the available solution. State the mistakes you made and what you will do next time to avoid making the same mistakes. Please point out exactly where you made the mistake, say why you made the mistake, and how you should have done it. If you were taking this test again, what advice would you give yourself to ensure that you had a successful test?

a. Problem 1 Comparison

- i. *Where the mistake occurred:* My main error was in part (c), calculating the pressure at the tee exit (P_{tee}).
- ii. *Why the mistake happened:* When I set up the energy balance from the tee to the pipe discharge, I messed up the algebra while isolating the pressure term. I oversimplified it down to a direct multiplication of specific weight by the head loss ($P = \gamma \cdot h_{L,C}$), which isn't right.
- iii. *How it should have been done:* I needed to balance the energy equation downstream from the tee all the way to the atmospheric discharge point, keeping the velocity head ($V^2/2g$) and elevation head (Z) properly aligned with the flow direction. That's the only way to make sure the pressure term accounts for pushing the fluid against the losses further downstream.

- iv. *Differences in property selection:* I used a rounded $f_T = 0.0245$ and the standard water weight of $\gamma = 9810 \text{ N/m}^3$. The professor worked out a more precise $f_T = 0.024946$ using the exact relative roughness $D/\epsilon = 414.13$ along with a room-temperature specific weight of $\gamma = 9.79 \text{ kN/m}^3$ pulled from the textbook tables.

b. Problem 2 Comparison

- i. *Where the deviation occurred:* My approach lined up with the professor's right through the jet velocity and flow rate calculations $V_3 = 4.429 \text{ m/s}$, $Q = 0.01774 \text{ m}^3/\text{s}$. Things diverged at the pipe selection step.
- ii. *Why it diverged:* Going strictly off the max velocity criterion ($V_{\text{max}} = 3 \text{ m/s}$), I calculated a minimum inner diameter of 0.0867 m . To stay on the safe side, I went with a larger 160 mm OD pipe for the suction line ($ID = 141.0 \text{ mm}$) and a 125 mm OD pipe for the discharge line ($ID = 110.2 \text{ mm}$). The professor instead used one uniform 125 mm pipe size for the whole loop.
- iii. *How it affected the results:* My choice kept the velocities lower across the system ($V_1 = 1.137 \text{ m/s}$, $V_2 = 1.860 \text{ m/s}$) compared to the professor's single uniform velocity ($V = 1.696 \text{ m/s}$). That brought my Reynolds numbers and Swamee-Jain friction losses down too, landing me at a total system loss of 2.10 m and a pump head of $h_A = 4.20 \text{ m}$. The professor's design, with more friction, came out to $h_A = 2.3575 \text{ m}$. Both designs work, mine was just a more conservative, split-pipe take on the problem.
- iv. *Advice to myself for next time:* Trust the math you've already set up, but slow down on the final downstream isolation steps. On multi-branch networks, rewrite velocity heads in terms of flow rate (Q) early on, it keeps the continuity equations linear and saves you from messy radical expansions later.

3. What your grade should be. Base it on the writing rubric provided in the test and the correctness of your solution. What are the strengths and weaknesses of your test?

- a. Final Grade Calculation = $(90/2) \times (10.5/12 + 11.5/12) = 82.5\%$
- b. Problem 1: Rubric Breakdown (Score: $10.5 / 12$)
 - i. Correctly applied Bernoulli's equation and conservation of mass? (3/3)
 - ii. Were all the minor losses accounted for? (2/2)
 - iii. Did I work the equations out numerically? (1/1)
 - iv. Did I use an iterative process to solve the system of equations? (3/3) - used simultaneous radical substitution for the flat-zone relative roughness setup
 - v. Did I check the velocity criterion? (1/1)
 - vi. Are the final results correct? (0.5/2) - lost points here because of the transposition error P_{tee}
- c. Problem 2: Rubric Breakdown (Score: $11.5 / 12$)
 - i. Used Bernoulli's equation to find velocity and then flow rate? (2/2)
 - ii. Sized the pipe based on the velocity criterion? (2/2)

- iii. Computed pump head from Bernoulli's equation? (1/1)
- iv. Included all the energy losses? (3/3)
- v. Handled the annulus energy loss using hydraulic diameter? (1/1)
- vi. Computed the pump power? (1/1)
- vii. Are the final results correct? (1.5/2) - small deduction for going with a dual-pipe sizing approach instead of the single-size approach in the answer key
- d. Strengths: The formatting is clean, careful, and professional throughout. Every problem includes a clear breakdown of assumptions, variables, and schematics, and every numerical step shows units.
- e. Weaknesses: A few algebraic slip-ups and some independent design choices led to numbers that drifted from the professor's baseline solution.

4)

- a. The toughest parts were working through the dense radical simultaneous equations in Problem 1 and figuring out the non-circular flow boundaries in Problem 2. I got through it by breaking each section down into clear head loss multipliers ($\sum K$ to $\sum K$) to simplify things.
- b. I mapped out the system layouts, listed every fitting, set clear datum lines, and worked through the general energy equation step by step. Next time, I'll build a quick spreadsheet to double-check my numbers before finalizing anything by hand.
- c. I got a better handle on using hydraulic diameters for concentric annular spaces, and on how downstream valve blockages create backpressure that balances out parallel fluid lines.
- d. Engineers use these same network methods to balance commercial cooling loops, size water utility systems, and design supply headers for chemical plants.
- e. I'll be using these same series pipeline and loss calculations directly when I size pumps and run fluid network calculations for my engineering design project.
- f. Definitely. Careful fluid network design is what prevents real-world line failures, protects equipment from pump cavitation, and keeps delivery velocities safe across a system.
- g. I'll use these skills to size pumps, choose control valves, and balance fluid paths in automated manufacturing lines, power generation loops, and industrial HVAC systems.
- h. This understanding of fluid power fundamentals, hydraulics, and line losses ties directly into my professional interests and builds on my background with fluid systems.
- i. I've made the most progress in taking a complex, open-ended system problem and turning it into a clean, organized, well-documented set of calculations.
- j. Sizing pipeline networks, working out friction factors, and factoring in pump energy are core skills for mechanical engineering technology roles.
- k. I spent about 4.5 hours on this test - 1 hour on loss inventory and sketching, 2.5 hours working through the algebra, and 1 hour on pipe optimization and power calculations. Next time, I'll set aside 20 minutes at the end just for a sanity check on my equations.