Name: _____.

MET 330 Fluid Mechanics
Dr. Orlando Ayala
Fall 2020
Test 3

Take home – Due Friday December 4th 2020 before midnight.

READ FIRST

1. RELAX!!!! DO NOT OVERTHINK THE PROBLEMS!!!! There is nothing hidden. The test was designed for you to pass and get the maximum number of points, while learning at the same time. HINT: THINK BEFORE TRYING TO USE/FIND EQUATIONS (OR EVEN FIND SIMILAR PROBLEMS)
2. The total points on this test are one hundred (100). Ten (10) points are from your HW assignments, and the other eighty (90) points will come from the problem solutions. I will not require technical writing for this test. You could still do it following the attached rubric, however you are under no obligation to do so it as I will not grade it.
3. There are 2 main different parts, each one is worth 90/2 of the total grade.
4. What you turn in should be only your own work. You cannot discuss the exam with anyone, except me. Call me, skype me, text me, email me, come to my office, if you have any question.
5. I do not read minds. You should be explicit and organized in your answers. Use drawings/figures. If you make a mistake, do not erase it. Rather use that opportunity to explain why you think it is a mistake and show the way to correct the problem.
6. You have to turn in your test ON TIME and ONLY through BLACKBOARD. You must submit only one file and it has to be a pdf file. For the ePortfolio (which is optional) you are supposed to upload this artifact to your Google drive. I will provide more instructions later.
7. Do not start at the last minute so you can handle anything that could happen. Late tests will not be accepted. Test submitted through email will not be accepted either.
8. Cheating is completely wrong. The ODU Student Honor Pledge reads: "I pledge to support the honor system of Old Dominion University. I will refrain from any form of academic dishonesty or deception, such as cheating or plagiarism." By attending Old Dominion University you have accepted the responsibility to abide by this code. This is an institutional policy approved by the Board of Visitors. It is important to remind you the following part of the Honor Code:

IX. PROHIBITED CONDUCT
A. Academic Integrity violations, including:
1. *Cheating*: Using unauthorized assistance, materials, study aids, or other information in any academic exercise (Examples of cheating include, but are not limited to, the following: using unapproved resources or assistance to complete an assignment, paper, project, quiz or exam; collaborating in violation of a faculty member's instructions; and submitting the same, or substantially the same, paper to more than one course for academic credit without first obtaining the approval of faculty).

With that said, you are NOT authorized to use any online source of any type, unless is ODU related.

The following system is the system you worked on the 1st test and it delivers gasoline (sg=0.68) at a temperature of 25 °C to a truck. The dimensions are the ones provided and calculated on the 1st test (if you computed certain parameters wrong on the 1st test, please get the dimension you need from the solution I provided).

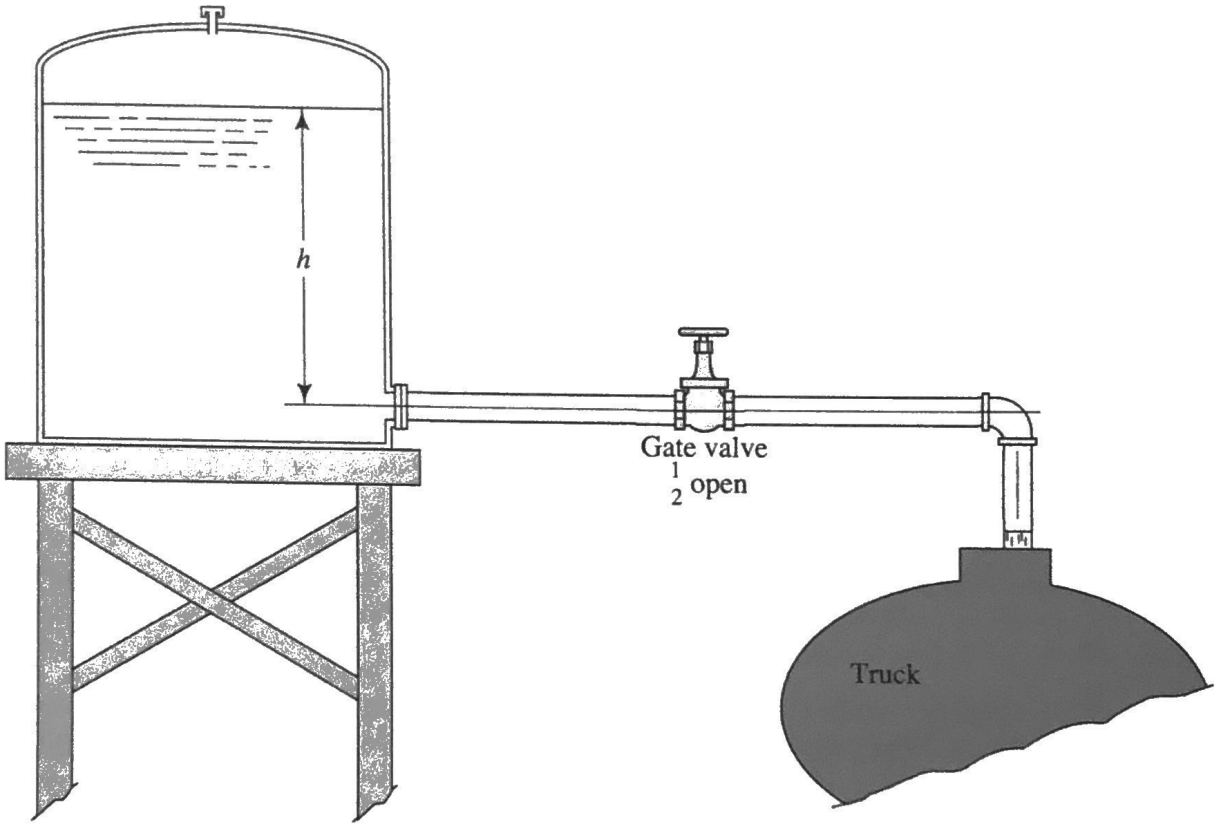

Figure 1. Schematic of the system you designed on the 1st test.

1. Your client wants you to revisit your design. The engineer wonders how much total flow rate would you get if you modify the pipeline system to the way shown in figure 2. The new branch is made up of a horizontal pipe whose length is 2/3 of the previous horizontal pipe length (figure 1) and the pipe vertical portions are 0.25 m long. The branch pipe diameter is the same as the one provided on the 1st test. The gasoline depth remains the same to the one you obtained on the 1st test.

2. Once again, your client wants you to revisit your design by modifying it to the way shown in figure 3. In this case, we all know that the flow rate passing through the new lower branch will be equal to the one passing through the upper branch (which you already calculated on the 1st part of this test) due to the symmetry. **Using ONLY the Hardy-Cross method**, prove that this is indeed the case (the flow rates through the upper and lower branch are the same). Please, make sure you use the appropriate new total flow rate.

NOTE: assume for the whole test that the pipe friction factors f are equal to f_T (the friction factor taken to be in the zone of complete turbulence – in this case it does not depend on Reynolds number). You cannot neglect the minor losses.

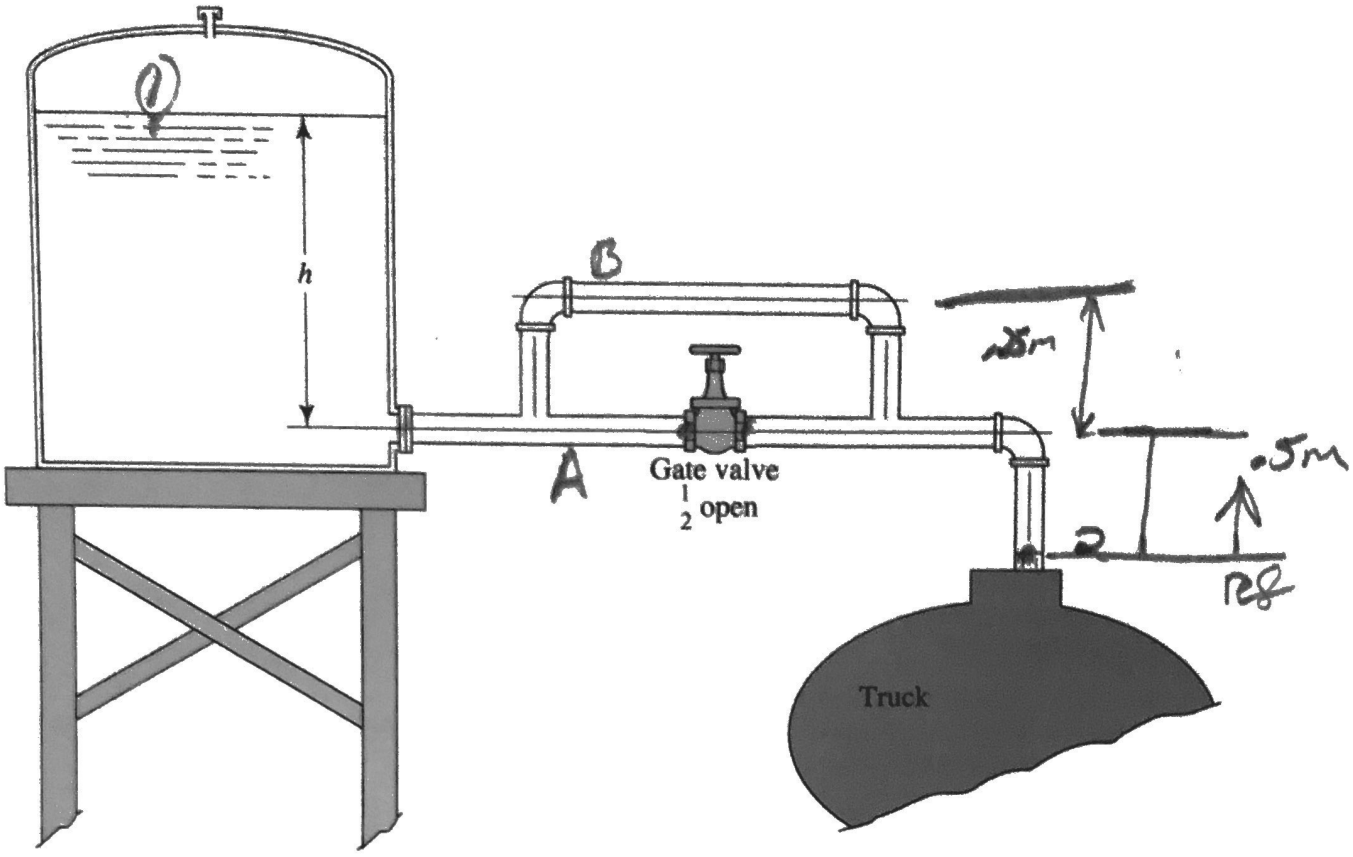

Figure 2. Schematic of the system for the 1st part of this test.

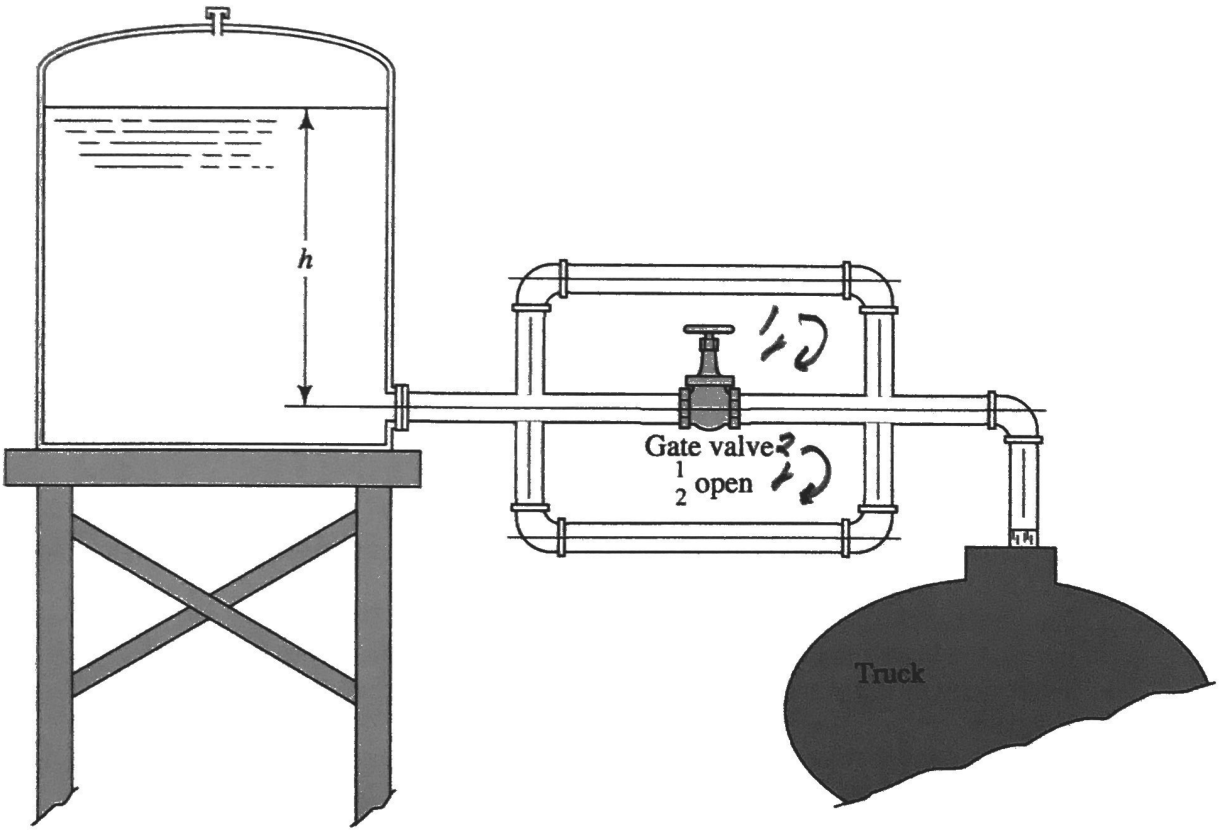

Figure 3. Schematic of the system for the 2nd part of this test.

3. (EXTRA 5 POINTS - OPTIONAL). Take a look at, at least, THREE of the following 3D virtual plant visits available in YouTube:

See where Tesla makes its cars: 360 Degree VR Factory Tour
https://www.youtube.com/watch?v=vmHvvZjV87U&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=1

Take a 360° tour of Brooklyn's M Factory
https://www.youtube.com/watch?v=vPZoAiroiSU&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=2&t=101s

Hershey's Virtual Factory Tour
https://www.youtube.com/watch?v=tmudiB9jMXc&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=3

Google Data Center 360° Tour
https://www.youtube.com/watch?v=zDAYZU4A3w0&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=4

Water Treatment Plant Virtual Tour
https://www.youtube.com/watch?v=sMcnJxdUF7c&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=5&t=543s

Toyota VR / 360° Factory Tour
https://www.youtube.com/watch?v=bvqDVjk56EI&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=6

Take a 360° Virtual Reality Tour of a Chicken Processing Plant
https://www.youtube.com/watch?v=xPaROXg72ic&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=7

Petrochemical Virtual Reality Tour (VR)
https://www.youtube.com/watch?v=Rhrsgj_drXw&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=8

360° Virtual Reality Tour of Advanced Manufacturing Plant
https://www.youtube.com/watch?v=D3imFNbGE_Q&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=9&t=178s

Virtual Reality Tour of Protolabs Manufacturing Facility
https://www.youtube.com/watch?v=67n7hOmLjrg&list=PLzPCFS9cADtxpnhfLA2Uanp4p-u4gjQAf&index=10

After taking a careful look at everything shown in the visit, please answer the following questions:

a. Did you watch the videos using a 3D virtual headset? Do you own one? If not, would be interested in owning one? Whether you are interested in owing one or not, explain why.
b. What systems did you identify in the virtual plan visits that are related to a fluid mechanics system?
c. What fluid mechanics concepts you have learned in this course you would use to study the performance or design such systems you observed?

Problem solution rubric

	Exceeds Standard 4 10 points	Meets Standard 3 7 points	Approaches Standard 2 4 points	Needs Attention 1 0 points
1. Purpose **5%**	The purpose of the section to be answered is clearly identified and stated.	The purpose of the section to be answered is identified, but is stated in a somewhat unclear manner.	The purpose of the section to be answered is partially identified, and is stated in a somewhat unclear manner.	The purpose of the section to be answered is erroneous or irrelevant.
2. Drawings & Diagrams **10%**	Clear and accurate diagrams are included and make the section easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.
3. Sources **5%**	Several reputable background sources were used and cited correctly.	A few reputable background sources are used and cited correctly.	A few background sources are used and cited correctly, but some are not reputable sources.	Background sources are cited incorrectly.
4. Design considerations (assumptions, safety, cost, etc) **10%**	Design is carried out with applicable assumptions and full attention to safety and cost, etc.	Design is generally carried out with assumptions and attention to safety, cost, etc.	Design is carried out with some assumptions and some attention to safety, cost, etc.	Assumptions, safety and cost were ignored in the design.
5. Data and variables **5%**	All data and variables are clearly described with all relevant details.	All data and variables are clearly described with most relevant details.	Most data and variables are clearly described with most relevant details.	Data and variables are not described OR the majority lack sufficient detail.
6. Procedure **25%**	Procedure is described in clear steps. The step description is in a complete and easy to understand short paragraph.	Procedure is described in clear steps but the step description is not in a complete short paragraph.	Procedure is described in clear steps. The step description is in a complete short paragraph but it is difficult to understand.	Procedure is not described in clear steps at all.
7. Calculations **20%**	All calculations are shown and the results are correct and labeled appropriately. The units of all values are shown.	Some calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results labeled appropriately.	No calculations are shown OR results are inaccurate or mislabeled.
8. Summary **5%**	Summary describes the design, the relevant information and some future implications.	Summary describes the design and some relevant information.	Summary describes the design.	No summary is written.
9. Materials **5%**	All materials used in the design are clearly and accurately described.	Almost all materials used in the design are clearly and accurately described.	Most of the materials used in the design are clearly and accurately described.	Many materials are described inaccurately OR are not described at all.
10. Analysis **10%**	The design is discussed and analyzed. Argumentative predictions are made about what might happen in case of change in the operation and how the design could be change.	The design is discussed and analyzed. Argumentative predictions are made about what might happen in case of change in the operation.	The design is discussed and analyzed. No argumentative predictions are made about what might happen in case of change in the operation and how the design could be change.	The design is not discussed and analyzed.