Name: _____.

MET 330 Fluid Mechanics
Dr. Orlando Ayala
Fall 2020
Test 2

Take home – Due Tuesday November 3rd 2020 before class time.

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 ten (10) other points are based on the basis of technical writing. The other eighty (80) points will come from the problem solutions. For the technical writing I will follow the attached rubric.

3. There are 6 main different parts, each one is worth 80/6 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.

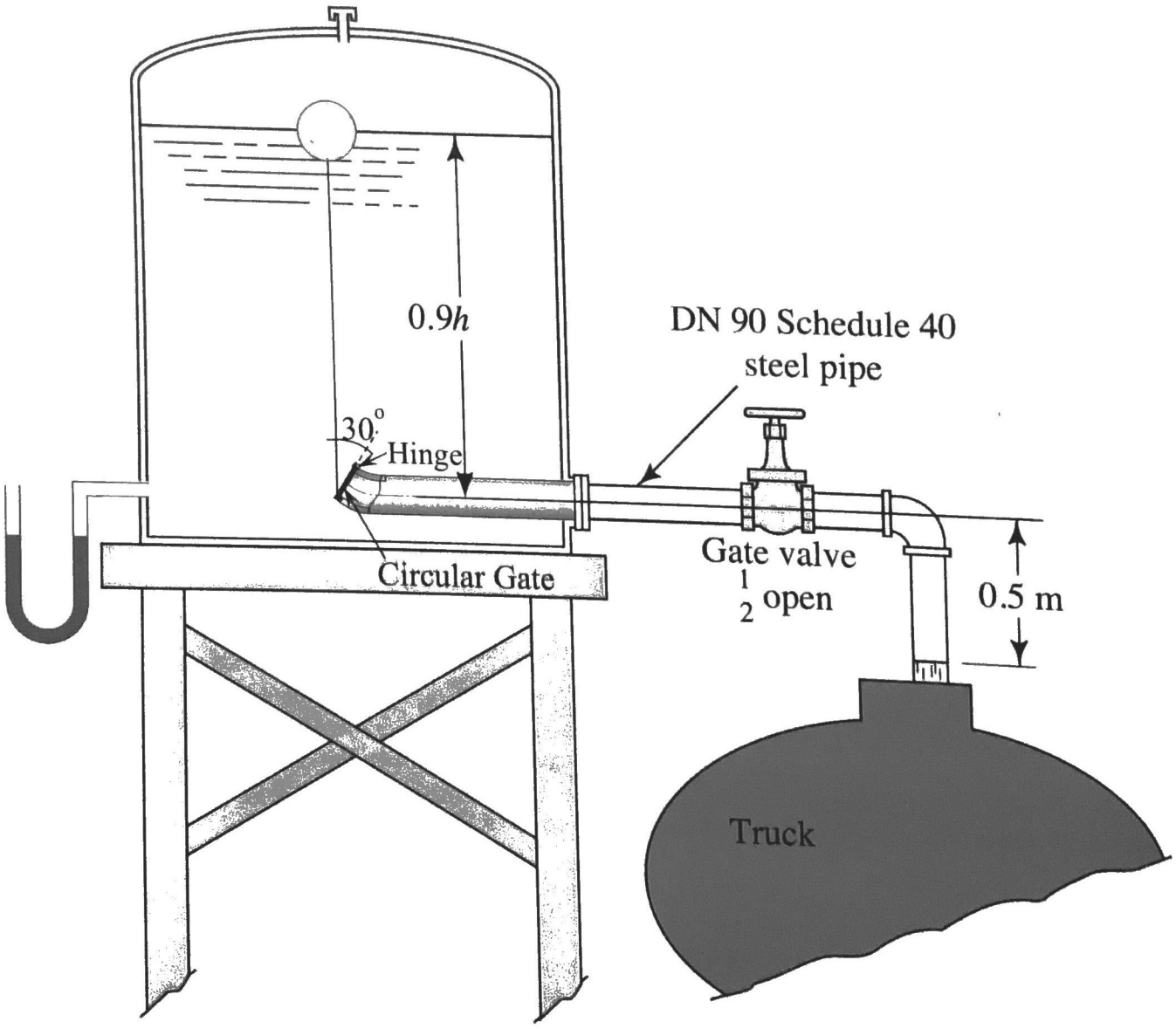
7. Do not start at the last minute so you can handle anything that could happen. Late tests will not be accepted. Test submitted through email will not be accepted either.

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.

You will continue the design you were hired for. As you know already, the system delivers gasoline (sg=0.68) at a temperature of 25 °C to a truck as shown in the figure (please note that the U-tube manometer on the left is a schematic representation only). Remember your client wants the system to handle 400 gpm. You will use all the design decisions made in the previous test. If your calculations were wrong, use the results from the solutions provided.



1. The second set of tasks you are in charge of is:

   a. In order to make sure the gravity driven system only delivers gasoline when the elevated tank is full, your client proposes to use a system as depicted in the picture. A circular gate seals the pipe opening to prohibit the flow. When the gasoline level reaches a depth of $0.9*h$, the half-way submerged spherical buoy opens the gate. How large should the buoy be for this to happen? Neglect the weight of the circular gate and the buoy. Also, prove that the buoy stable when it starts to pull the gate.

   b. The discharge pipe needs to be supported. Your civil engineer colleague requires to know the relevant forces for the support design. Calculate the total horizontal and vertical forces due to the moving fluid in the **WHOLE** discharge pipe-elbow-valve system (from the tank exit to the opening to the atmosphere).

   c. Your client proposes to use a flow nozzle to measure the flow. For a nozzle diameter to pipe diameter ratio of 0.5, what is the pressure drop across the nozzle?

   d. Your client also proposes to use an open channel under the truck to collect the gasoline in case of accidental spillage. The client prefers to use a trapezoidal cross section. How deep (y) the open channel should be to handle a possible spillage of 400 gpm? The angle of the lateral walls is 60°. The width at the top of the water (T) is $T=2.309*y$ (see table 14.3 in the book). The channel slope is 0.1 percent and is made of unfinished concrete.

   e. You should verify your design in case of the occurrence of water hammer and/or cavitation. If the valve in the pipe closes suddenly, what is the pressure increment after the sudden closing? The modulus of elasticity of steel is 200 GPa. Would the pipe fail? To answer this question, you must use equation 11-9 in the book, and then compare the thickness you get out of that equation to the actual thickness of the selected pipe. Also, could cavitation occur in the system? Where?

   f. If there is an object at the bottom of the open channel, what is its maximum weight so the fluid flow drags it by sliding it along the bottom surface? Assume the object does not tumbles and that the coefficient of friction is 0.6. The object has a shape of a square cylinder and the flow is perpendicular to one of the flat long face. The length of the square cylinder is $0.5*y$ and the side dimension is $0.1*y$, where y is the open channel depth

   The company would like you to do all your work by hand but also, they need you to create an excel spreadsheet to run automatically all calculations. You must make sure the excel solutions match the hand calculations.

Problem solution rubric

	Exceeds Standard	Meets Standard	Approaches Standard	Needs Attention
	4	3	2	1
	10 points	7 points	4 points	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.