Sinking Car Project – Math 151 – Calculus 2

If you like, you can work with one other student (in this class) on this project. You should write up your findings and the answers to all the questions below in the form of a report: use words and paragraphs, inserting the mathematics supporting the claims you make at the appropriate places in your report. Do not simply list the answers to the questions! As always, Written Work Guidelines apply.

Your Assignment

- Due Monday Oct 24 [2 points]:
  1. (1 point) Go to the gym over the weekend, and get on a leg press machine (ask around if you don't know what that machine is).
     a. Put the weight up pretty high, and try to press it with your legs. See what the highest weight is that you can lift with your legs, and report that to me. (Alternately, you can see how much weight you can press with your arms.)
     b. Now, raise the weight a little more, and give the platform a kick with both legs. Can you get it to budge with a higher weight if you kick? What's the heaviest weight that you can budge while kicking? (Please don't hurt yourselves.)
  2. (1 point) Find a car that is similar to a car you can imagine yourself driving (use a friend's car, maybe, so you don't upset the owner of the car). Now, measure the following things:
     a. The height of the bottom of the door above the ground.
     b. The actual height of the door, from top to bottom.
     c. A list of the widths of the door, taken at 1 inch intervals from the top of the door to the bottom of the door. So if the door is 36 inches tall, you will give me 36 widths.
- Due Tuesday Nov 1, Final report [8 points]: Suppose you lose control of your car, and you accidentally drive into a river that is 10 feet deep. Suppose your car sinks to the bottom, and you have fancy electric windows that don't work when the car is underwater, your windows are rolled up, and your car doesn't have any water in it yet (so that there's only water pressure from the outside).
  1. Using two of the numbers you found in the previous part of the assignment, write down the integral which will calculate the exact hydrostatic force exerted by the water on the door. Use the letter w to represent the width function.
  2. Using your list of widths gathered earlier and Simpson's rule, estimate the hydrostatic force exerted by the water on the car door. (this should take into account all of the numbers in the previous part of this assignment!).
  3. Compare this force to the amount of force you would be able to generate on the door by kicking. Would you be able to kick the door open?
  4. If this ever happened to you, you would probably be frightened, and have some adrenaline flowing through your system. What if the adrenaline made you 3 times as strong as you were that day in the gym. Could you kick open the door then?

FYI: The Fastest Method to Escape a Sinking Car If your car enters the water, it should float for a minute or two. Unhook your seatbelt and lower the window (most electric windows should still work while you're floating). Do not try to open the door, because the water pressure will keep it from budging.

How to Escape If Your Window Won't Open Release your seatbelt, and wait for the interior of the car to fill up with water. When the water reaches your neck, there will be enough water pressure on the inside of your door that your door should open without much of a fight. Push yourself out of the car and swim as fast as you can to the surface.

Sinking Car Project Grading Rubric

Name(s): _____

You must staple this rubric to the front of your project.

_____ / 1 pt **Weight lifting data turned in on time**

_____ / 1 pt **Car door measurement data turned in on time**

_____ / 2 pts **The solution is written as integrated report**, and not simply as list of answers to 3 questions. This report is made up of paragraphs, with the mathematical calculations and the data brought in to the report at the points where they are needed (with the exception that large tables of data may be placed in an appendix, and referred to at the appropriate place in the report). Actual calculations are given their own separate line or lines in the appropriate places in the report, and are seen as parts of sentences, rather than just appearing out of nowhere. The earlier parts of the project are not simply stapled on, but instead re-written into the report in the appropriate place.

_____ / 3 pts **The mathematics is correct**

_____ / 3 pts **The reasoning behind the mathematics is shown.** For example,

- All variables used in the project must be defined before their use (e.g. what does the letter "y" refer to in your project?). Then these variables are represented on the pictures and in relevant places when labeling the data.
- The door measurement data is represented in terms of the variables set up in the problem. As such, this data may need to be adjusted or rewritten.
- Any included data is labelled – tables have relevant headers, which are written when necessary in terms of the variables set up in the problem.
- The integral that represents the total force on the door is shown clearly and is easy to find.
- The development of the components of the above integral is supported with explanations and picture(s).
- The variables used in the above integral are represented on the pictures and in relevant places when labeling the data.
- The Simpson's Rule approximation to the integral is written out, along with the final numerical approximation.