Ferrari S.p.A.
Maranello, Italy

Math 113 Students
Suite 125, Manchester Hall
Wake Forest University
Winston-Salem, NC 27109

14 April 2010

Dear Students:

I am writing for your help. After many years of being thirsty while driving really fast around hairpin turns in the Italian Alps, we at Ferrari are now providing cup-holders in our cars. Unfortunately, our American drivers report that their bottles of water and cans of Coke keep tipping over.

Unlike our friends at Toyota these days, we are dedicated to solving even the most minute problems that our owners experience; we are engineering the world's finest cup-holder. But we need your expertise on finding the centers of mass for the these beverages.

Take a standard Coke can; you should be able to measure and lookup its dimensions. The center of its mass is the point about which its mass is balanced: as much above as below, as much in front as in back, as much to the left as to the right. When the can is empty, its center of mass is in the center of the can; when it is full, the center of mass is in the center of the can. In between, the center of mass is lower. We want you to find the center of mass as a function of the height h of the Coke in the can.

For our purposes, you may assume the can is an aluminum hollow cylinder with some wall thickness t_w and some thickness to the top and bottom t_b. (Neglect any other features of the can, e.g., the raised bottom, and the pop-top.)

Next, do the same calculation for a plastic bottle; your frazzled professor, if he happens to be in town that day, will be able to provide the dimensions to you. (See the last page of this file.)

We at Ferrari appreciate your consulting work, and we look forward to your answers.

Yours sincerely,
Enzo Ferrari

p.s., Stop by for a test-drive sometime!

Re: **Written Requirements for Project**
To: Math 113 students
From: Jason Parsley

It's always good to comply with a request from Italian sports-car manufacturers, and so I expect you to answer Mr. Ferrari's request. I have included a drawing of the plastic bottle and its relevant dimensions.

For this project, you will need to read §6.3 on applications of triple integrals to learn about the center of mass. You will need to find the density δ of all relevant fluids contained in these beverage holders.

Requirements for Written Report

You will work in groups of 2 students, as given on the last page; there's one group of 3. Your findings should be detailed in a typed technical report of 3-8 pages (not including figures). Mr. Ferrari will accept hand-drawn or computer-generated graphics (possibly from Maple); as for calculations, they may be typed or (neatly) hand-drawn in ink on typing paper (i.e., no notebook paper); the use of color pictures is encouraged.

This is a technical report; you will be evaluated on how clearly and correctly it communicates the desired results. I leave the formatting choices to you. One difficult task with any technical report is to be concise and thorough at the same time. (A technical report that is much longer than it should be is as bad as one that is shorter than it should be.)

The report should be written in a clear, concise manner using proper grammar. You are free to use any references you like. You should cite any references that you utilize, except for the course lecture and book. I encourage you to work within your group and to work very little with other groups; please cite any group which has helped you with your project.

The report is due at the start of class on **Tuesday, April 27th**.

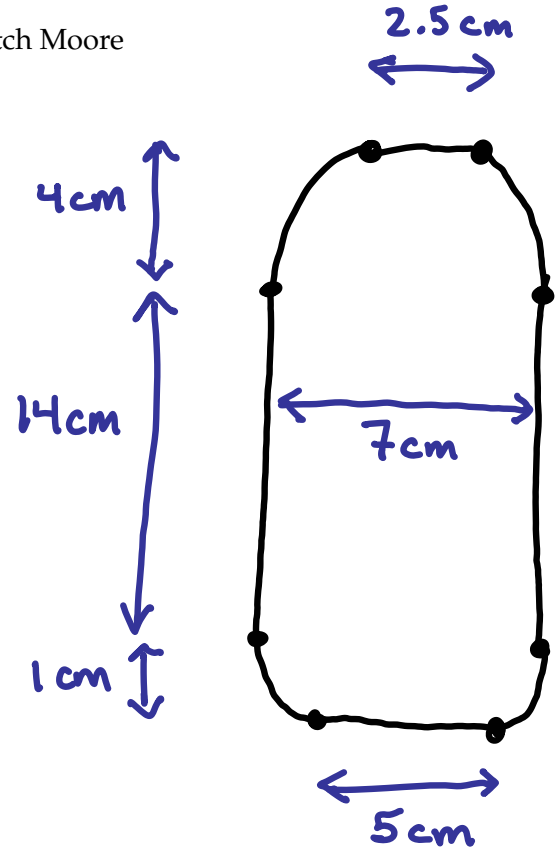
Grade Determination

Your compensation ('grade', if you prefer such language) will be calculated in five categories as given below. The first four concern the correctness of your mathematical presentation and explanation. The fifth measures your composition style.

Category	*Worth*
Mathematical Description of the Problem	15 pts
Correct Solution	40 pts
Explanation of Reasoning for Solution	30 pts
Style, Figures, and Grammar	15 pts
Total	*100 pts*

Project Groups

1. Calvin Arter, Gavin Borg
2. Kaitlin Battreall, Ben Blais
3. Mike Carlotti, Greg Cordo
4. Zac Christ, Rakeem Chesney
5. Katie Crabtree, Mikal Drye
6. Matt Deal, Epiphany Espinosa, Evan Trawick
7. Wes Farrell, Gretchen Kaiser
8. Colleen Hannan, Winston Fleishman
9. CJ Junewicz, Xiaochen Hu
10. Sam Kitchin, Shannon McGorry
11. Andrew McCarty, Tyler Kruse
12. Sungju Moon, Faith Sedberry
13. Caitlin Pulling, Xinyu Yao
14. Stewart Warther, Mitch Moore



Sketch of water bottle