

Le Bleu Water  
 $\frac{1}{2}$  Full St.  
Advance, NC 27006

Math 112 Students  
Suite 020, Manchester Hall  
Wake Forest University  
Winston-Salem, NC 27109

15 October 2009

Dear Math 112 Students:

We ask you to consider a classic, challenging water-in-a-glass problem. A cylindrical glass of radius  $r$  and height  $L$  is filled with water and then tilted until the water remaining in the glass exactly covers its base. A sketch follows on the next page. We want you to use calculus to determine the volume of water in the glass. You will find our technical requirements for the report following this letter.

**Task 1:** Determine a way to ‘slice’ the water into parallel *rectangular* cross sections. Then, using your expertise on volumes through integrals [that’s why we pay your exorbitant fees, after all], set up a definite integral for the volume of water in the glass. Use this to find the volume of water in the glass.

**Task 2:** Determine a way to ‘slice’ the water into parallel cross sections that are *trapezoids*. Then, set up a definite integral for the volume of water in the glass. Use this to find the volume of water in the glass, and thereby confirm your answer to Task 1.

**Task 3:** Find the volume of the water in the glass purely by geometric considerations, without using any calculus.

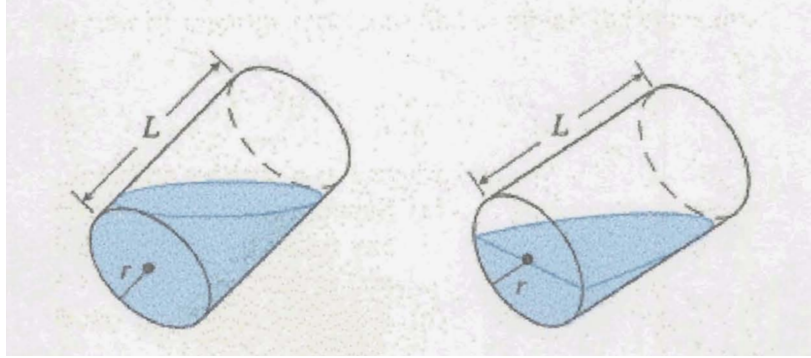
Now suppose the glass is further tilted until the water covers only half the base.

**Task 4:** Determine a way to ‘slice’ the water into parallel *triangular* cross sections. Then, set up a definite integral for the volume of water in the glass. Use this to find the volume of water in the glass.

**Task 5:** Determine a way to ‘slice’ the water into parallel *rectangular* cross sections. Then, set up a definite integral for the volume of water in the glass. Use this to find the volume of water in the glass, and thereby confirm your answer to Task 4.

**Task 6:** Determine a way to ‘slice’ the water into parallel *circular* cross sections. Then, set up a definite integral for the volume of water in the glass. Use this to find the volume of water in the glass, and thereby confirm your answer to Task 4.

Yours sincerely,  
Florence (Flo) Rivers  
Chief Scientific Officer, Le Bleu



### Requirements for Written Report

You will work in groups of three; there is one group of two. The group listings are up to your professor.

Your findings should be detailed in a typed technical report of 3-8 pages. Le Bleu will accept (neatly) hand-drawn calculations and figures; professional graphics, generated from Maple, would be appreciated, but are not required. No scratch work should be submitted.

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. No group meeting with me is required; Dr. Parsley is available for consultation, either in office hours or by appointment.

The report is due at the start of class on **Thursday, October 29th**. You should submit an electronic copy of this project on Sakai, and submit a printed copy in class.

### Grade Determination

Your compensation ('grade', if you prefer such language) will be calculated in four categories as given below.

<i>Category</i>	<i>Worth</i>
Mathematical Description of the Problem	20 pts
Correct Solution	30 pts
Explanation of Reasoning for Solutions	35 pts
Style and Grammar	15 pts
<i>Total</i>	<i>100 pts</i>