

You have been hired to design a beer glass for a new local brewery, **Numbers**. Your group, maximum of five people, will write a formal report describing your design and explaining why Numbers Brewery should select your glass. The design needs to be unique, but at the same time resemble existing beer glasses. The beer glass will be made of glass and must hold exactly 16 ounces when filled to the rim.

The glass design will come from a **curve** that you determine. This curve is then rotated around a line, thus forming an inner surface of the beer glass. I recommend you determine your curve to be a function of x , and then rotate this curve around the x -axis. This curve must have at least one zero slope of its tangent *within the height of the glass* so that it is pleasing to look at, as well as functional to hold. I recommend that you measure other glasses to get a general sense of what are reasonable dimensions.

Your report is not limited to, but must include:

- Title and names of group members
- A brief introduction on how you went about coming up with your design
- The equation of your curve and how you determined the equation of the curve
- An explanation of how you know it holds 16 ounces. Include the neat work showing how you found the key value(s) that gives your glass a 16 ounce volume.
- An explanation of where the tangent's slope is 0 and how you know that.
- Assuming the glass is $\frac{1}{8}$ of an inch thick except for the bottom, which is $\frac{3}{8}$ inches thick; *determine how much glass it will take to make one of these glasses.*
- **Please note:** Your verifications of capacity and glass amount should include the integrals used to calculate them. However, you do not have to evaluate the integrals by hand.
- Computer generated graphs of your original curve and the glass itself. You can go to <http://math.exeter.edu/rparris/winplot.html> to download a free version of Winplot. I recommend this tool because it is easy to graph a revolved curve with it (see back of this sheet).
- A summary of why your design should be selected by Numbers Brewery. This is where you get to really be a salesperson!
- Each group member needs to submit a "Group Work Assessment Form" to assess the participation of each of your fellow group members. These will be submitted directly to me, Liz, your instructor, and will be used in calculating your overall score on the project.

This project will represent 10% of your course grade. It will be graded on completeness and neatness, as well as accuracy (see the scoring sheet for details). **The project is due, with at least 2 names on it, Monday of Week 10 for 5% bonus; Wednesday for 3% bonus; and Friday, before finals week, for 1% bonus. The absolute last day I will accept the project is Wednesday during finals week.**

Solo labs will receive a 5% penalty; part of the learning process requires that you are able to communicate your mathematical concepts with your colleagues. You should do this project in groups of 2 or 3, with a maximum of 5 people to be considered for any bonus points and to minimize your work load. *We may* have some time to work on this project in class, but you will

definitely need to schedule group time outside of class. The biggest mistake you could make on this project is procrastination! **Your report must be hand typed with a minimum 12-point font**, though you may neatly write your calculations by hand either within the body of the report or as well-labeled attachments (e.g., "For the calculation of the amount of glass needed, see Figure 4"). Or if you prefer, you may use Word's equation editor (see me if you need help).

Suggested Time Line:

End of week 7: Have an idea of how to determine the generating curve.

End of week 8: Have your design done.

End of week 9: Have an outline of report done.

Week 10: Finish writing, proofread, double check calculations. Compare report to the scoring rubric. See the next page and include one copy of the scoring rubric with your report.

WinPlot

WinPlot is a free graphing software package.

You can go to: <http://math.exeter.edu/rparris/winplot.html> to download a version of Winplot. You will need to get prior instructor approval to use a different software package.

WinPlot Help

To get started:

- When you initially open up WinPlot, you'll see a blank greenish window that says "Window" and "Help" at the top.
- Go to the "Window" menu and choose "2-dim". That will open a new window with blank axes.

To graph your curve:

- Go to the "Equa" menu and choose "1. Explicit".
- Type in your function, hit the "lock interval" box, and choose the interval over which you want to define your function by picking a "low x" and "high x". Then hit "ok".
- If you want to edit your function, go back to the "Equa" menu and choose "Inventory".

To revolve your curve around the x-axis:

- Go to the "One" menu and choose "Revolve surface...".
- It should already be set up to revolve around the x-axis, but you can click the "x-axis" button to be sure.
- Adjust your "arc start" and "arc stop" so they match your "low x" and "high x" from the previous process.
- Your "angle start" and "angle stop" should already be set at 0 and 2π (about 6.28319), but verify that.
- Click "see surface". Note that this will only show the lateral surface of your glass, not the base, but that's fine for your report.

Beer Glass Project -- Scoring Sheet (Please attach a copy of this to your report).

____ (10 points) The report has an appropriate introduction and conclusion. The introduction explains how you went about coming up with your design, not your generating equation, and the conclusion does a good job of convincing Numbers to select your design.

____ (5 points) Your design is unique, yet practical.

____ (20 points) The report explains, in detail, how you came up with the generating curve and clearly states what that curve is as a function.

____ (10 points) The report has an accurate computer generated graph of a) the generating curve and b) the glass. Make sure that the units on the axes for the generating curve are visible and large enough to see.

____ (15 points) The report explains clearly, in detail, how it was determined that the glass holds 16 ounces and includes the mathematics to support the claim. The glass actually does hold 16 ounces to a tolerance of ± 0.1 ounce.

____ (15 points) The calculation for the amount of material in the glass is accurate. This needs to be very clear and easy to follow. Round your calculation to the nearest 100th of a cubic inch.

____ (15 points) The generating curve has at least one point at which the slope is zero, and the report contains a clear verification of this. Indicate the critical value(s) of your generating curve. Remember, the critical values are the x – coordinates of the zero slopes.

____ (10 points) The report format is appropriately formal—organized and clear, complete, proofread, well-packaged, and typed, using a minimum of 12-point font.

____ Subtotal

____ Bonus

____ Total