Dear MAC,

Our glass manufacturing company, **Trendy Glassware**, is a leader in manufacturing drinking glasses. We take pride in creating quality, yet inexpensive glassware using the latest glass manufacturing techniques. We are in a position where we are able to update our current line of drinking glasses and we would like to design new glassware. We wish to contract your highly recommended firm for its mathematical expertise. To help with our design process, we wish to investigate the construction and volume of existing types of drinking glasses. We would like you to pick a drinking glass of your choice (for example, a wine glass, coffee mug, juice glass, etc.) and study its construction. You are to inspect the shape of the glass and determine its volume. Then determine the dimensions such a glass should have in order to minimize the cost of creation (material and manufacturing) while maintaining the volume and basic shape of the original container.

The Glass Materials Division of **Trendy Glassware** are providing you with the following design specifications and manufacturing costs.

- The glass material used in glass manufacturing costs 5 cents per cubic centimeter.
- The techniques of manufacturing result in the thickness of the glass on the sides being $1/20$th of the height of the glass used in that portion and the thickness of the glass on the base being $1/10$th of the radius or maximum length of the glass used in that portion.
- Any patterns imprinted into the glass cost 1 cent per cubic centimeter.
- Any seams require an extra one centimeter of glass thickness over the attachment area to allow for glass melting which acts as the ‘glue’ between pieces. Seams are required for the base and any stems or handles.
- Labor for glass melting (for attaching extra pieces) costs 2 cents per cubic centimeter of extra seam material.
- Labor costs for glass manufacturing varies based on the amount of glass used. The more glass that is used, the faster it is for the machines to create the final product. The cost for labor is $C = 130 - g/10$ cents where $g$ is the amount of glass used in cubic centimeters, for up to 600 cm$^3$ of glass, otherwise the cost is fixed at $0.70$ per cubic centimeter of glass used.
We are requesting a final report including the following items.

- A description of the entire process that you use.
- A photograph and sketch of the glassware that you are modeling.
- Details of the construction of the glassware – omitting or ignoring any details in the model must be justified.
- Justification of any assumptions made to simplify the model (such as number of seams, handle size or stem length) and commentary on how those assumptions may or may not affect the final results.
- A recommendation as to whether it is worth changing the current dimensions of the model glassware to minimize the cost of manufacturing, and if so, what are the new dimensions.
- The first page of the report is to be a summary of your findings for the C.E.O. of Trendy Glassware, R. Bestglass. Please keep in mind that Mr. Bestglass has little or no knowledge of Calculus. The remainder of your report should detail the mathematics you used and the items described above so our scientists can study your report in depth.

We are also requesting a poster presentation of your results and modeling process to decide if we should consider using your firm for future projects.

We wish to receive your final report and poster presentation on Wednesday April 13, 2005. To assist you with your investigations, one of our scientists, Dr. M. K. Hurdal, has agreed to answer any questions you may have. She has also agreed to look at a draft report to verify your progress and offer extra advice. The draft is required by Monday April 4. We at Trendy Glassware are sure that this will be a profitable endeavor for everyone and look forward to receiving your report.

Sincerely,

R. Bestglass,
C.E.O., Trendy Glassware