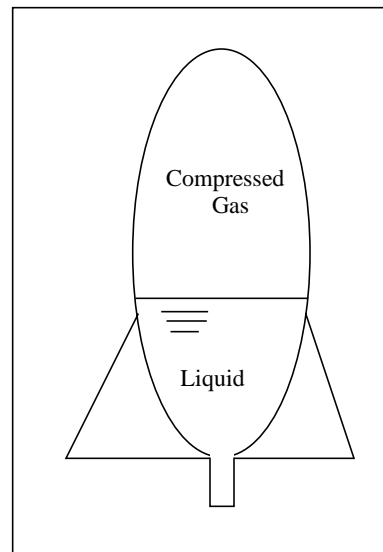


## Design of a Water Rocket

Many of you may have seen these toy water rockets that are propelled by water and air pressure. The rocket is a streamlined, hollow, plastic container that can be partially filled with water, then pressurized by a small hand pump. When properly “primed”, the rocket is released and is propelled upward by the jet of water expelled through a narrow nozzle at the bottom. Your assignment is to design a water rocket that reaches the greatest possible altitude before returning to earth. Among the parameters of the design that can be varied are:

1. Geometry and dimensions of the liquid-gas chamber and ejection nozzle.
2. The initial volume of liquid.
3. The properties of the liquid and gas used for propulsion.
4. The initial pressure used to “charge” the rocket.
5. The material used to construct the rocket.



You are, for the most part, free to come up with any design you choose. Innovation will be richly rewarded in the grading. We have several constraints, however, to impose.

1. You are not allowed to use any combustible mixture, or, for that matter, any means of propulsion other than the ejection of liquid due to the pressurized gas.
2. The total contained volume (liquid Plus gas) must not exceed  $1000\text{cm}^3$ .
3. The chamber must be designed so that it operates with a safety factor of 2.0. That is, the burst pressure of the chamber must be twice as high as the maximum operating pressure. (You may need to use a little 2.001/2.002 for this!) [Ed. note: 2.001 is a mechanics of structures course, 2.002 a materials course].

Your report should include a full analysis of the rocket flight from launch to the time at which it reaches maximum altitude, and most importantly, a predicted maximum altitude. You will need to make certain assumptions in doing your analysis, but be sure that these are clearly stated.

Questions can be directed to any of the 2.005 staff. These guidelines are purposely brief and intended to stimulate your creative juices. But, if you have questions, feel free to ask any of the staff. Also, as the need arises, a special class hour may be scheduled to discuss issues that may come up. Finally, if you would like to inspect one version of a commercially-available water rocket, you can come to the course office.