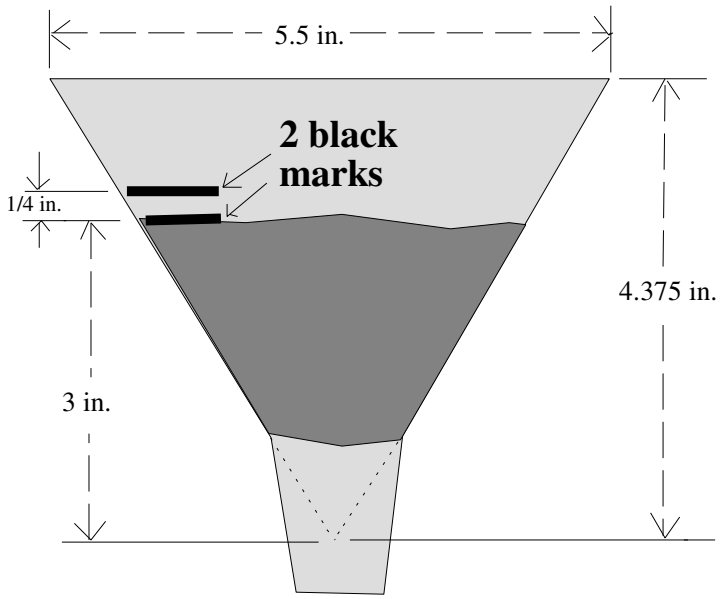
Project #2 - **CALCULUS IN YOUR SINK!**

Introduction: Many calculus courses include related-rate problems where a conical container is filled with a substance at a constant volume rate. At a given time you are able to calculate the rate at which the height of the substance is changing with respect to time. In this project, you will turn on an ordinary kitchen faucet, measure the volume rate, and with the faucet still running, fill up the provided conical container and measure the rate at which the height of the water changes when the height of the water is 3 inches. You will compare this rate to the rate calculated using calculus.



Procedure:

1. You will need to gather some measuring container (like an ordinary measuring cup). If your not into cooking, use an empty beverage container. You will also need some sort of timing device which measures to the nearest second. (An ordinary wall clock will do). You will also need the provided funnel.

2. Turn on the faucet so that the lowest continual flow is achieved. (Turn on until water stops dripping).

3. Measure the flow rate by filling up a measuring container and recording the time needed. *Leave the faucet running after measuring this rate!*

4. With the faucet still running place water into the funnel. Observe how long it takes for the water level to pass from the bottom mark to the top mark on the side of the funnel. This change in level is equal to 1/4 inch.

5. Convert the flow rate observed in step 3 into the units of in^3/sec.

6. Convert the rate of change of the height observed in step 4 into the units of inches/sec.

7. Using the ratio of height to radius (which may be calculated), obtain an equation of volume in terms of height alone. (See P.158 #19) Note that the ratio of *diameter* to height is 5.5 inches to 4.375 inches.

   Differentiate with respect to t and solve for dh/dt when h=3 inches. Note: you will need to use your value of dV/dt calculated in step 5.

Write-up (Except for equations, all answers must be typed using complete sentences!)

A. Comparing the two rates obtained in steps 6 and 7, what is the percent error? Describe factors that would contribute to this error.

B. Assuming that your measurements were all very good, describe why error is introduced due to the method in which you measured dh/dt in step 4.

C. Describe why would this experiment be much more complicated if there was a hole in the bottom in the conical container.