



## MathLab 1 - Finding the Height of a Cone

**Purpose:** Find the height of a cone of which an ordinary part cup is a section.

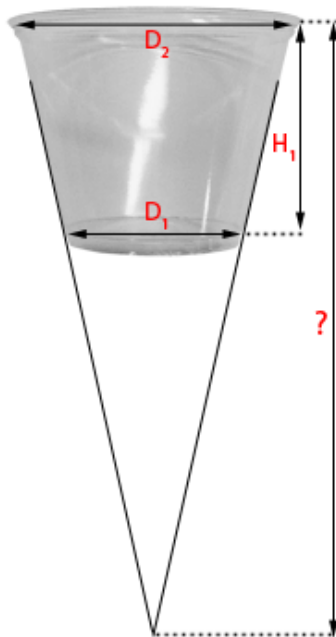
**Math principles:** Similar triangles, ratios, solving a linear equation, reading a ruler

**Use three students to demo this lab.**

1. Student 1 will record data on the board.
2. Student 2 will perform the measurements with a centimeter ruler.
3. Student 3 will assist (hold the cup, etc.)



**Equipment needed:** One party cup, centimeter ruler (underlines items supplied in accompanying kit)



### Looking at the big picture:

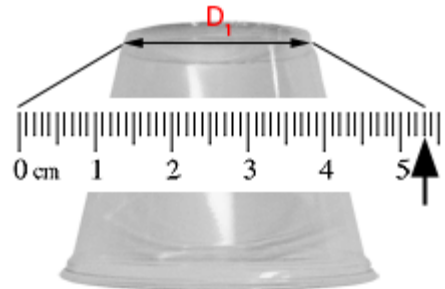
Shown here with extended lines is the cone for which we are to **find the height** (depicted here with a **question mark**).

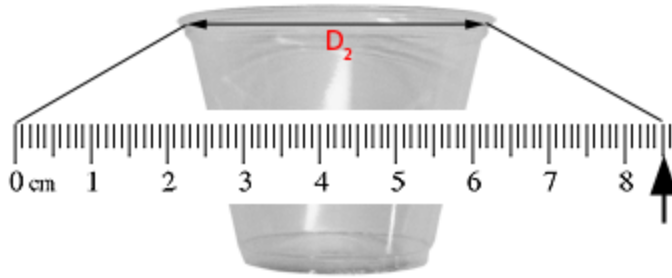
The dimensions  $D_1$ ,  $D_2$ , and  $H_1$  will ultimately be applied to the sides of two **similar triangles** from which the final calculations will be made. However, we must first obtain these measurements as follows:

### Measure small diameter:

With the cup turned upside down, measure the small **inside** diameter ( $D_1$ ) of the cup. The actual measurement is marked with an arrow on the ruler in this picture.

Students at their seats (and not part of the demo team) can read the ruler from this picture and obtain their own measurements.



**Measure large diameter:**

Next, with the cup upright, measure the large **inside** diameter ( $D_2$ ). Notice the cup is flared slightly at the top, so reduce the inside diameter by .2cm.

The actual measurement is marked with an arrow in this picture.

**Measure the height:**

Finally, measure the height of the cup ( $H_1$ ). Be sure to measure all the way **to the top**.

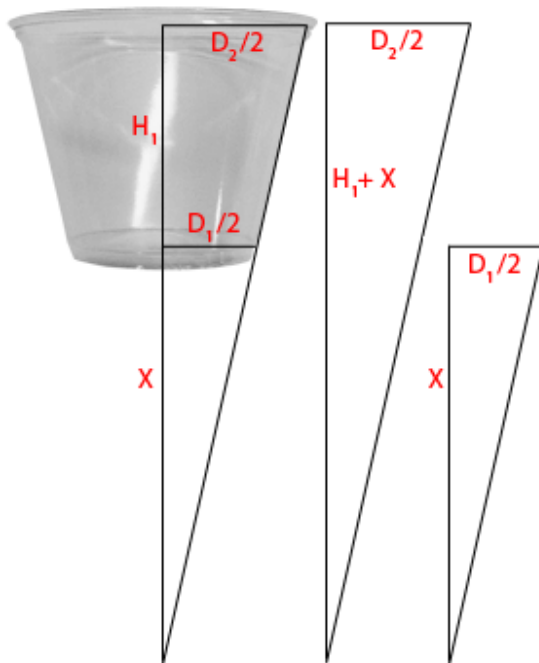
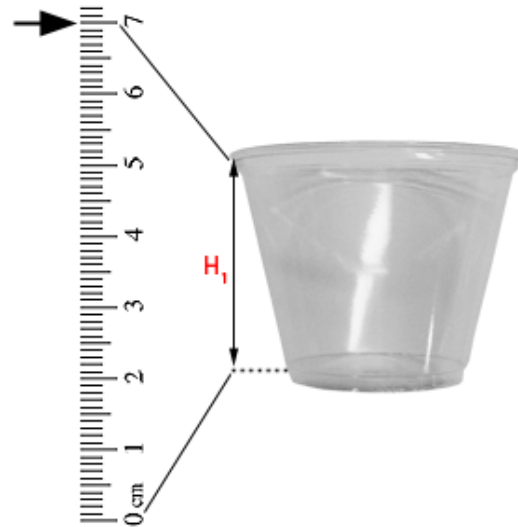
The actual measurement is marked with an arrow on the ruler in this picture.

The three measurements should be close to the following values:

$$D_1 = 5.3 \text{ cm}$$

$$D_2 = 8.5 \text{ cm}$$

$$H_1 = 7.0 \text{ cm}$$

**Final calculation:**

From the two similar triangles, set up the following proportion:

$$\frac{.5D_2}{H_1 + X} = \frac{.5D_1}{X}$$

Cross multiply, substitute in the values obtained for  $D_1$ ,  $D_2$ , and  $H_1$  and get:

$$.5(8.5)X = .5(5.3)(7+X)$$

Solve for x and get **X = 11.59**

(This could be solved on a graphing calculator letting Y1 be the left side and Y2 the right, graph, and note the intersection.)

$$\begin{aligned} \text{Height of the cone} &= X + H_1 \\ &= 11.59 + 7 \\ &= \mathbf{18.59 \text{ cm}} \end{aligned}$$

**Enrichment activities:****Calculator activity:**

From the enrichment part of the DVD menu see the video on how to solve the linear equation,  $.5(8.5)X = .5(5.3)(7+X)$ , on a graphing calculator.

**In depth questions:**

1. A centimeter ruler was used for this lab. There are 10 subdivisions between the centimeter marks. What is the length of each of those small subdivisions?

*1 mm*

2. The two similar triangle used in this particular lab were right triangles. Do all similar triangles have to be right triangles?

*No*

3. The proportion equation from which we solved for x in this problem was:

$$\frac{.5D2}{H1 + X} = \frac{.5D1}{X}$$

Would the result have been the same if the positions of .5D1 and H1 + X had been interchanged?

*Yes, cross multiplying would yield the same result.*