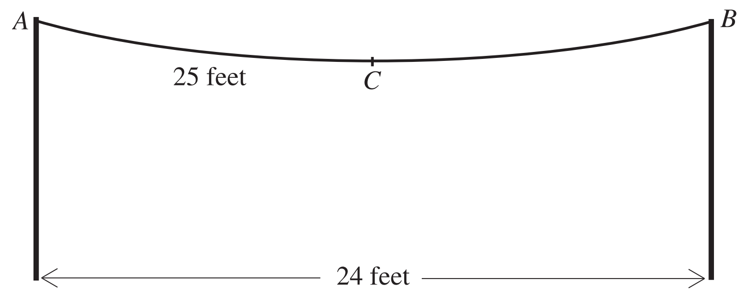
Quiz **Name**

A clothesline of length 25 feet is attached to two poles at points A and B. The poles are 24 feet apart. The straight line that connects the points A and B is horizontal. See the figure below.

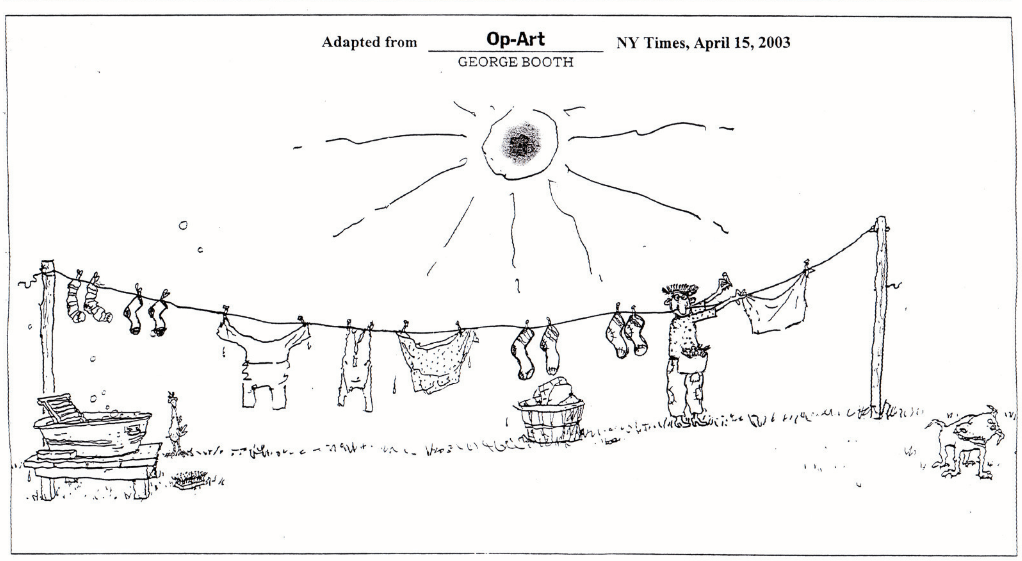


1. A laundry bag containing 35 pounds of wet laundry is attached to the clothesline at its midpoint C. Compared to the weight of the laundry, the weight of both the clothesline and the laundry bag are negligible.

a. Show that in the situation just described, the point C is 3.5 feet below the horizontal AB.

b. Let T be the tension in the clothesline, and draw a diagram of the forces acting at C. Combine your force diagram with the geometry to show that $T = 62.5$ pounds.

2. The items in the laundry bag are taken out of the bag and suspended individually on the clothesline in such a way that the load is distributed evenly per horizontal foot. Therefore the



clothesline supports $w = \frac{35}{25} = 1.4$ pounds per foot. Let $d = 12$ feet be one-half the distance between the two posts. The point C has shifted from its previous situation. It is now s feet below the segment AB. Place a coordinate system into the first figure in such a way that the origin is at C and the x-axis is parallel to the segment AB.

a. Let L be the length of the part of the clothesline from C to B. Recall from Section 10.2 that

$$L = \int_0^d \sqrt{1 + \left(\tfrac{2s}{d^2}x\right)^2}\, dx$$

and that

$$L = \int_0^d \sqrt{1 + \left(\tfrac{2s}{d^2}x\right)^2}\, dx \approx d + \tfrac{2}{3}\left(\tfrac{s}{d}\right)^2 d - \tfrac{2}{5}\left(\tfrac{s}{d}\right)^4 d.$$

b. Use the approximation and the quadratic formula to derive an estimate for s^2. From this, deduce the approximation $s \approx 3.06$ feet.

c. Review the main results of Section 8.2 and use the conclusion of (2b) to show that the maximum tension and the minimum tension in the clothesline are 36.98 pounds and 32.94 pounds, respectively. Compare this with the tension computed in Problem (1b).

Formulas

$T_d = wd\sqrt{\left(\frac{d}{2s}\right)^2 + 1}$ and $T_0 = \frac{1}{2}\frac{wd^2}{s}$