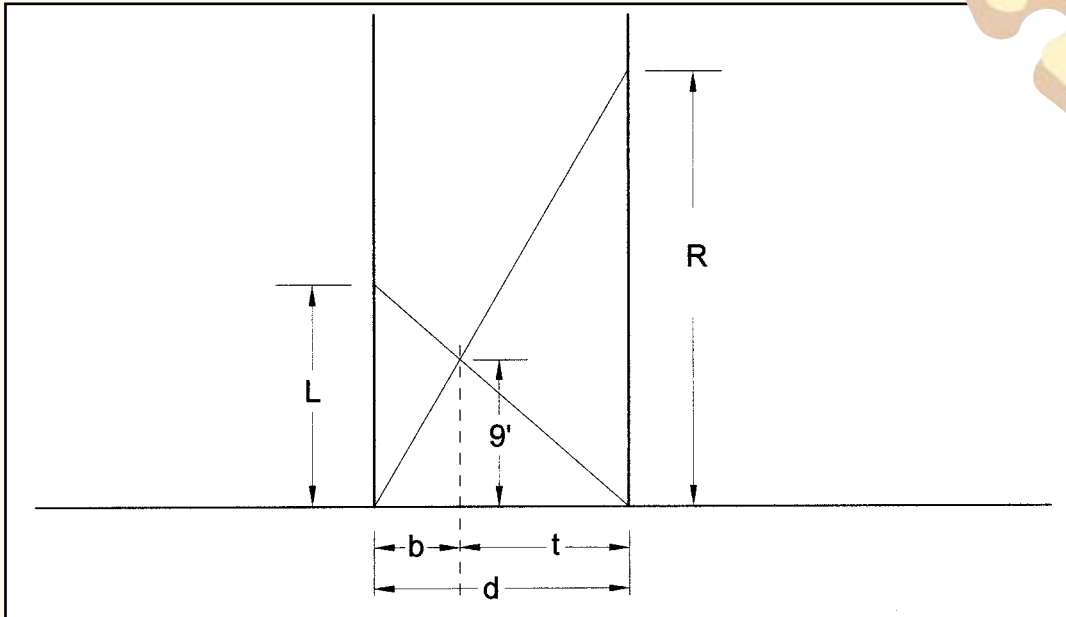
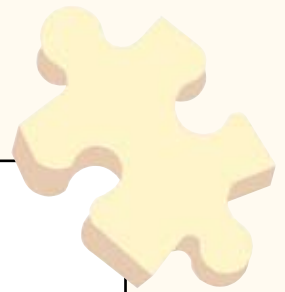




## Solution to Problem 117



By similar triangles,  $\frac{b}{9} = \frac{d}{R}$  and  $\frac{t}{9} = \frac{d}{L}$

$$b = 9d / R \text{ and } t = 9d / L$$

$$9d / R + 9d / L = d$$

$$1 / R + 1 / L = 1 / 9$$

$$L^2 = 20^2 - d^2 = 400 - d^2, \text{ so that } d^2 = 400 - L^2$$

$$R^2 = 30^2 - d^2 = 900 - d^2 = 900 - 400 + L^2 = 500 + L^2$$

$$1 / \sqrt{500 + L^2} + 1 / L - 1 / 9 = 0 \quad (1)$$

There is no direct solution, so iteration is necessary:

For  $L = 5$ , (1) yields 0.0933

For  $L = 10$ , (1) yields 0.0297 (The trend is towards zero)

For  $L = 15$ , (1) yields -0.0073 (Too far)

Linear interpolation between 10 and 15 gives  $L=14.0135$ , then (1) is -0.00186

Returning to  $L = 13$ , (1) yields 0.0045

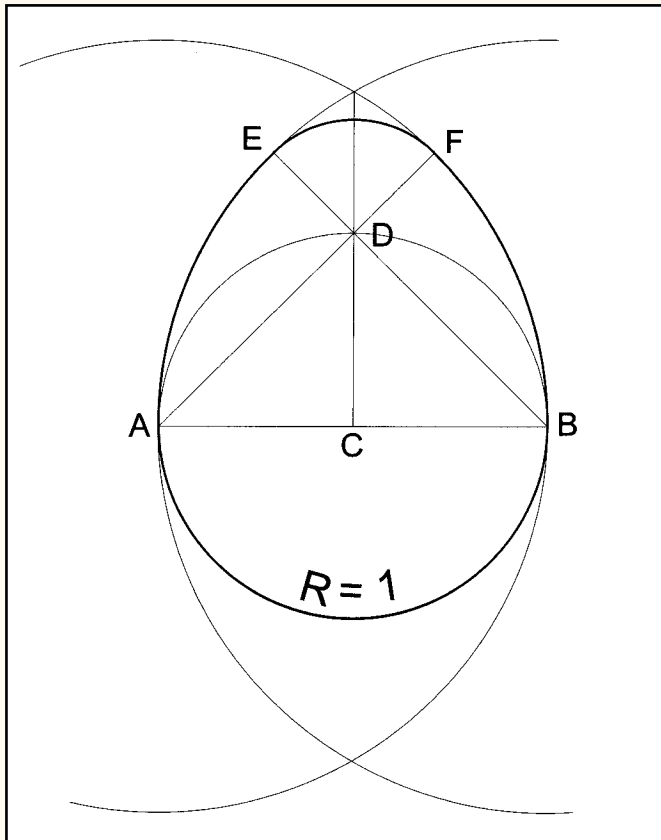
Interpolation between 13 and 14.0135 gives  $L= 13.7163$  and (1) is 0.00008

$$d^2 = 400 - L^2 = 400 - 13.7163^2 = 211.863, \quad d = 14.556'$$

Note: Equation (1) can be expanded into a fourth degree equation with one unknown and solved explicitly, but the algebra is tedious and complicated.



## Solution to Problem 118



$$A-C = C-B = C-D = 1$$

$$A-D = D-B = \sqrt{2}$$

$$E-D = D-F = 2 - \sqrt{2}$$

The area below line A-C-B,  $A_1 = \frac{1}{2} \pi 1^2 = \pi / 2$

Sector A-B-E = sector F-A-B =  $\frac{1}{8} \pi 2^2 = \pi / 2$

Sector E-D-F =  $\frac{1}{4} \pi (2 - \sqrt{2})^2 = 0.085786438 \pi$

Triangle A-D-B =  $2 \times 1 \times 1 \times \frac{1}{2} = 1$

Area<sub>egg</sub> =  $A_1 + \text{sector A-E-B} + \text{sector F-A-B} + \text{sector E-D-F} - \Delta A-D-B$

$$= \pi/2 + \pi/2 + \pi/2 + 0.085786438 \pi - 1 = 3.981895023$$