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Regulars

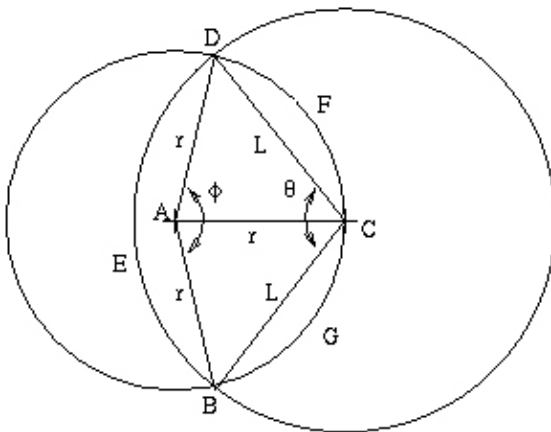
A Reader's Solution



The first correct solution we received for [Puzzle No 8 – The Gobbling Goat](#) was this one from V. Shashidhar.

You can see the more detailed [PASS Maths solution](#) for a step-by-step explanation of how to tackle the problem.

The answer to the question is 115.8 metres.



$r = 100$ meters; $L =$ length of the rope

It comes as a root to the equation

$$2r^2 \arcsin\left(\frac{L}{2r}\right) - \frac{L}{2} \sqrt{4r^2 - L^2} + L^2 \arccos\left(\frac{L}{2r}\right) = \frac{\pi r^2}{2} \quad (1)$$

where $r = 100$ metres and L is the length of the rope used to tie the goat.

The derivation is as follows (see figure):

A Reader's Solution

$$\begin{aligned}\theta &= 2 \arccos \frac{L}{2r} \\ \phi &= 4 \arcsin \frac{L}{2r} \\ \text{Area}(CDEB) &= \frac{\theta L^2}{2} \\ \text{Area}(DCF) &= \text{Area}(ADFC) - \text{Area}(ADC) \\ &= r^2 \arcsin \frac{L}{2r} - \frac{L}{4} \sqrt{4r^2 - L^2} \\ \text{Area}(EDFCGB) &= \text{Area}(CDEB) + 2\text{Area}(DCF) \\ &= \frac{\pi r^2}{2}\end{aligned}$$

This implies equation (1).



Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.