technical proof

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TP A.3
Minimum cue stick elevation required for a head-spot-to-foot-spot center-ball-hit shot

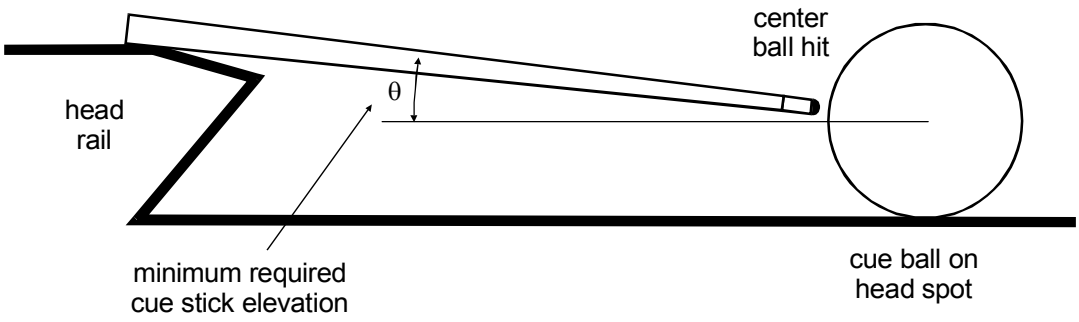
supporting:
"The Illustrated Principles of Pool and Billiards"
http://billiards.colostate.edu
by David G. Alciatore, PhD, PE ("Dr. Dave")

ball diameter: $D := 2.25 \cdot in$

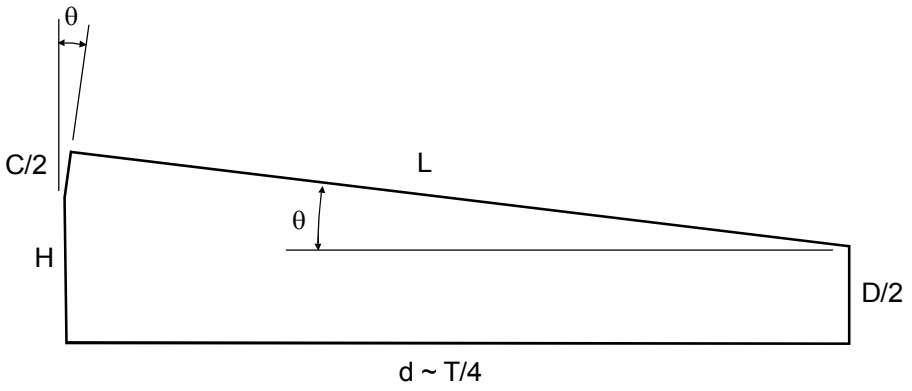
table size: $T := 8 \cdot ft$

rail height above playing surface: $H := \left(1 + \frac{11}{32}\right) \cdot in$

cue stick thickness at rail: $C := 0.722 \cdot in$



NOT DRAWN TO SCALE



initial guesses for unknowns:

$$d := \frac{T}{4} \qquad L := d \qquad \theta := 3 \cdot deg$$

Solving two loop closure equations (in the horizontal and vertical directions) for the unknown elevation angle:

Given

$$d = L \cdot \cos(\theta) + \frac{C}{2} \cdot \sin(\theta)$$

$$\frac{D}{2} + L \cdot \sin(\theta) = H + \frac{C}{2} \cdot \cos(\theta)$$

$$\begin{pmatrix} \theta \\ L \end{pmatrix} := Find(\theta, L)$$

$$\theta = 1.384\ deg \qquad L = 23.998\ in$$