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
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ball diameter: \( D := 2.25 \text{ in} \)

table size: \( T := 8 \text{ ft} \)

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

cue stick thickness at rail: \( C := 0.722 \text{ in} \)

NOT DRAWN TO SCALE
initial guesses for unknowns:

\[ d := \frac{T}{4}, \quad L := d, \quad \theta := 3 \text{ deg} \]

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

Given

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

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

\[ \begin{pmatrix} \theta \\ L \end{pmatrix} := \text{Find}(\theta, L) \]

\[ \theta = 1.384 \text{ deg} \quad L = 23.998 \text{ in} \]