Solution

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Draw QC, CD, DA and AC.

QCDA is a rhombus.

Angle CQA = 60°. Angle CAE = 30°.

QD is perpendicular to AC.

$EA = \frac{\sqrt{3}}{3}$

$AH = 3 - \frac{\sqrt{3}}{3}, AB = 2$

$BH = \sqrt{\frac{40}{3} - 2\sqrt{3}} = 3.14153$, within 0.00006 of π.