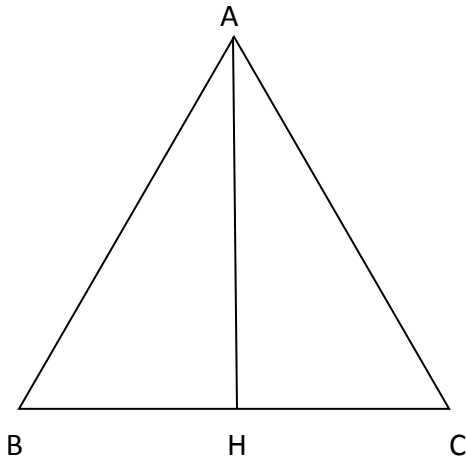


## Answer on Question #61214 – Math – Trigonometry

### Question

Evaluate  $\tan 30^\circ$  without using a calculator by using ratios in a reference triangle.

### Solution



Let ABC be an equilateral triangle with  $AB = AC = BC = 1$ .

Drop an altitude  $AH$  from the top angle  $A$ , which cut the angle in half, dividing the equilateral triangle into two right triangles with a  $30^\circ$  degree angle. Because  $AH$  is a median,

$$BH = HC = \frac{BC}{2} = \frac{1}{2}.$$

Using the Pythagorean Theorem

$$AH^2 + BH^2 = AB^2,$$

$$AH^2 = AB^2 - BH^2,$$

$$AH^2 = 1^2 - \left(\frac{1}{2}\right)^2 = 1 - \frac{1}{4} = \frac{3}{4},$$

find

$$AH = \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2}.$$

By definition,  $\tan 30^\circ$  is given by

$$\tan 30^\circ = \tan \angle BAH = \frac{BH}{AH},$$

$$\tan 30^\circ = \frac{\frac{1}{2}}{\frac{\sqrt{3}}{2}} = \frac{1}{2} \cdot \frac{2}{\sqrt{3}} = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} \approx 0.577.$$

**Answer:**  $\frac{\sqrt{3}}{3}$ .