Using Trigonometry with Right Triangles

The word *trigonometry* comes from two Greek terms, *trigon* meaning triangle and *metron* meaning measure.

A ratio of the lengths of sides of a right triangle is called a ***trigonometric ratio***. The three most common ratios are **sine**, **cosine**, and **tangent**. Their abbreviations are *sin*, *cos*, and *tan*.

Trigonometric Ratio	Abbreviation	Definition
sine of $\angle A$	sin A	$\frac{\text{opposite}}{\text{hypotenuse}}$
cosine of $\angle A$	cos A	$\frac{\text{adjacent}}{\text{hypotenuse}}$
tangent of $\angle A$	tan A	$\frac{\text{opposite}}{\text{adjacent}}$

Sine
Opposite
Hypotenuse

Cosine
Adjacent
Hypotenuse

Tangent
Opposite
Adjacent

SOH CAH TOA

Example 1

Find the sin S, cos S, tan S, sin E, cos E, and tan E. Express each ratio as a fraction.

$\sin S = \frac{3}{5}$

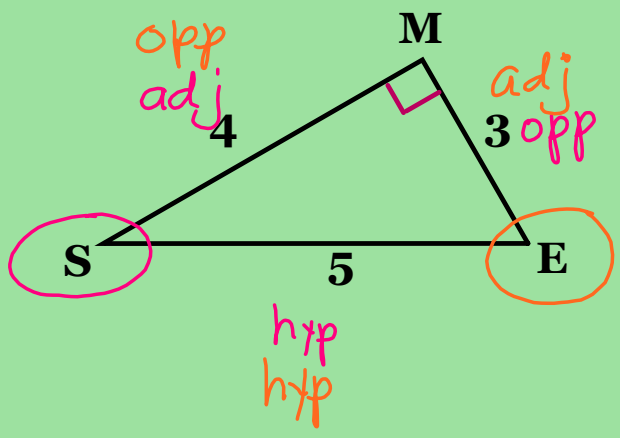
$\cos S = \frac{4}{5}$

$\tan S = \frac{3}{4}$

$\sin E = \frac{4}{5}$

$\cos E = \frac{3}{5}$

$\tan E = \frac{4}{3}$



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Example 2

Find the sin A, cos A, tan A, sin B, cos B, and tan B. Express each ratio as a fraction.

$\sin A = \frac{10}{26} = \frac{5}{13}$

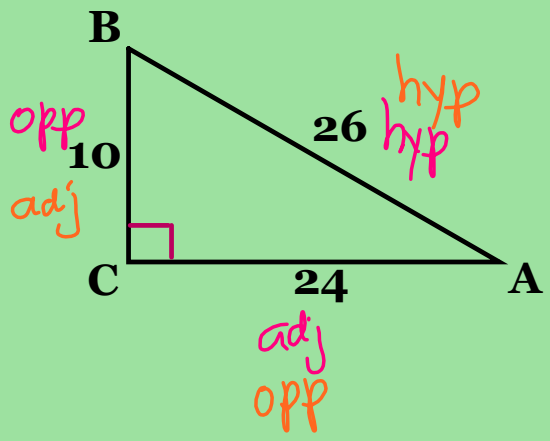
$\cos A = \frac{24}{26} = \frac{12}{13}$

$\tan A = \frac{10}{24} = \frac{5}{12}$

$\sin B = \frac{24}{26} = \frac{12}{13}$

$\cos B = \frac{10}{26} = \frac{5}{13}$

$\tan B = \frac{24}{10} = \frac{12}{5}$



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Before using the trig functions on the calculator, make sure that the calculator mode is set in degrees.

Example 3

Find each value using a calculator. Round to the nearest ten thousandths.

a) $\cos 41^\circ \approx 0.7547$

b) $\sin 78^\circ \approx .9781$

c) $\cos 84^\circ \approx .1045$

d) $\sin 43^\circ \approx .6820$

Example 4

Solve for x.

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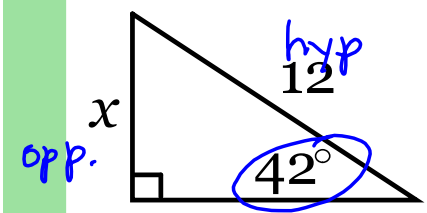


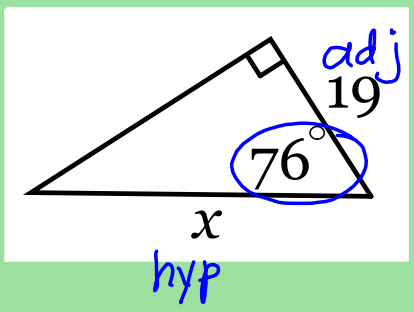
$12 \cdot \sin 42^\circ = \frac{x}{12} \cdot 12$

$12 \cdot \sin 42^\circ = x$

$8.0 \approx x$

Example 5
Solve for x.

~~SOH~~ CAH ~~TOA~~



$x \cdot \cos 76° = \frac{19}{x} \cdot x$

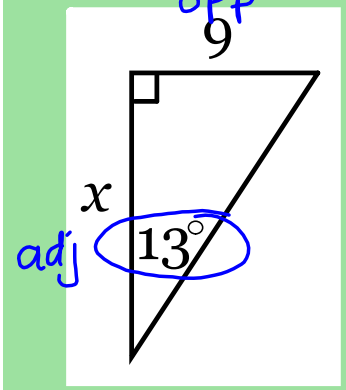
$\frac{x \cdot \cos 76°}{\cos 76°} = \frac{19}{\cos 76°}$

$x = \frac{19}{\cos 76°}$

$x \approx 78.5$

Example 6
Solve for x.

~~SOH~~ ~~CAH~~ TOA



$x \cdot \tan 13° = \frac{9}{x} \cdot x$

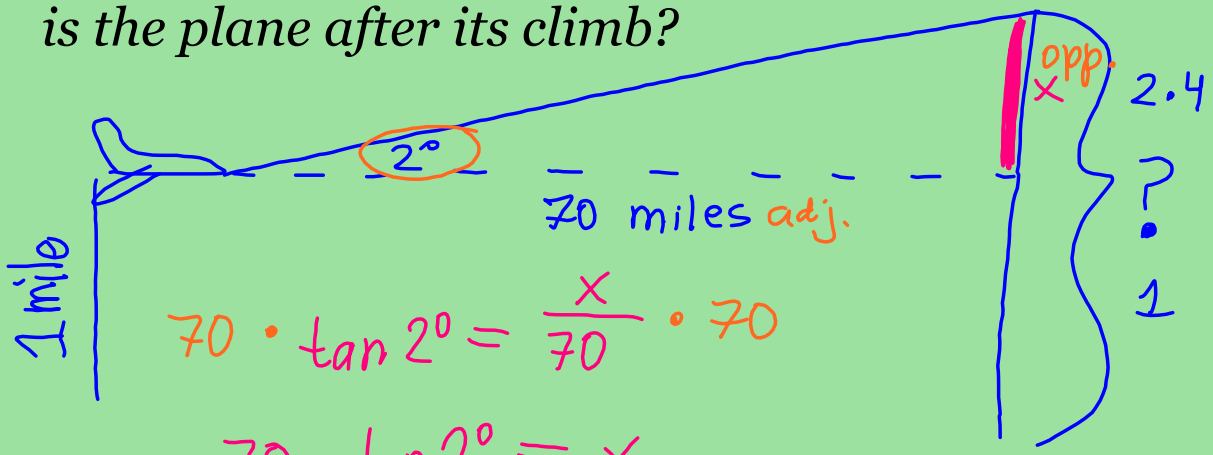
$\frac{x \cdot \tan 13°}{\tan 13°} = \frac{9}{\tan 13°}$

$x = \frac{9}{\tan 13°}$

$x \approx 39.0$

Example 7

A plane is one mile above sea level when it begins to climb at a constant angle of 2° for the next 70 ground miles. How far above sea level is the plane after its climb?



$70 \cdot \tan 2^\circ = \frac{x}{70} \cdot 70$

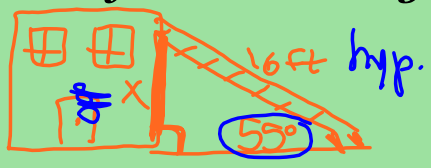
$70 \cdot \tan 2^\circ = x$

$x \approx 2.4$

3.4 miles above sea level

Example 8

A 16-foot ladder is propped against a building. The angle it forms with the ground measures 55°. How far up the side of the building does the ladder reach?



$16 \cdot \sin 55^\circ = \frac{x}{16} \cdot 16$

$16 \cdot \sin 55^\circ = x$

$x \approx 13.1$ ft