Math 1330 - Section 7.1
Solving right triangles

In this section, we will solve right triangles, which means that you will find all lengths and measures that were not given. You will use the six trigonometric functions of an angle to do this.

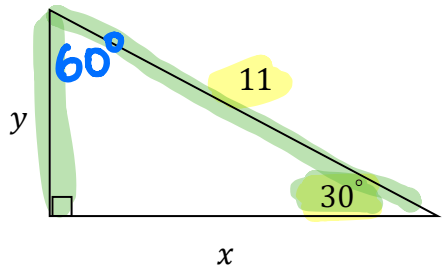
$\sin\theta = \frac{opposite}{hypotenuse}$ $\quad\quad$ $\cot\theta = \frac{adjacent}{opposite}$

$\cos\theta = \frac{adjacent}{hypotenuse}$ $\quad\quad$ $\sec\theta = \frac{hypotense}{adjacent}$

$\tan\theta = \frac{opposite}{adjacent}$ $\quad\quad$ $\csc\theta = \frac{hypotense}{opposite}$

A useful mnemonic device: SOH-CAH-TOA

Example 1: Use the given angle and the given side to find x and y in the triangle below.



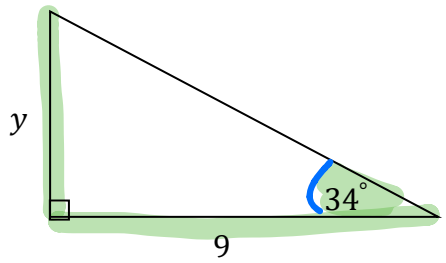
$11\cdot\cos(30^\circ) = \frac{x}{11}\cdot 11$

$x = 11\cos(30^\circ) = \boxed{\frac{11\cdot\sqrt{3}}{2}}$

$11\cdot\sin(30^\circ) = \frac{y}{11}\cdot 11$

$y = 11\cdot\sin(30^\circ) = 11\cdot\frac{1}{2} = \boxed{\frac{11}{2}}$

Example 2: Use the given angle and the given side to find y in the triangle below.

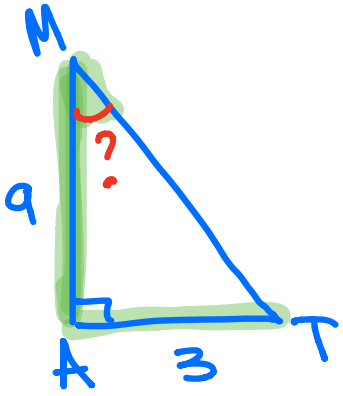


$9 \cdot \tan(34°) = \frac{y}{9} \cdot 9$

$y = 9 \cdot \tan(34°)$ test

Calculator
Use on quizzes & homework → $y = 6.07$

Example 3: In ΔMAT with right angle A, $MA = 9$ cm and $AT = 3$ cm. Use the given information to find the measure of angles M and T.



$\tan M = \frac{3}{9} = \frac{1}{3}$

$\tan M = \frac{1}{3}$

$m\angle M = \arctan\left(\frac{1}{3}\right)$ test

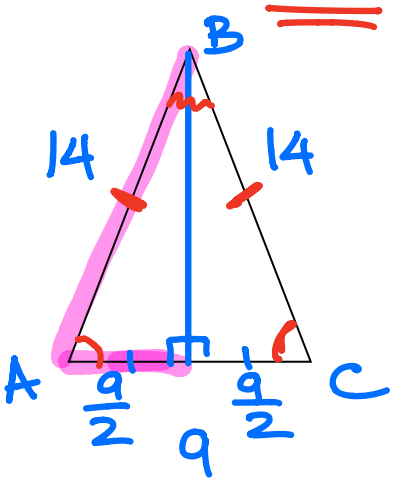
calculator
$= 18.43°$ quiz or hw

$m\angle M + m\angle T = 90°$

$m\angle T = 90 - \arctan\left(\frac{1}{3}\right)$ test

$= 90 - 18.43 = 71.57°$ quiz

Example 4: An isosceles triangle has sides measuring 9 inches, 14 inches, and 14 inches. What are the measures of its angles?



$\cos A = \frac{9}{2} \div 14 = \frac{9}{2} \cdot \frac{1}{14}$

$\cos A = \frac{9}{28}$

$m\angle A = \arccos\left(\frac{9}{28}\right)$ test

$= \cos^{-1}\left(\frac{9}{28}\right)$

calc. $= 71.25°$

$m\angle C = 71.25°$

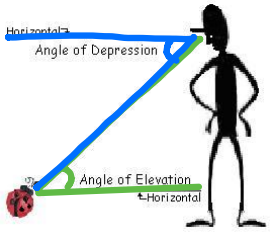
$m\angle A + m\angle C + m\angle B = 180°$

$m\angle B = 180 - 2\arccos\left(\frac{9}{28}\right) = 180 - 2(71.25)$

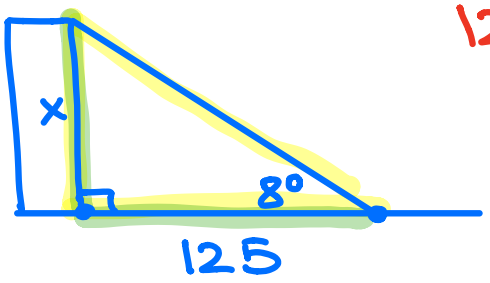
$= 37.5°$

An **angle of elevation** is an angle that is formed by a ~~horizontal~~ ray and another ray above the horizontal.

An **angle of depression** is an angle that is formed by a ~~horizontal~~ ray and another ray below the horizontal.



Example 5: The angle of elevation to the top of a building from a point on the ground 125 feet away from the building is 8°. How tall is the building?

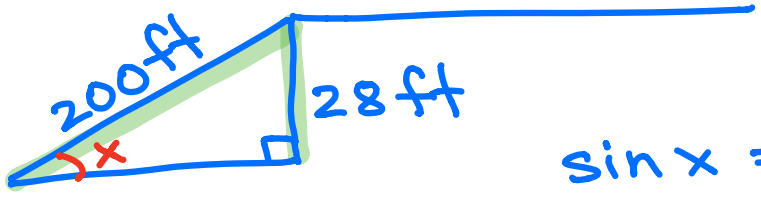


$125 \cdot \tan(8°) = \frac{x}{125} \cdot 125$

$x = 125 \cdot \tan(8°)$ test

calcul. = 17.57 ft quiz

Example 6: A ramp leading to the freeway overpass is 200 feet long and rises 28 feet. What is the angle of elevation of the ramp to the freeway?

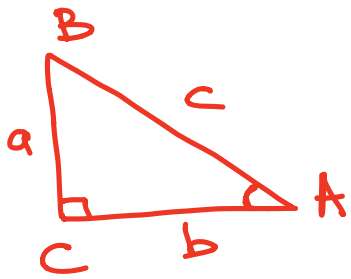


$\sin x = \frac{28}{200} = \frac{7}{50}$

$\sin x = \frac{7}{50}$

$x = \arcsin\left(\frac{7}{50}\right)$

$= 8.05°$

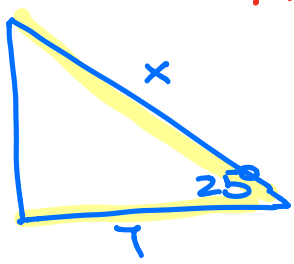


$\cos A = \frac{b}{c}$ $\quad \sin A = \frac{a}{c}$

$c \cos A = b$ $\quad c \sin A = a$

$c = \frac{b}{\cos A}$ $\quad c = \frac{a}{\sin A}$

$\tan A = \frac{a}{b}$ $\quad a = b \cdot \tan A$ $\quad b = \frac{a}{\tan A}$



$x \cos(25°) = \frac{7}{x} \cdot x$

$x \cos(25°) = 7$

$x = \frac{7}{\cos(25°)}$