

# Trigonometry for Physics

There are 3 trig functions that you will use on a regular basis in physics problems: sine, cosine and tangent. An easy way to remember them is: SOH CAH TOA

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \quad \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \quad \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

The Pythagorean theorem is another formula that you will use frequently in physics.

$$a^2 + b^2 = c^2$$

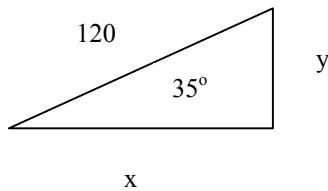
Often in physics problems you are given the magnitude of a vector (the hypotenuse of a right triangle) and one of the angles in the triangle. You then need to determine the x and y components of the triangle. (This is where it is important that you understand how to use vectors, see information on vectors)

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} \Rightarrow (\text{hypotenuse})(\sin\theta) = \text{opposite}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} \Rightarrow (\text{hypotenuse})(\cos\theta) = \text{adjacent}$$

## Example:

A projectile is fired into the air at a  $35^\circ$  angle to the horizontal and an initial velocity of 120 m/s, what are the x and y components of the velocity vector?



$$\sin 35 = \frac{y}{120\text{m/s}} \Rightarrow (120\text{ m/s})(\sin 35) = \text{velocity in the y direction} = \mathbf{69\text{ m/s}}$$

$$\cos 35 = \frac{x}{120\text{m/s}} \Rightarrow (120\text{ m/s})(\cos 35) = \text{velocity in the x direction} = \mathbf{98\text{ m/s}}$$

$69^2 + 98^2 = 120^2$  Since this is true you know that the 2 velocities you calculated are correct.

## Problems:

1. A block slides down a  $45^\circ$  slope for a total of 2.8 meters. What is the change in the height of the block?

**Solution**

2. A 65 meter rope that is connected to the top of the building, it is attached to the ground 50 meters from a building. What angle does the rope make with the ground?

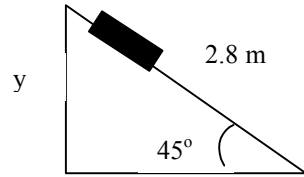
**Solution**

3. A projectile has an initial horizontal velocity of 5 m/s and an initial vertical velocity of 3 m/s second upward. At what angle was the projectile fired?

**Solution**

## Solutions:

1. A block slides down a  $45^\circ$  slope for a total of 2.8 meters. What is the change in the height of the block?

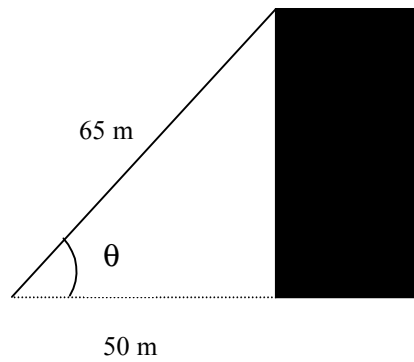


$$\sin 45^\circ = \frac{y}{2.8m}$$

$$(2.8m)(\sin 45^\circ) = y \Rightarrow y = 2.0 \text{ m}$$

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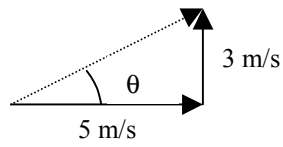


$$\cos \theta = \frac{50m}{65m} = 0.769$$

$$\cos^{-1} 0.769 = \theta \quad \Rightarrow \quad \theta = 40^\circ$$

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3. A projectile has an initial horizontal velocity of 5 m/s and an initial vertical velocity of 3 m/s second upward. At what angle was the projectile fired?



$$\tan \theta = \frac{3m/s}{5m/s} = 0.6$$

$$\tan^{-1} 0.6 = \theta \quad \Rightarrow \quad \theta = 31^\circ$$

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