H2.01

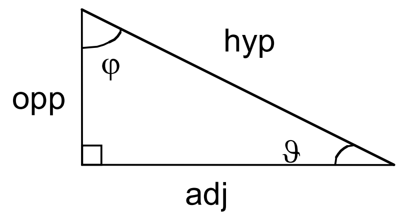
TRIGONOMETRY FOR PHYSICS

Right Triangle Trigonometry

This is a right triangle.

$\vartheta + \varphi = 90°$

ϑ = "theta" (also θ)
φ = "phi" (also ϕ)



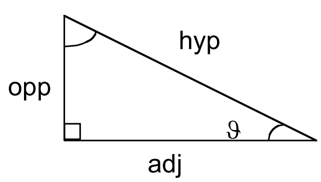
We will **always** label the angle that we are interested in finding ϑ, so forget φ. Label the side across from the angle ϑ "opp" for opposite. Label the side next to ϑ "adj" for adjacent. Label the side across from the right angle "hyp" for hypotenuse.

Three trigonometric functions are all that we need: sine, cosine, and tangent.

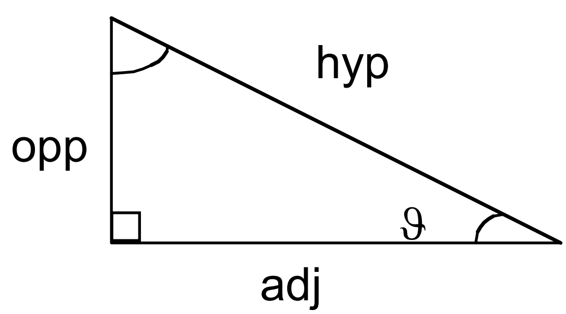
$$\boxed{\sin\vartheta = \frac{opp}{hyp} \quad \cos\vartheta = \frac{adj}{hyp} \quad \tan\vartheta = \frac{opp}{adj}}$$

Know this:

SOH – CAH – TOA

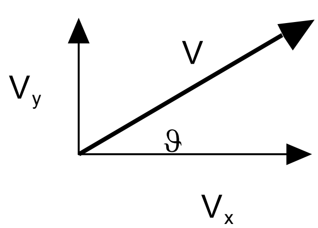


Since any two right triangles with the same angles are **similar**, the sine, cosine, and tangent do not depend on the size of the triangle.



Here is a practical application:

Suppose that you have the velocity vector pictured below.



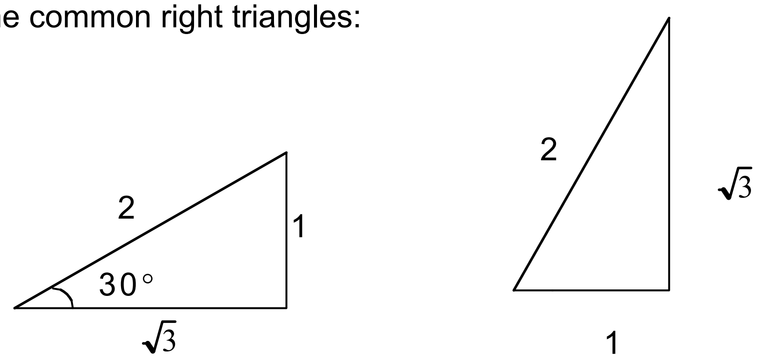
Suppose that you know V and wish to calculate V_y.

$\frac{V_y}{V} = \frac{opp}{hyp} = \sin\vartheta$; $\boxed{V_y = V\sin\vartheta}$

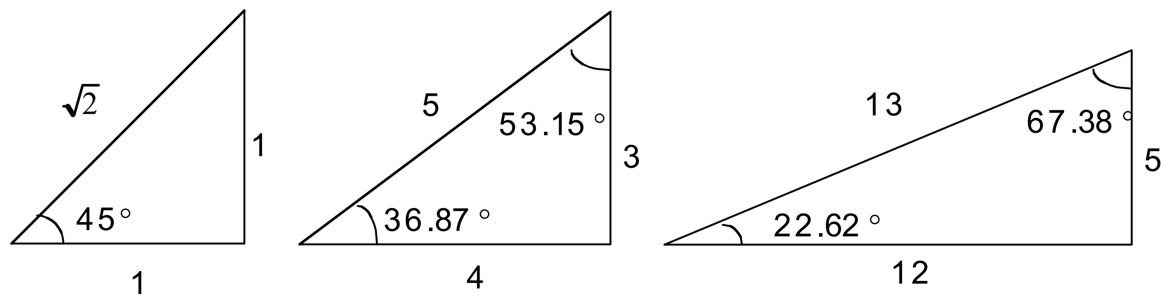
and, by the same reasoning,

$\frac{V_x}{V} = \frac{adj}{hyp} = \cos\vartheta$; $\boxed{V_x = V\cos\vartheta}$

Some common right triangles:



Note: These are the same triangle!



Important angles:

Angle	sin ϑ	cos ϑ	tan ϑ
0°	0	1	0
22.62°	$\frac{5}{13} \approx 0.3846$	$\frac{12}{13} \approx 0.9231$	$\frac{5}{12} \approx 0.4167$
30°	$\frac{1}{2} = 0.5$	$\frac{\sqrt{3}}{2} \approx 0.8660$	$\frac{\sqrt{3}}{3} \approx 0.5774$
36.87°	$\frac{3}{5} = 0.6$	$\frac{4}{5} = 0.8$	$\frac{3}{4} = 0.75$
45°	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{2}}{2}$	1
53.13°	$\frac{4}{5} = 0.8$	$\frac{3}{5} = 0.6$	$\frac{4}{3} \approx 1.333$
60°	$\frac{\sqrt{3}}{2} \approx 0.8660$	$\frac{1}{2} = 0.5$	$\sqrt{3} \approx 1.732$
67.38°	$\frac{12}{13} \approx 0.9231$	$\frac{5}{13} \approx 0.3846$	$\frac{12}{5} = 2.4$
90°	1	0	u/d
180°	0	-1	0
270°	-1	0	u/d

Note: sin ϑ and cos ϑ are always ≤ 1!