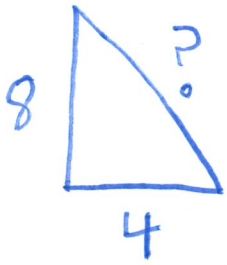
Pythagorean Theorem Review

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

legs of a right triangle

hypotenuse

You can determine the length of the hypotenuse of a right triangle if you have the legs.



$8^2 + 4^2 = c^2$

$64 + 16 = c^2$

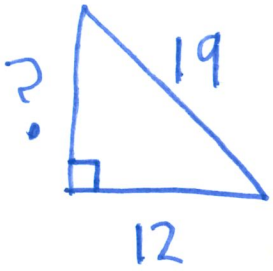
$80 = c^2$

$\sqrt{80} = c$

$8.944 = c$

$\sqrt{8^2 + 4^2} = c$

You can determine the length of one of the legs of a right triangle if you have one of the legs and the hypotenuse.

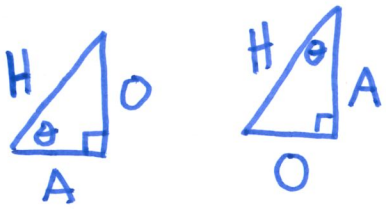


$12^2 + b^2 = 19^2$

$19^2 - 12^2 = b^2$

$\sqrt{19^2 - 12^2} = 14.73$

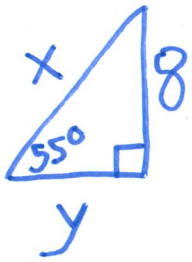
≈ 15



Right Angle Trig Review

Remember $\sin\theta = \frac{Opp}{Hyp}$ $\cos\theta = \frac{Adj}{Hyp}$ $\tan\theta = \frac{Opp}{Adj}$

You can determine the length of the unknown side of a right triangle using trig:



$\tan 55 = \frac{8}{y}$

$y = \frac{8}{\tan 55} = 5.6$

$x \frac{\sin 55^\circ}{1} = \frac{8}{x} x$

$x \sin 55^\circ = 8$

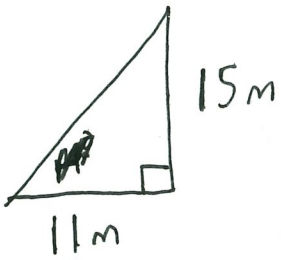
$x = \frac{8}{\sin 55}$ $x = 9.8$

$\cos 48 = \frac{x}{14}$

$14 \cdot \cos 48 = x$

$x = 9.4$

You can determine an unknown angle of a right triangle using trig:



$\tan\theta = \frac{15m}{11m}$

$\tan^{-1}\left(\frac{15}{11}\right) = \theta$

$\theta = 54^\circ$

2-D Vectors

Recall a scalar has only magnitude where as a vector has both magnitude and direction.

Sketch the following displacements

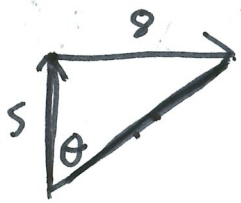
5 metres North

5 metres East

5m SW

5m 25° N of E

To add vectors we put them tail to tip. Frank walks 5 metres North and 8 metres East. What is their displacement?



$\sqrt{5^2 + 8^2} = 9.4m$

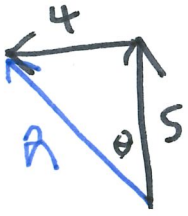
$\approx 9m$

$\tan^{-1}\left(\frac{8}{5}\right) = 58° \approx 60°$

9m, 60° E of N

To subtract vectors we add the opposite. Consider 5m North minus 4m East, What is the result?

5mN + 4mW



$\sqrt{4^2 + 5^2} = 6.4m \approx 6m$

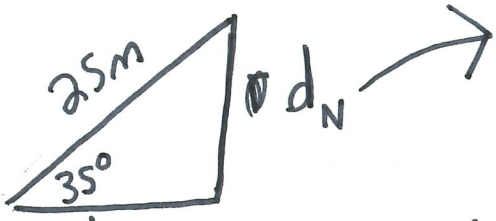
$\tan^{-1}\left(\frac{4}{5}\right) = 39° \approx 40°$

6m, 40° W of N

Vector Components

We can break a vector into its horizontal and vertical ___components___

Someone walks 25m 35° North of East. How far to the North have they gone? How far to the East?



$\sin 35 = \frac{d_N}{25m}$

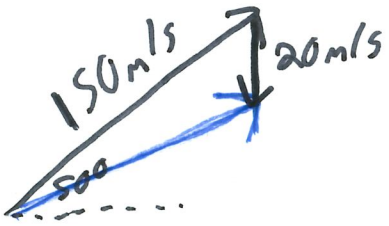
$25 \times \sin 35 = 14.3m$

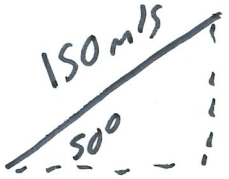
Went 14m North, 2.0x10' m East

d_E → $\cos 35 = \frac{d_E}{25}$ → $d_E = 25 \times \cos 35 = 20.5m$

We can use components to add (or subtract) vectors which are not at right angles.

A plane is pointed 50° North of East and is flying at 150 m/s relative to the air. There is a wind blowing 20 m/s due south. How fast and in what direction does the plane travel?

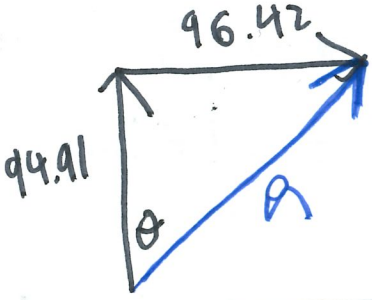




$\sin 50 \times 150 = 114.91 m/s$

$\cos 50 \times 150 = 96.42 m/s$

20 m/s



$\sqrt{94.91^2 + 96.42^2}$

$= 135.29 m/s$

$\approx 100 m/s$

$\tan^{-1}\left(\frac{96.42}{94.91}\right) = 45° \approx 50°$

100 m/s, 50°

North/South direction

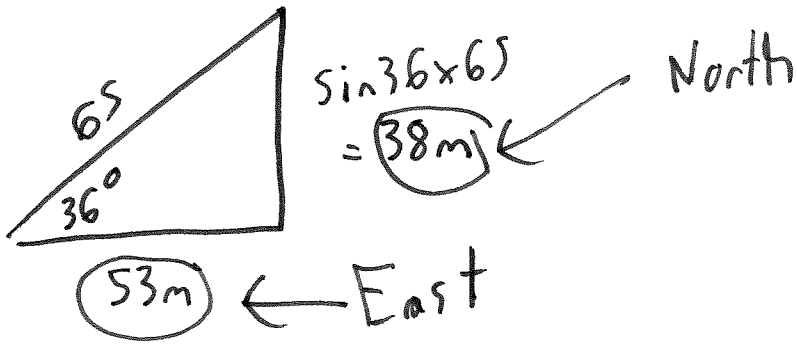
114.91 m/s N + 20 m/s S

$= 94.91 m/s$ N

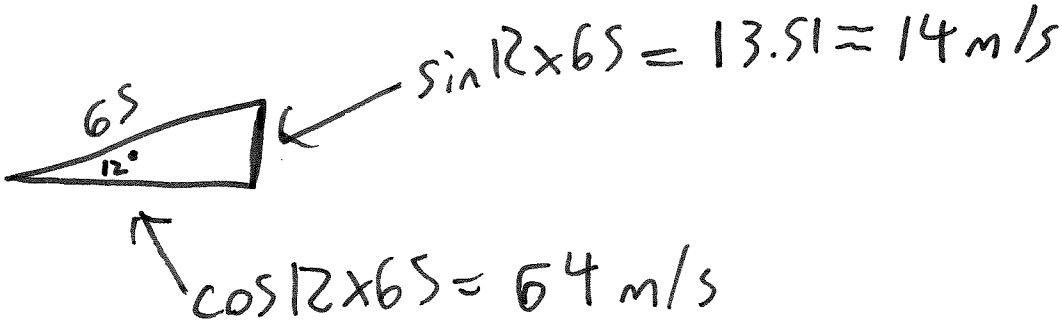
East/West direction

96.42 m/s E

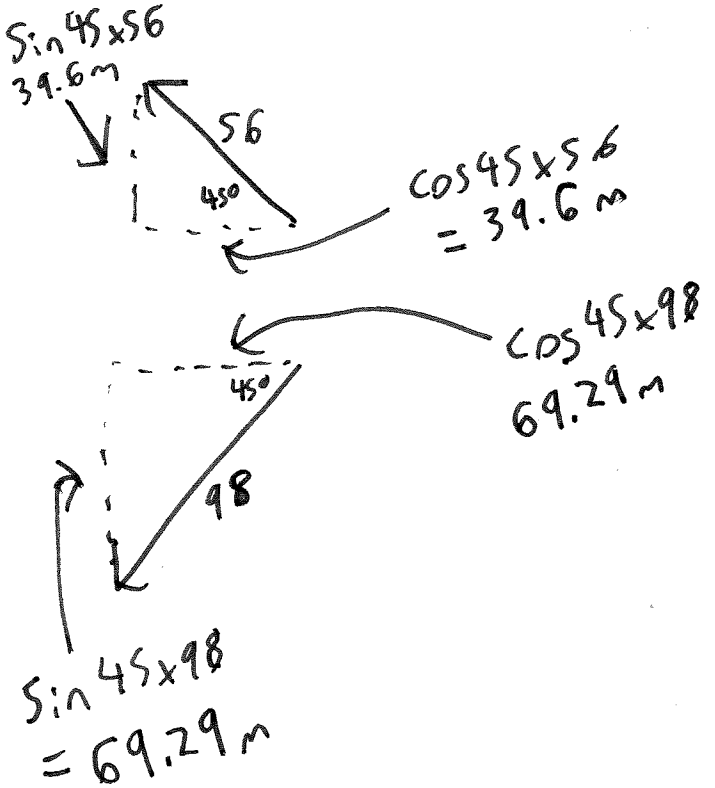
Practice: Roughly sketch 65m, 36° N of E. Then break it into its North component and East component.



Roughly sketch 65m/s, 12° above the horizontal, and break it into its vertical and horizontal components.



Use components to add: 56 m NW + 98 m SW



North/South direction

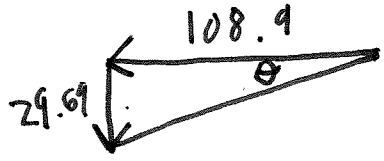
39.6m N + 69.29m S

= 39.6m N − 69.29m S

= −29.69m N = 29.69m S

East/West

39.6m W + 69.29m W = 108.9m W



$\sqrt{29.69^2 + 108.9^2}$

$\tan^{-1}\left(\frac{29.69}{108.9}\right)$

110m, 15° S of W