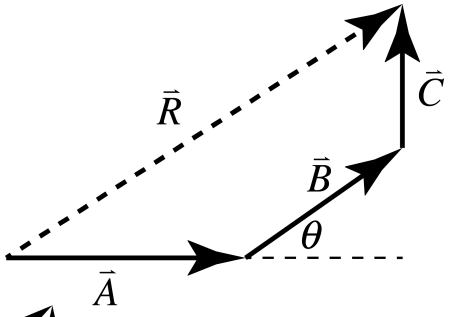
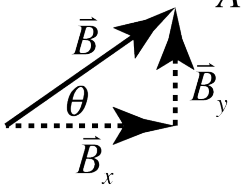
Flipping Physics Lecture Notes:
Introductory Vector Addition Problem using Component Vectors

Example Problem: Slow Velocity Racer races 50.0 cm East, then turns 35° North of East and scoots for 40.0 cm. She then turns and moseys another 30.0 cm North. What was her total displacement?



$\vec{A} = 50.0cm\ E$, $\vec{B} = 40.0cm\ N\ of\ E$, $\vec{C} = 30.0cm\ N$ &
$\vec{A} + \vec{B} + \vec{C} = \vec{R} = ?$

Break vector $\vec{B}$ in to its components.

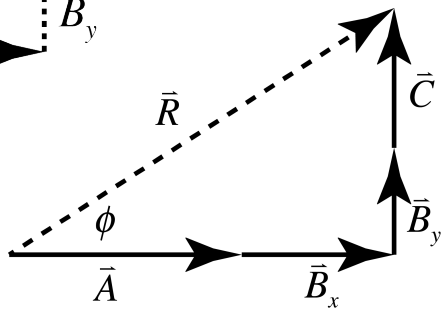


$$\sin\theta = \frac{O}{H} = \frac{\vec{B}_y}{\vec{B}} \Rightarrow \vec{B}_y = \vec{B}\sin\theta = 40\sin(35) = 22.943cm$$

$$\cos\theta = \frac{A}{H} = \frac{\vec{B}_x}{\vec{B}} \Rightarrow \vec{B}_x = \vec{B}\cos\theta = 40\cos(35) = 32.766cm$$

Redraw the Vector Diagram.

And now we have a right triangle and can use SOH CAH TOA and the Pythagorean theorem.



$$a^2 + b^2 = c^2 \Rightarrow R^2 = \left(A + B_x\right)^2 + \left(B_y + C\right)^2$$

$$\Rightarrow R = \sqrt{\left(A + B_x\right)^2 + \left(B_y + C\right)^2} = \sqrt{\left(50 + 32.766\right)^2 + \left(22.943 + 30\right)^2} = 98.251cm$$

$$\tan\phi = \frac{O}{A} = \frac{B_y + C}{A + B_x} \Rightarrow \phi = \tan^{-1}\left(\frac{B_y + C}{A + B_x}\right) = \tan^{-1}\left(\frac{22.943 + 30}{50 + 32.766}\right) = 32.606°$$

$$\Rightarrow \boxed{\vec{R} \approx 98cm\ @\ 33°\ N\ of\ E}$$

Flipping Physics Lecture Notes:
Using a Data Table to Make Vector Addition Problems Easier

An Easy way to see that this works is by using a table.

Vector	x-direction (cm)	y-direction (cm)
$\vec{A}$	50	0
$\vec{B}$	32.766	22.943
$\vec{C}$	0	30
$\vec{R}$	$\vec{R}_x = 50 + 32.766 + 0 = 82.766$	$\vec{R}_y = 0 + 22.943 + 30 = 52.943$

And you can see that the components $\vec{R}_x$ and $\vec{R}_y$ add up to vector $\vec{R}$.