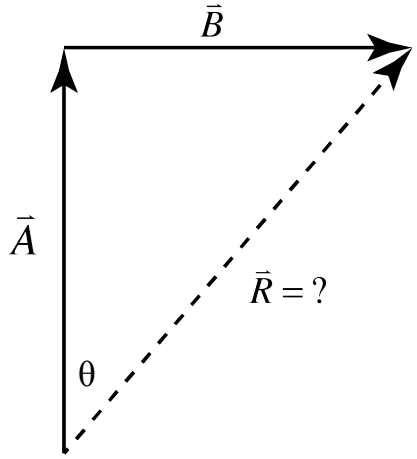
Flipping Physics Lecture Notes:
Introductory Tip-to-Tail Vector Addition Problem

Determining the velocity of the track: $v = \frac{\Delta x}{\Delta t} = \frac{600 mm\ North}{12.2\ \text{sec}} = 49.180 \approx 49 \frac{mm}{s} North$

The Velocity Vectors: $[Track]\ \vec{A} = 49 \frac{mm}{s} North\ \ \&\ \ [racecar] \vec{B} = 42 \frac{mm}{s} East$



$\vec{A} + \vec{B} = \vec{R} = ?$

This is called Tip-to-Tail Vector Addition. To add vectors $\vec{A}$ and $\vec{B}$, the tip of vector $\vec{A}$ is placed on the tail of vector $\vec{B}$. The result is called the Resultant Vector $\vec{R}$, which is what we are trying to find.

We can find the magnitude of $\vec{R}$ by using the Pythagorean theorem:

$$a^2 + b^2 = c^2 \Rightarrow R^2 = A^2 + B^2 \Rightarrow R = \sqrt{A^2 + B^2} = \sqrt{49^2 + 42^2} = 64.537 \approx 65 \frac{mm}{s}$$

We can find the direction of $\vec{R}$ by using SOH CAH TOA:

$$\tan\theta = \frac{O}{A} = \frac{B}{A} = \frac{42}{49} \Rightarrow \theta = \tan^{-1}\left(\frac{42}{49}\right) = 40.601° \approx 41°$$

Therefore the resultant velocity *vector* $\vec{R}$ is: $\boxed{\vec{R} \approx 65 \frac{mm}{s} @ 41°\ E\ of\ N}$

In other words: $\vec{A} + \vec{B} = \vec{R} \Rightarrow 49 \frac{mm}{s} North + 42 \frac{mm}{s} East \approx 65 \frac{mm}{s} @ 41° E\ of\ N$

(The cardinal direction East of North will be explained in the next video)