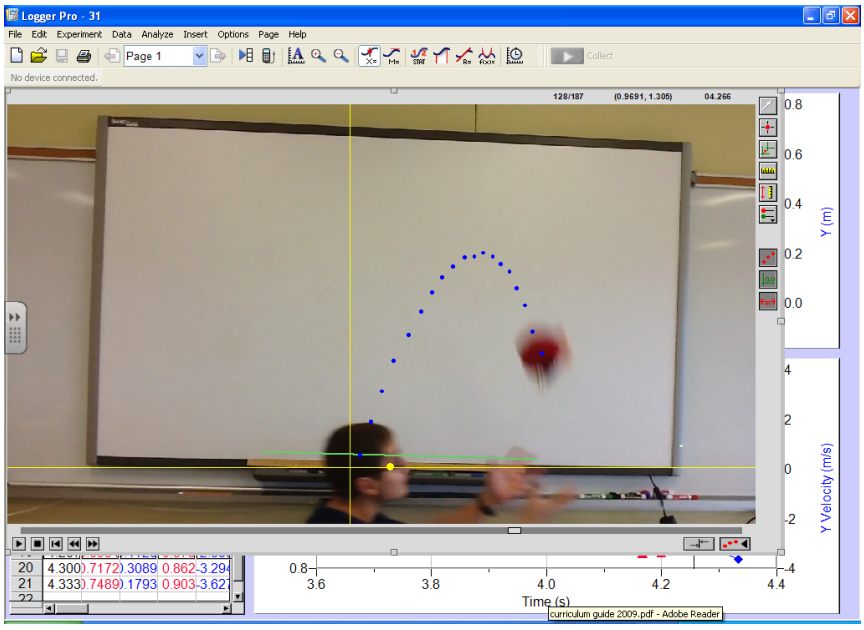
Relative Velocity

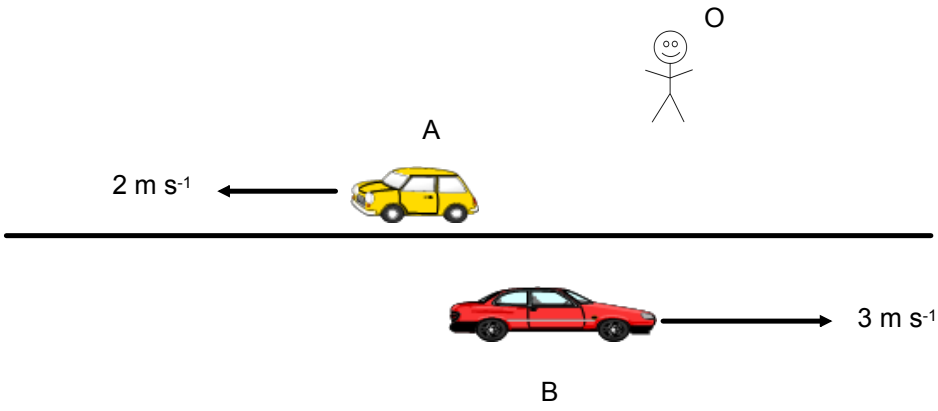
The motion of a ball thrown up in a train depends on the observer's frame of reference.

To the observer in the train..... ball goes straight up/down

To the observer outside the train..... ball follows a parabolic trajectory



Relative Velocity in one dimension



What is the velocity of B relative to A?

$5\ m\,s^{-1}\ [E]$

$$\vec{V}_{BA} = \vec{V}_{BO} - \vec{V}_{AO}$$

$$= 3\,ms^{-1}[E] - 2\,ms^{-1}[W]$$

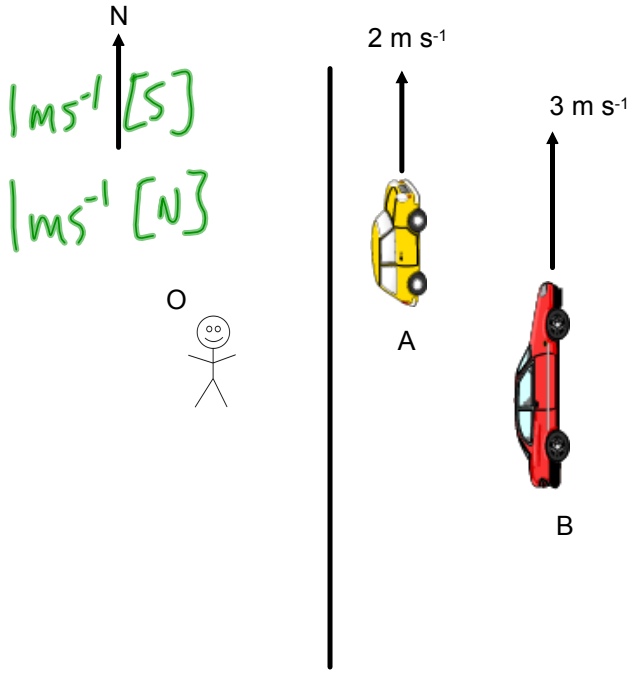
$$= 3\,ms^{-1}[E] - (-2\,ms^{-1}[E])$$

$$= 5\,ms^{-1}[E]$$

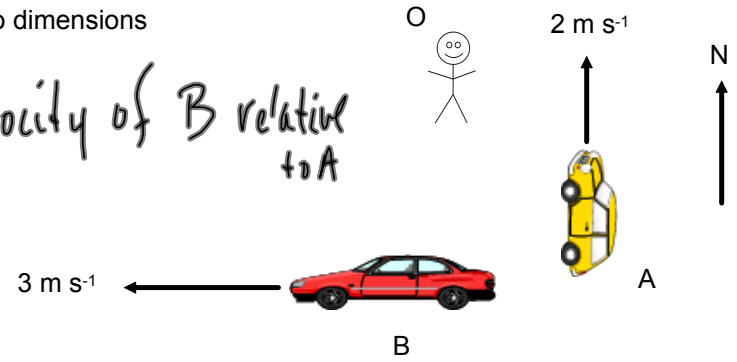
Example:

What is the velocity of A relative to B? 1 ms^{-1} [S]

What is the velocity of B relative to A? 1 ms^{-1} [N]



Relative velocity in two dimensions



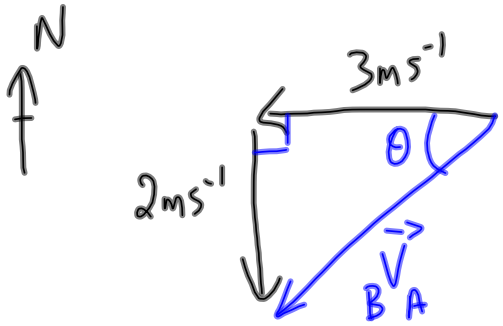
What is the velocity of B relative to A

$$\vec{V}_{BA} = \vec{V}_{BO} - \vec{V}_{AO}$$

$$\vec{V}_{BA} = 3ms^{-1}[W] - 2ms^{-1}[N]$$

$$\vec{V}_{BA} = 3ms^{-1}[W] + (-2ms^{-1}[N])$$

$$\vec{V}_{BA} = 3ms^{-1}[W] + 2ms^{-1}[S]$$



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

$$c^2 = (2ms^{-1})^2 + (3ms^{-1})^2$$

$$c = 3.6\ ms^{-1}$$

$$c = 4ms^{-1}$$

$$\vec{V}_{BA} = 4ms^{-1}[W34°S]$$

$$\tan\theta = \frac{2ms^{-1}}{3ms^{-1}}$$

$$\theta = 34°$$