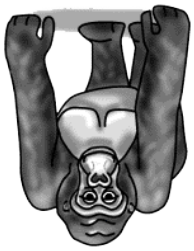
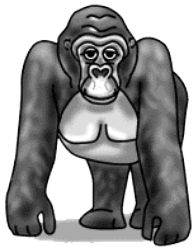
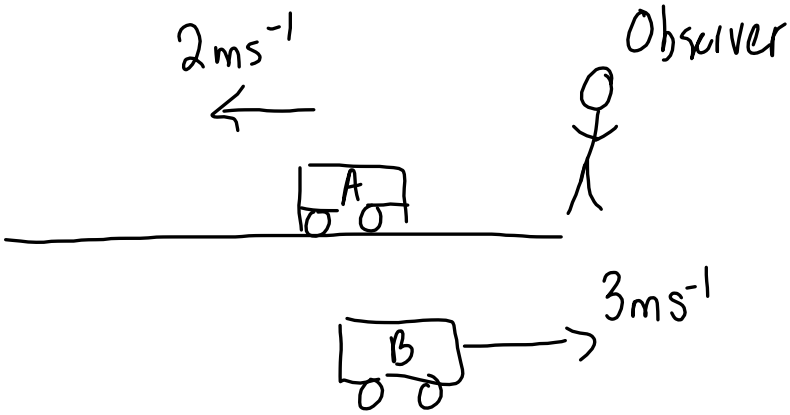
Relative Motion + Frames of Reference




Who is upside down?




Depends on the observer

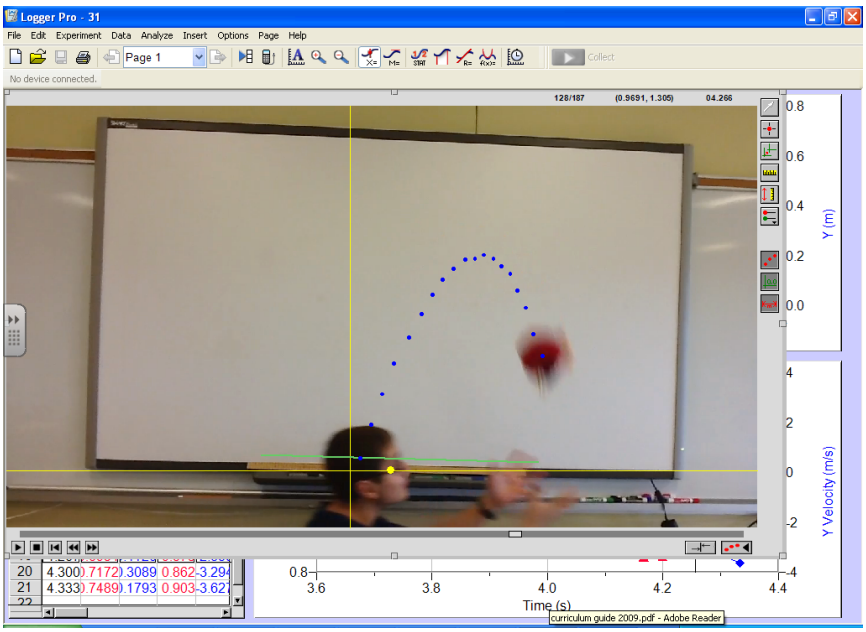


Relative Velocity

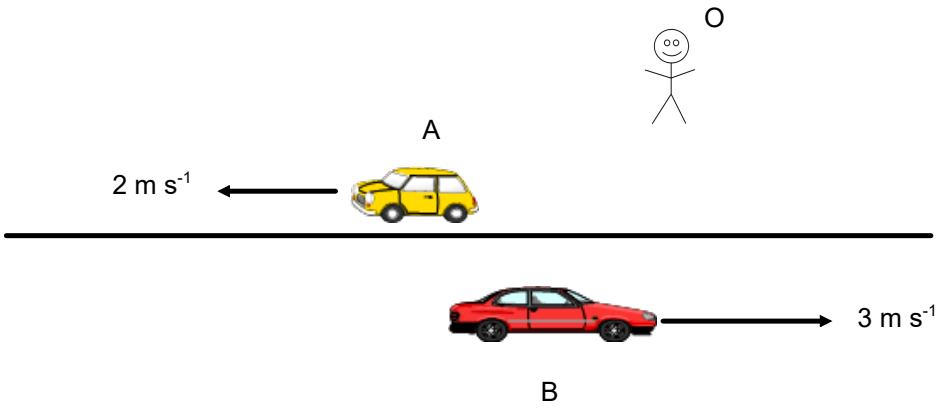
The motion of a ball thrown up in a train depends on the observer's frame of reference.

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?

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

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

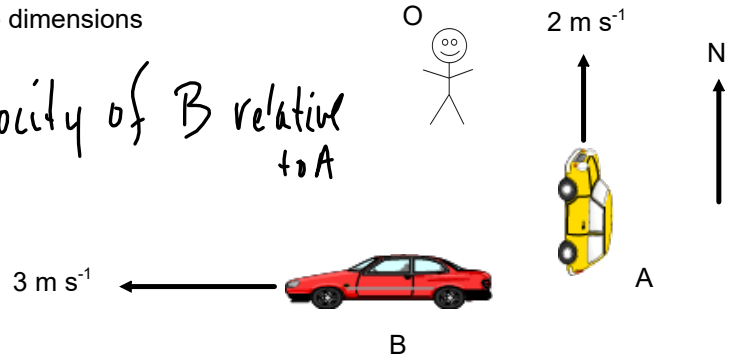
$= 3\,ms^{-1}[E] - 2\,ms^{-1}[W]$

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

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

Relative velocity in two dimensions

What is the velocity of B relative to A

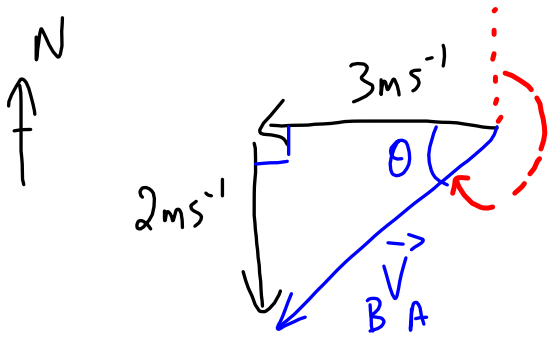


$$\vec{V}_{BA} = \vec{V}_{BO} - \vec{V}_{AO}$$

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

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

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



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

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

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

$$c \doteq 4ms^{-1}$$

$$\vec{V}_{BA} = 4ms^{-1}[W34°S]$$

236° T

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

$$\theta = 34°$$

Example:

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

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