

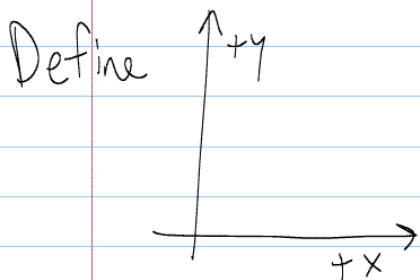
PHY131H1F Centre-screen notes
Wednesday Sep. 26, 2012

Speeding up or \Leftrightarrow The acceleration
slowing down vector has
a component
parallel to \vec{a}_{\parallel}
velocity.

Turning or \Leftrightarrow \vec{a} has a
changing direction component
of velocity perpendicular to \vec{v}
 \vec{a}_{\perp}

Projectile Motion (free fall)

\rightarrow idea: only non-negligible
force is gravity.



\leftarrow near surface of the
Earth.

for a projectile with
no air resistance:

$$a_y = -9.80 \text{ m/s}^2$$

$$a_x = 0 \quad \Leftrightarrow \quad v_x = v_{0x} = v_{fx} \\ = \text{constant}$$

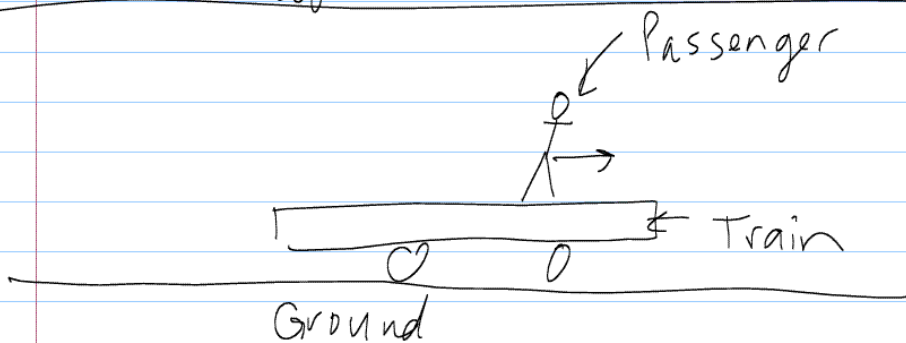
$$v_x = \frac{\Delta x}{\Delta t}$$

\vec{r}_{CB} means position vector
of object C in
reference frame of B.

\vec{r}_{CA} = position vector of C
in ref. frame A

\vec{r}_{AB} = position of origin of
ref. frame A in
ref. frame B.

$$\vec{v}_{CB} = \frac{d\vec{r}_{CB}}{dt}, \text{ etc.}$$



Note $\vec{v}_{12} = -\vec{v}_{21}$

Use this and equation

$$\vec{v}_{AB} = \vec{v}_{A\cancel{C}} + \vec{v}_{\cancel{C}B}$$

to solve relative velocity questions

Ex. 1

Define train motion positive:

$$\vec{v}_{TG} = +36 \text{ m/s}$$

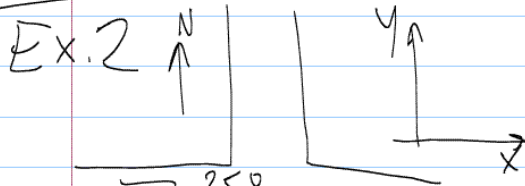
Passenger: $\vec{v}_{PT} = +5 \text{ m/s}$

Find \vec{v}_{PG}

$$\vec{v}_{PG} = \vec{v}_{PT} + \vec{v}_{TG}$$

$$\vec{V}_{PG} = 36 \text{ m/s} + 5 \text{ m/s} = 41 \text{ m/s}$$

Ex. 2



Define $+y = \text{North}$

$+x = \text{East}$

| | x | y |
|----------------|---------------------|---------------------|
| \vec{V}_{AG} | $+25.0 \text{ m/s}$ | 0 |
| \vec{V}_{BG} | 0 | $+15.8 \text{ m/s}$ |

Need \vec{V}_{AB}

$$\vec{V}_{AB} = \vec{V}_{AG} + \vec{V}_{GB}$$

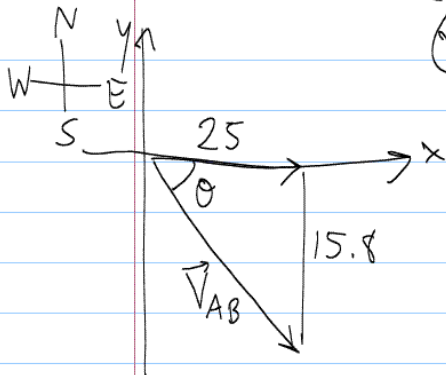
Note $\vec{V}_{GB} = -\vec{V}_{BG}$

$$\vec{V}_{AB} = \vec{V}_{AG} - \vec{V}_{BG}$$

Components:

$$(V_{AB})_x = (V_{AG})_x - (V_{BG})_x = 25.0 \text{ m/s}$$

$$(V_{AB})_y = (V_{AG})_y - (V_{BG})_y = -15.8 \text{ m/s}$$



$$|\vec{V}_{AB}| = \sqrt{25^2 + 15.8^2}$$

$$= 29.6 \text{ m/s}$$

$$\tan \theta = \frac{15.8}{25} \Rightarrow \theta = \tan^{-1} \left(\frac{15.8}{25} \right)$$

$$= 32.3^\circ$$

$$\vec{V}_{AB} = 29.6 \text{ m/s}, 32.3^\circ \text{ South of East}$$