(1

4A-sp13 2-11-13

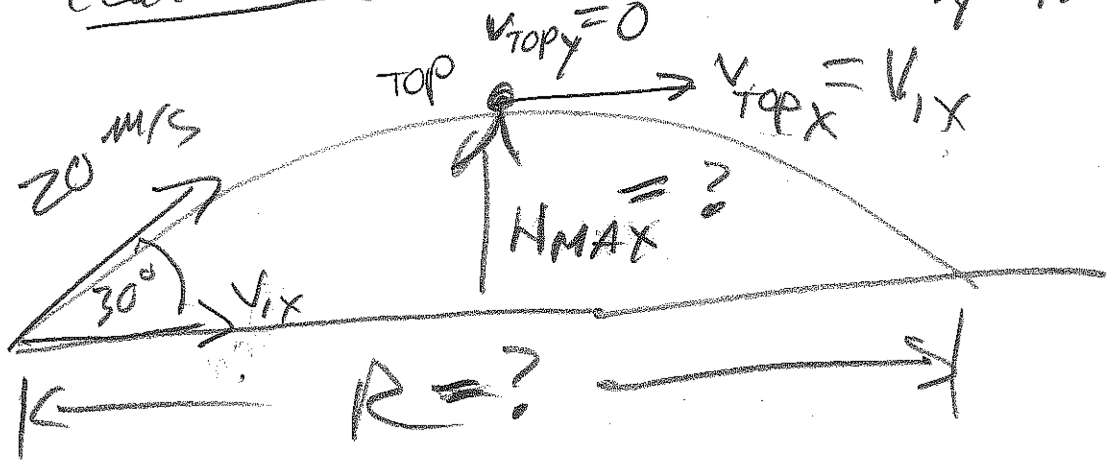
Revisit ICQ 3 with new inputs:

$v_1 = |\vec{v}_1| = 20\,\text{m/s}$

$v_{1x} = 20\frac{m}{s}\cos 30°$
$= v_1 \cos 30$

classical problem:

$v_{1y} = v_1 \sin 30°$



Y (POS)

(A) $H_{max} = ?$

WAY 1 $v_{2y} = v_{1y} - g\Delta t$

AT TOP: $0 = v_1 \sin 30 - g\Delta t$

$\vec{a} = -g\hat{j}$

$a_y = -g$

$$\Delta t_{top} = \frac{v_1 \sin 30}{g} = \frac{(20\frac{m}{s})\frac{1}{2}}{9.8\frac{m}{s^2}} = 1.02\,(s)$$

$$\Delta y = \underbrace{v_{1y}}_{v_1 \sin 30°}\Delta t - \frac{1}{2}g\Delta t^2$$

$$H_{MAX} = \left(20\frac{m}{s}\right)\cdot\underbrace{\frac{1}{2}}_{\sin 30}(1.02s) - \left(4.9\frac{m}{s^2}\right)(1.02s)^2 \cong \boxed{5\,(m) = 5.0\,(m)}$$

A) $H_{max} = ?$

Way 2

$$v_{2y}^2 = v_{1y}^2 - 2g\Delta y$$

$$\downarrow$$

$$0 = (v_1 \sin 30)^2 - 2g \cdot H_{MAX}$$

$$H_{MAX} = \frac{v_1^2 \sin^2 30}{2 \cdot g}$$

$$= \frac{\left(20\frac{m}{s}\right)^2 \cdot \frac{1}{4}}{19.6\frac{m}{s^2}}$$

$$\approx 5\ (m)$$

B) $R = v_{1x} \cdot \Delta t_{TOTAL}$

Δt_{TOTAL}: $\Delta y = 0 = v_{1y}\Delta t - \frac{1}{2}g\Delta t^2$

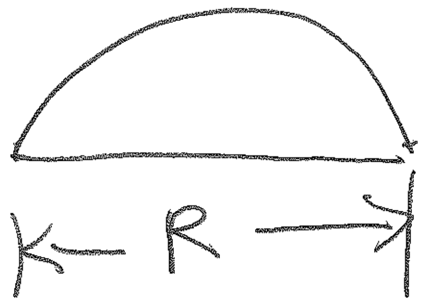
$$0 = v_1 \sin\theta \Delta t - \frac{1}{2}g\Delta t^2 = \Delta t\left(v_1 \sin 30 - \frac{1}{2}g\Delta t\right)$$

$$\Delta t = 0 \text{ OR } \Delta t = \frac{2v_1 \sin 30}{g} = 2.04\ (s)$$

(13) $R = \left(20\,\frac{m}{s}\right)\cos 30 \cdot (2.04\,s)$

$= 35.33\ (m)$

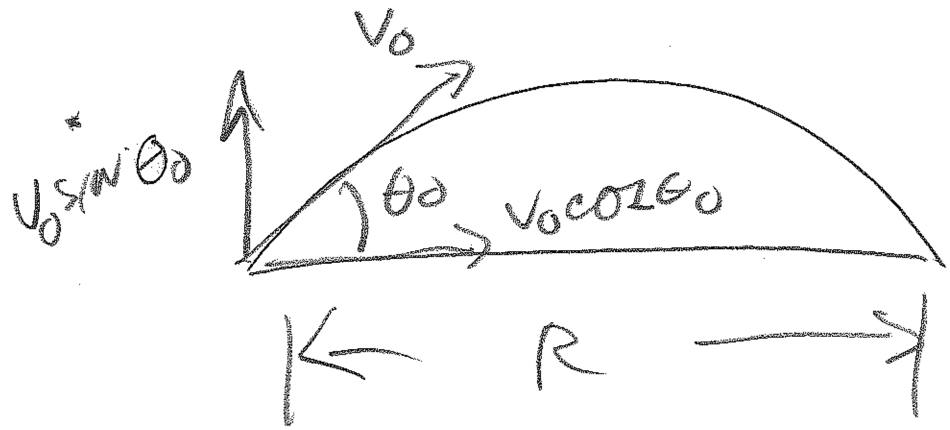
(sig. Fig!)



mastermsphysc.com:

see video tutor Demo "Range of a Gun at 2 Firing angles" comment on video

videotutor Demo: "Range of gun, 2 angles"



$$R = v_0 \cos\theta_0 \cdot t$$

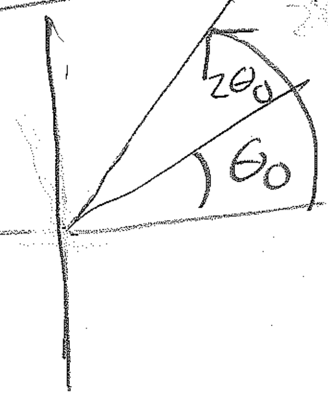
$$R = v_0 \cos\theta_0 \cdot \frac{2\, v_0 \sin\theta_0}{g}$$

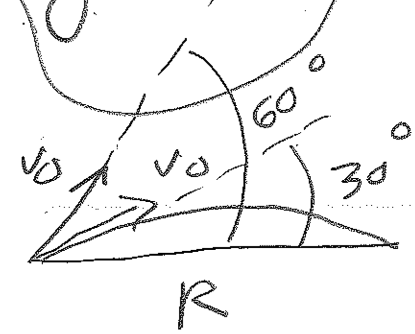
$$R = \frac{2 v_0^2 \cos\theta_0 \cdot \sin\theta_0}{g}$$

FOR any R,

$$R = \frac{v_0^2 \sin 2\theta_0}{g}$$

there are 2 values of θ, except for MAXIMUM R at $\theta = 45^\circ$

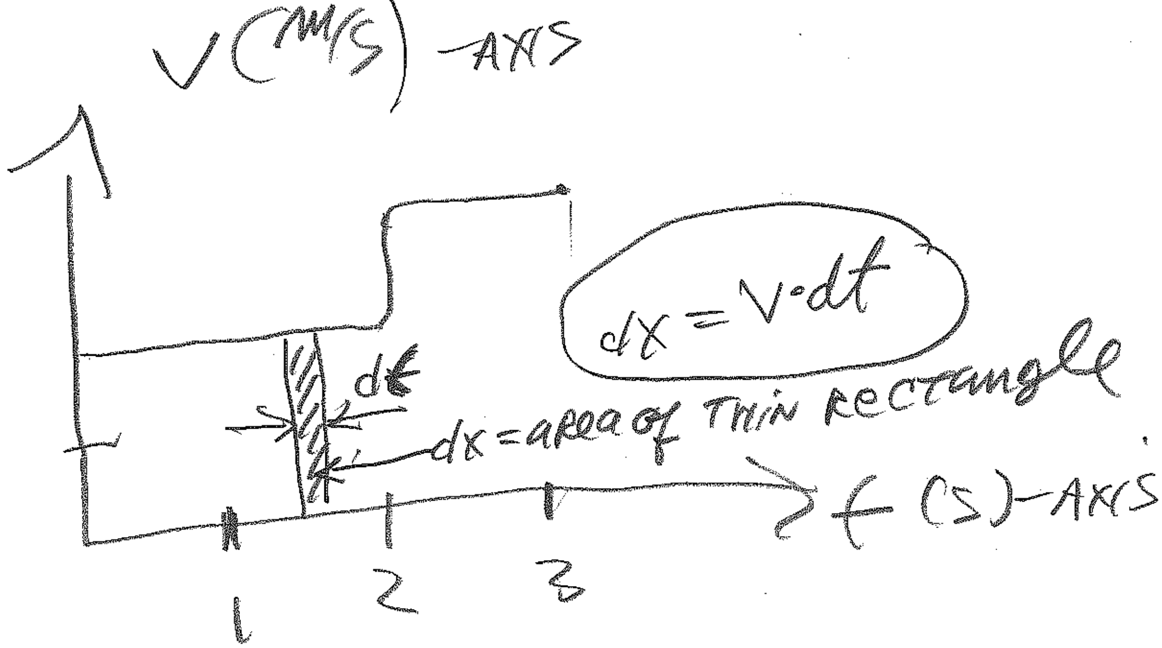




Questions on Quiz 2?

Sec 2.2

2.9 = # 9, ch2



$\Delta x = v_x \cdot \Delta t$ IF v_x = constant.

review calculus:

$$dx = v\,dt \Rightarrow x = \int v\,dt + C$$

$$\Delta x = \int_{t_1}^{t_2} v\,dt = \text{AREA under v-curve}$$

(d.) $\bar{v}$ and $|\bar{v}|$

$\bar{v}$ = Average velocity

$|\bar{v}|$ = Average speed.

general comment:

$\frac{dx}{dt} = v$ = instantaneous velocity.

$\left|\frac{dx}{dt}\right| = |v|$ = instantaneous speed.

(a.)

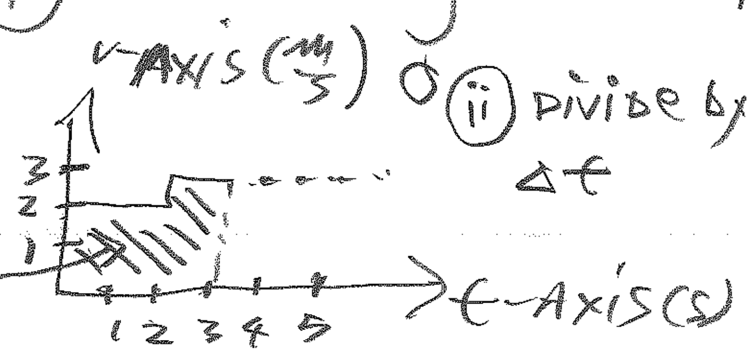
$\bar{v} = \frac{\Delta x}{\Delta t}$

(i) FIND $\Delta x = \int_0^3 v\,dt = 7m$

$\boxed{2.3\frac{m}{s}} = 7m/\Delta t = \frac{7m}{3(s)}$

(ii) Divide by Δt

area



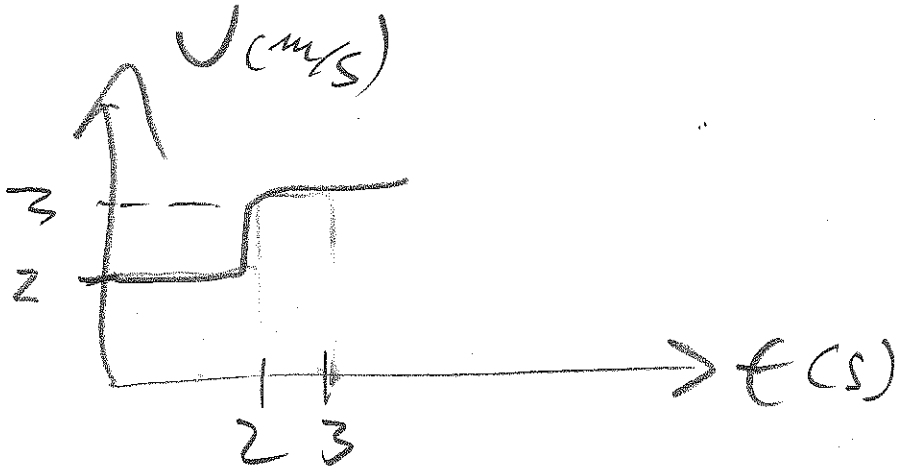
NOTE: $\bar{v} = |\bar{v}|$

$|\bar{v}|$ = average speed.

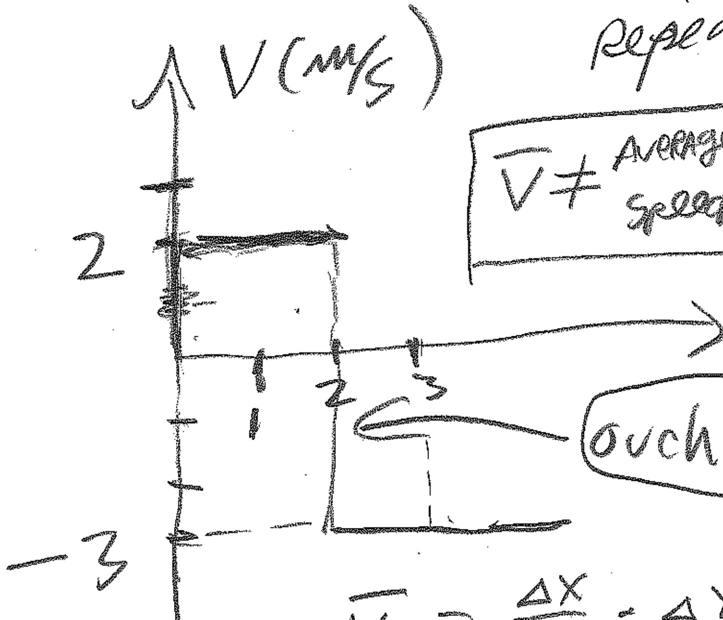
(6

9) — CH 2

b.



change



Repeat $\bar{v}$ and average speed

$\boxed{\bar{V} \neq \text{average speed}}$

note: average speed $\neq |\bar{V}|$

you changed direction

t (s)

ouch! $a_x = -\infty$

$\bar{V} = \frac{\Delta x}{\Delta t}$; Δx = area under curve

$= 2 \cdot 2 - (3)(1)$

$= (2\frac{m}{s})(2s) - (3\frac{m}{s})(1s) = 1m$

$\bar{V} = \frac{1m}{3(s)} = \boxed{0.33\frac{m}{s}}$

(7.

(b.)

$$\text{Average speed} \neq |\bar{v}|$$

$$\text{average speed} = \frac{\text{TOTAL DISTANCE}}{\text{TOTAL TIME}}$$

$$= \frac{(2.2 + 3.1)\,m}{3\,(s)}$$

$$= \frac{7}{3}\frac{m}{s} = 2.33\frac{m}{s}$$

note: $\text{Average speed} = 2.33\frac{m}{s}$

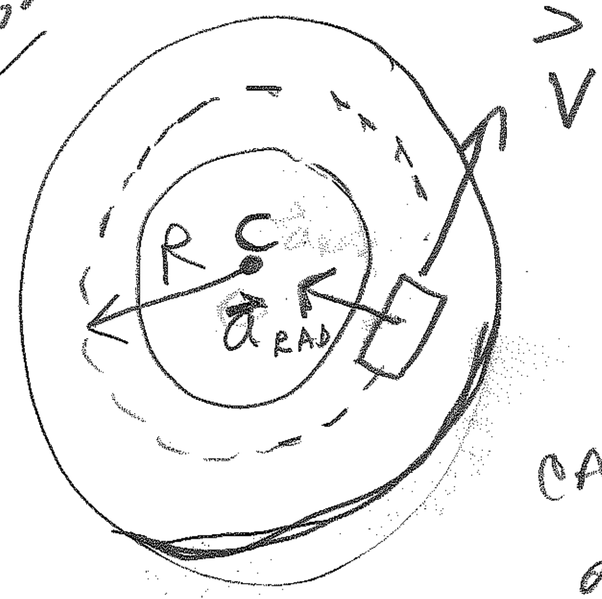
$|\bar{v}| = 0.33\frac{m}{s} < \text{average speed}$

reason: smaller displacement in part (b).

p.44A 2-11-13 — CH3 Finish! (8.

see 3.4

Example 3.11: ASTON MARTIN V8 ROUNDS a CIRCULAR TRACK.



$$\left|\vec{a}_{RAD}\right| = \frac{\left|\vec{V}\right|^2}{R}$$

CAR ON a TRACK, CIRCULAR.

SINCE $\vec{V}$ is changing DIRECTION, CAR is accelerating even if speed $|\vec{V}|$ is constant

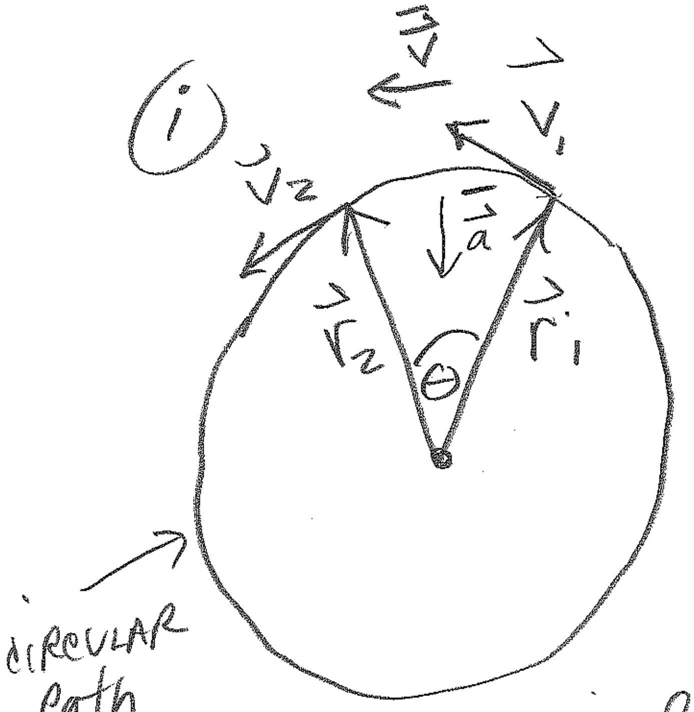
Applications of 2-D motion

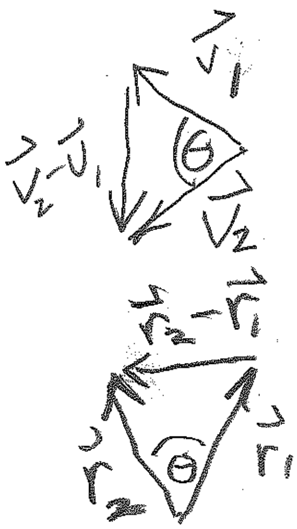
(A) circular motion

(i) uniform (speed constant)

(ii) non-uniform

(i)



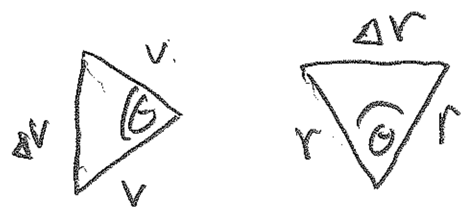


$$\vec{a} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$

$$\Delta t = t_2 - t_1$$

$$\vec{v} = \frac{\vec{r}_2 - \vec{r}_1}{\Delta t}$$

Similiar triangles:



$$|\vec{v}_1| = |\vec{v}_2| = v$$

$$|\vec{v}_2 - \vec{v}_1| = \Delta v$$

$$|\vec{r}_1| = |\vec{r}_2| = r$$

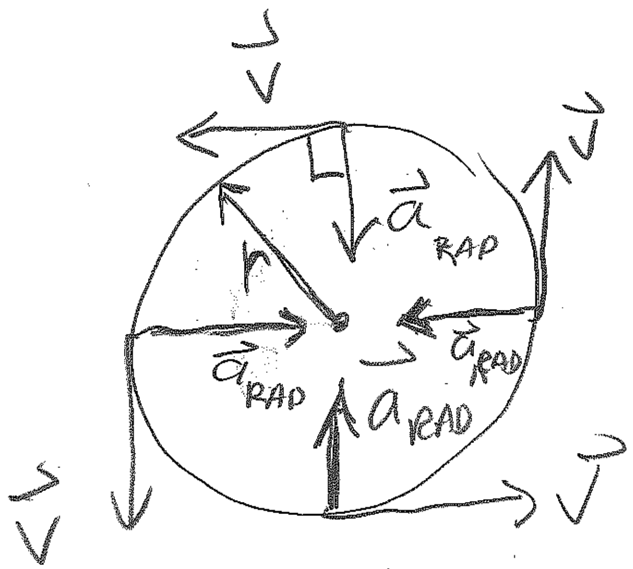
$$|\vec{r}_2 - \vec{r}_1| = \Delta r$$

$$\frac{\Delta v}{v} = \frac{\Delta r}{r} \Rightarrow \Delta v = \frac{v}{r} \cdot \Delta r$$

$$\lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \lim_{\Delta t \to 0} \frac{v}{r} \frac{\Delta r}{\Delta t} = \frac{v}{r} v = \frac{v^2}{r} \equiv a_{RAD}$$

(i)

$$v = |\vec{v}|$$



$$|\vec{a}_{RAD}| = \frac{v^2}{r} = a_{RAD}$$

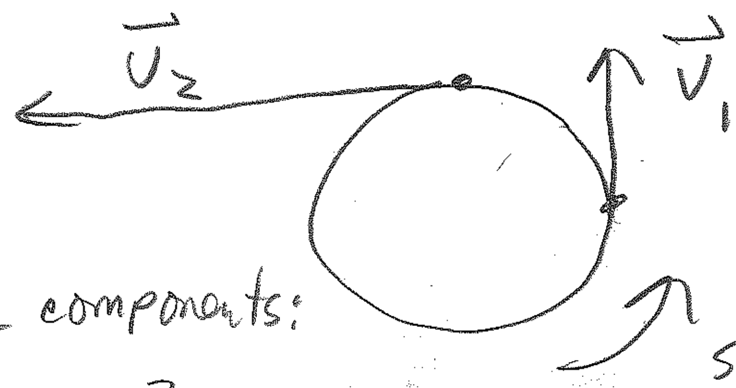
NOTE: $v = \dfrac{2\pi r}{T}$

Time for one rev. $= T =$ period

$$\boxed{a_{RAD} = \frac{4\pi^2 r}{T^2}}$$

(ii)

non-uniform: example of speeding up.

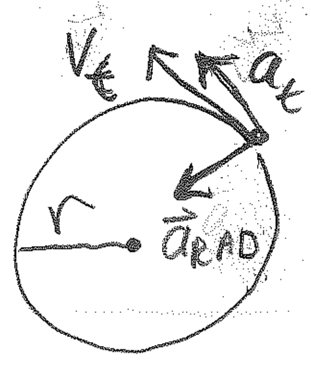


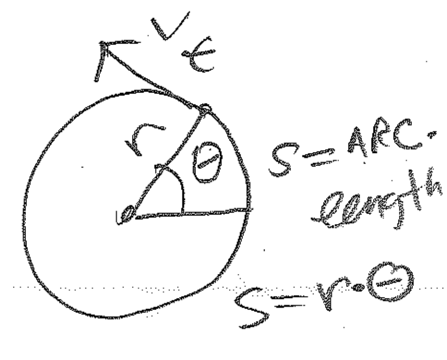
Tangential components:

$$a_t = \frac{dv_t}{dt} = \frac{d^2 s}{dt^2}$$

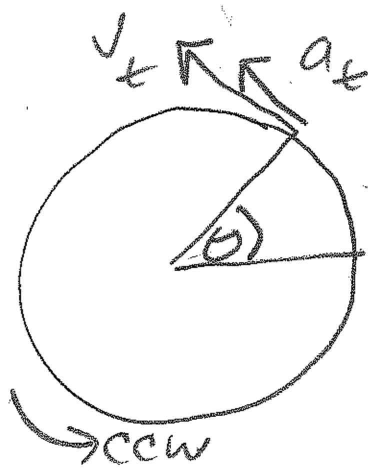
$$v_t = \frac{ds}{dt}$$

$$|\vec{a}_{RAD}| = v_t^2/r$$





Let's talk about signs of v_t, a_t:



s increasing

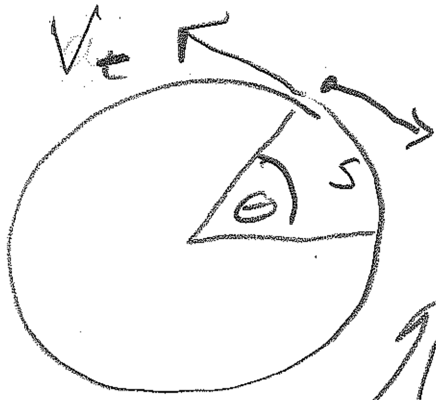
speeding up

$\frac{ds}{dt} > 0$.

ccw motion

$a_t > 0$

$v_t > 0$



$a_t = \frac{dV_t}{dt} < 0$

$a_t < 0$

$\frac{d^2s}{dt^2} < 0$

SLOWING down

s increasing.

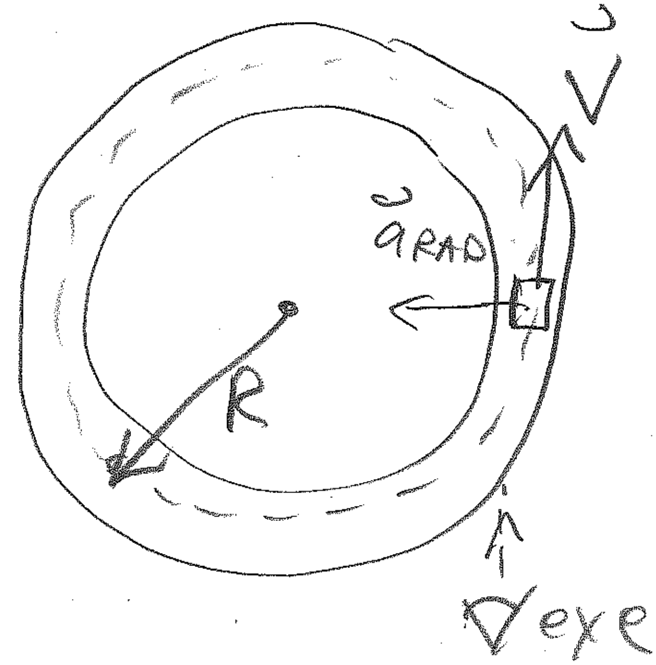
ccw motion.

s is increasing.

$\frac{ds}{dt} > 0$. Thus $v_t = \frac{ds}{dt} > 0$

Active — PHYSICS
at masteringphysics.com

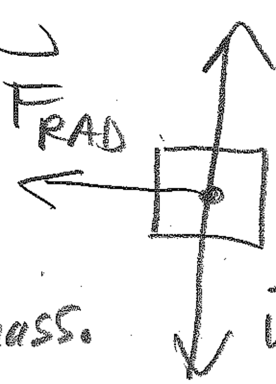
4.5



eye-view

CH 4
CH 5

centripetal force $= \vec{F}_{RAD}$

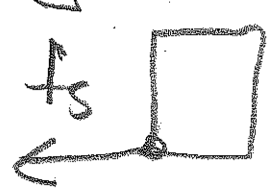


$\vec{N}$ = NORMAL force

$\vec{W}$ = weight

$\vec{F}_{RAD} = m \cdot \vec{a}_{RAD}$, m = mass.

$|\vec{F}_{RAD}| = F_{RAD} = \frac{mv^2}{R}$

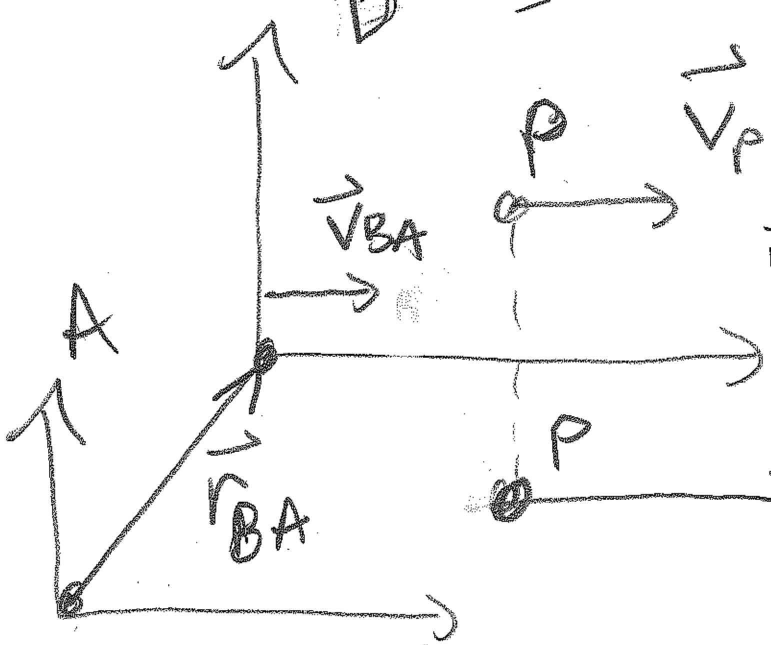


$\vec{f}_s$ = static friction force.

$\vec{f}_s = \vec{F}_{RAD}$

Relative motion CH3, sec. 3.5.

B = BART train



$\vec{V}_{PB}$ = velocity of P relative to B.

$\vec{V}_{BA}$ = velocity of B relative to A

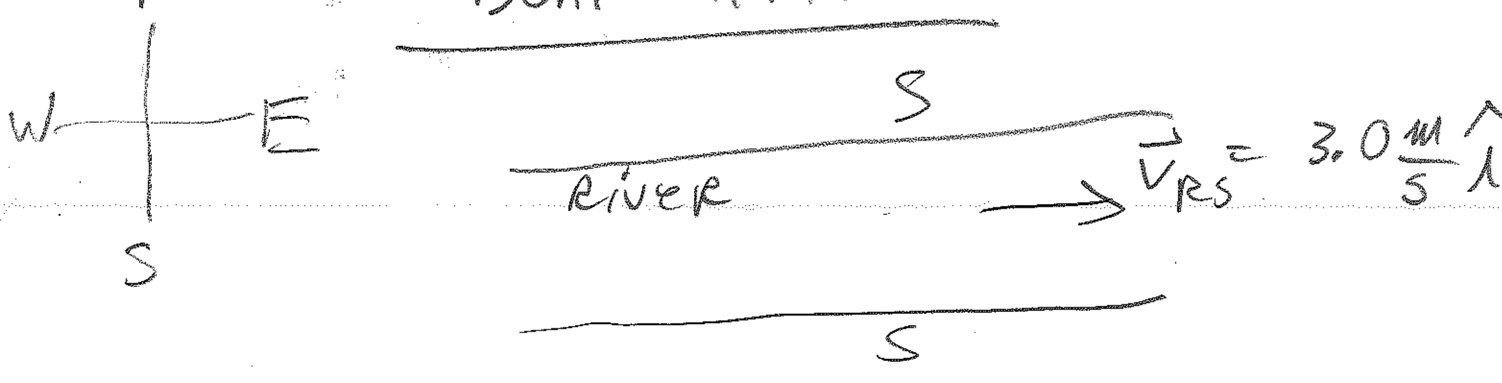
$\vec{V}_{PA}$ = velocity of P relative to A.

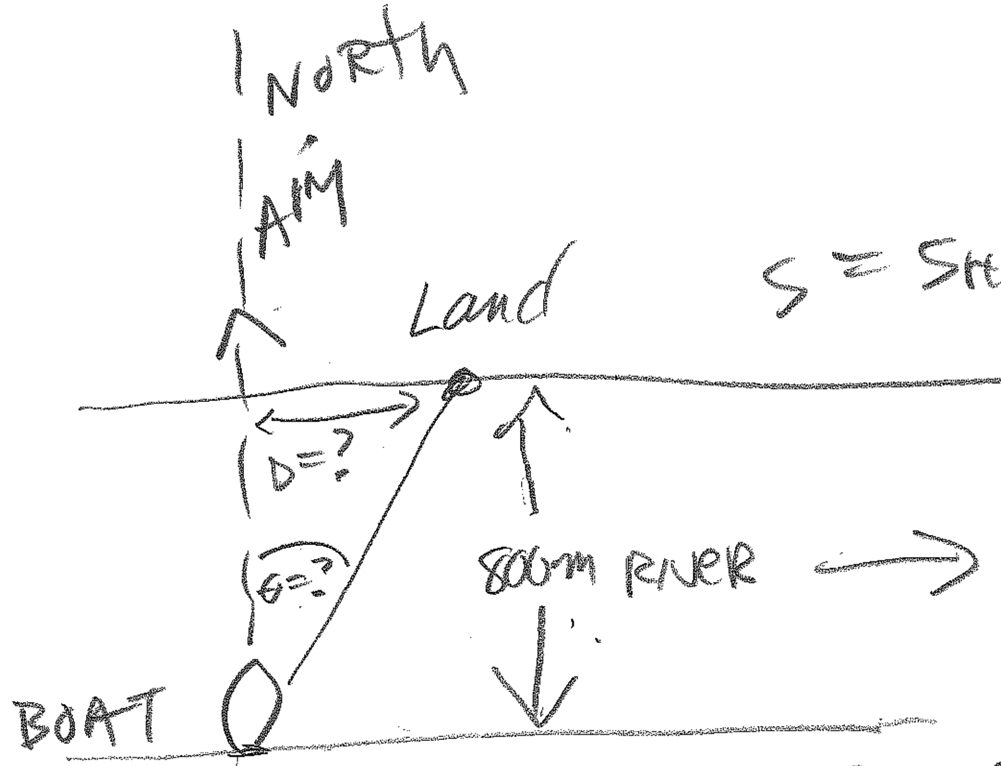
A = BART STATION

$$\vec{V}_{PA} = \vec{V}_{PB} + \vec{V}_{BA}$$

simple example

BOAT ON RIVER:





S = SHORE

$\longrightarrow 3.0\,\frac{m}{s}\,\hat{i} = \vec{V}_{RS}$

START at South SHORE. S = SHORE

BOAT HAS a speed 4.0 $\frac{m}{s}$ relative TO water, whether OR NOT WATER is moving relative TO shore.

DUE WED/FRI IN LABS

ICQ 4

see #35 CH3

IF THE BOAT AIMS DUE NORTH, FIND:

(a) MAGnitude of $\vec{V}_{BS}$

(b) angle of $\vec{V}_{BS}$ with NORTH-South AXIS.

(c) HOW FAR DOWNSTREAM DO YOU LAND?

Solution

$\vec{V}_{BS} = \vec{V}_{BR} + \vec{V}_{RS}$