Phys 2110-4 1/30/12

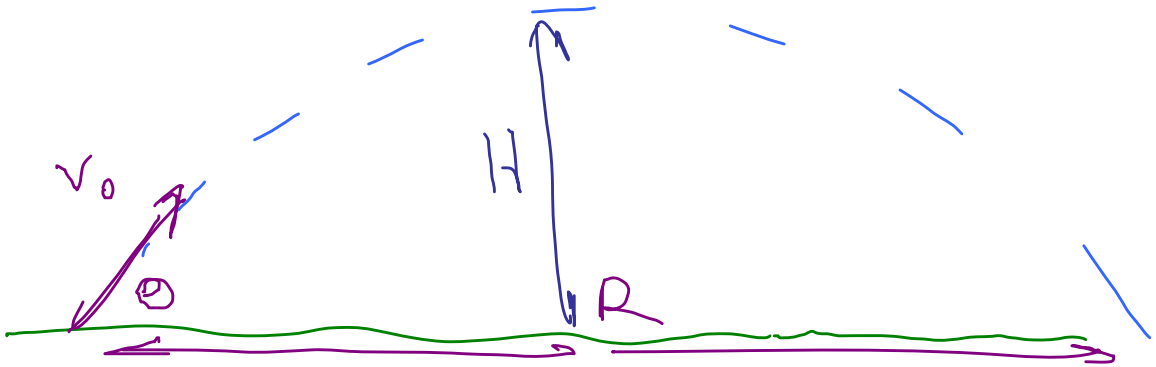
Note Title 1/30/2012

Confed: 3.31 $a_x = 0.393\ m/s^2$

$a_y = 0.275\ m/s^2$

$\Delta x = 48.8\ m$ $\Delta y = 5.46\ m$

Dir 6.4° $r = 49.1\ m$



$V_{x_0} = V_0 \cos\theta \qquad V_{y_0} = V_0 \sin\theta$

$a_x = 0 \qquad a_y = -g = -9.8 \frac{m}{s^2}$

Time in flight: When does $y = 0$?

$$y = (V_0 \sin\theta)t - \frac{1}{2}gt^2 = 0$$

$$t\left[V_0 \sin\theta - \frac{1}{2}gt\right] = 0$$

$t = 0 \longrightarrow$ $\boxed{t = \frac{2V_0 \sin\theta}{g}}$

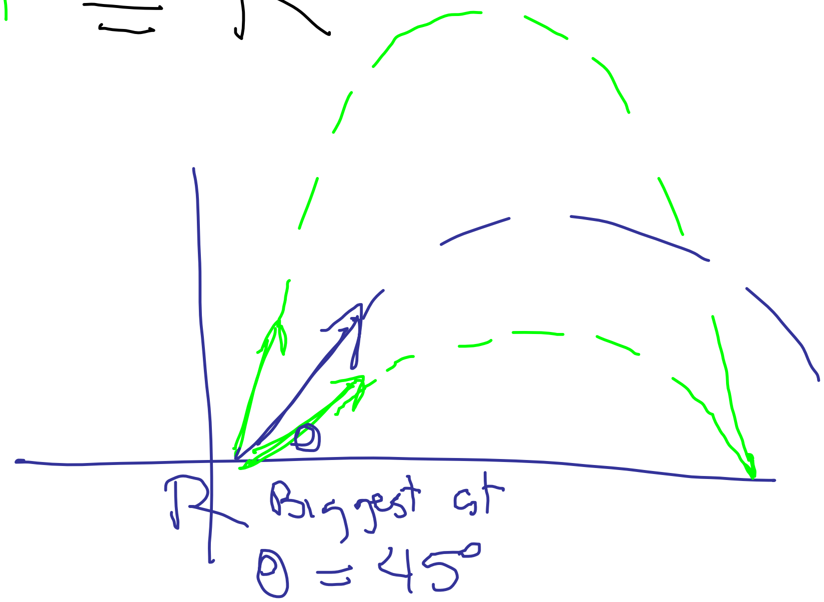
Range? What is x at this time?

$$x = (v_0 \cos\theta)\,t$$

$$= (v_0 \cos\theta)\left(\frac{2 v_0 \sin\theta}{g}\right)$$

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

$$= \frac{v_0^2 \sin 2\theta}{g}$$



Complementary angles

20, 70   30, 60

Max ht at $v_y = 0$

$$v_y = v_{y0} + a_y t$$

$$= v_0 \sin\theta - g t = 0$$

$$t = \frac{v_0 \sin\theta}{g}$$

$$\frac{1}{2} \frac{v_0^2 \sin^2\theta}{g}$$

Find y at this time

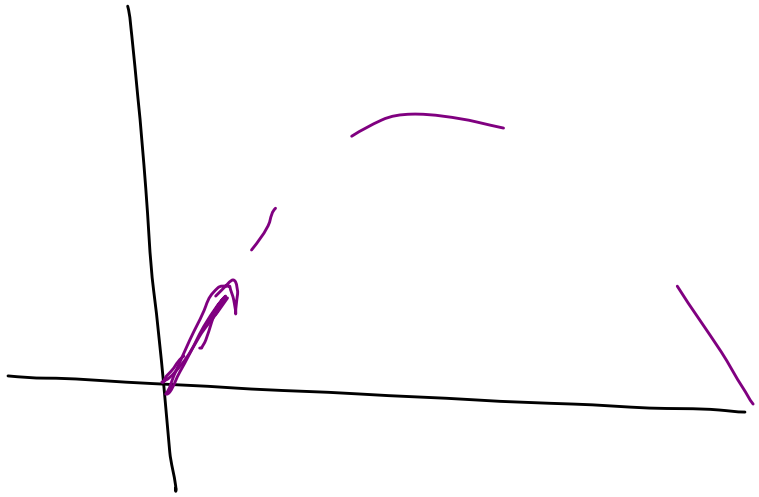
$$y = v_0 \sin\theta \left(\frac{v_0 \sin\theta}{g}\right) - \frac{1}{2} g \left(\frac{v_0 \sin\theta}{g}\right)^2$$

$$= \frac{1}{2} \frac{v_0^2 \sin^2\theta}{g}$$

Shape of the trajectory

$$x = v_0 \cos\theta \, t$$

$$t = \frac{x}{v_0 \cos\theta}$$

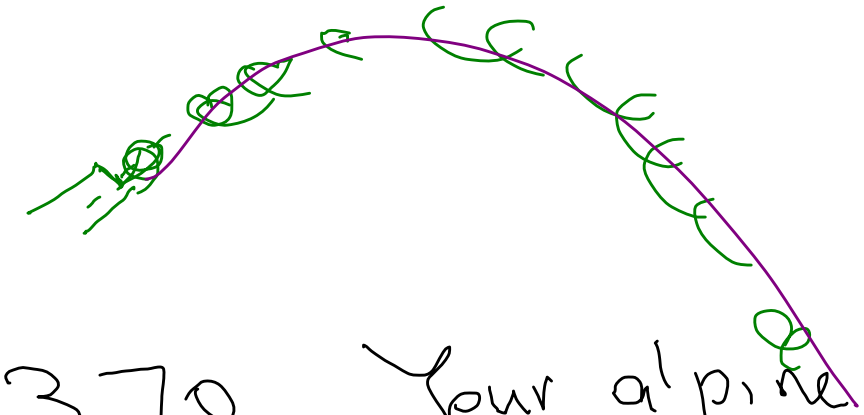


plug into y eqn for t

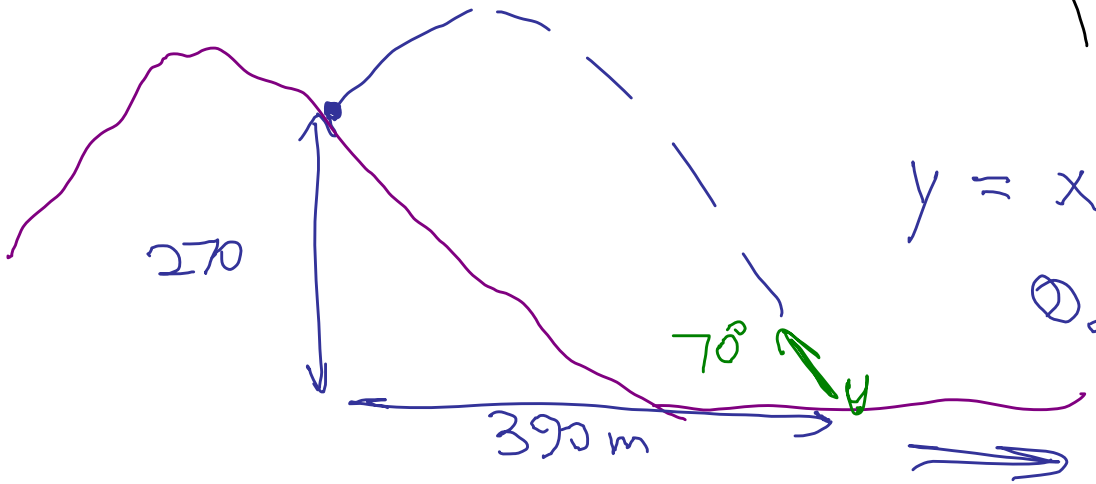
$$y = v_0 \sin\theta \left(\frac{x}{v_0 \cos\theta}\right) - \frac{1}{2} g \left(\frac{x}{v_0 \cos\theta}\right)^2$$

$$= \tan\theta \, x - \frac{1}{2} \frac{g x^2}{v_0^2 \cos^2\theta}$$

Parabola face down



3.70 Your alpine rescue team uses a slingshot to shoot packet. Find launch speed.



$$y = x\tan\theta_0 - \frac{g x^2}{2 v_0^2 \cos^2\theta_0}$$

$\theta_0 = 70$

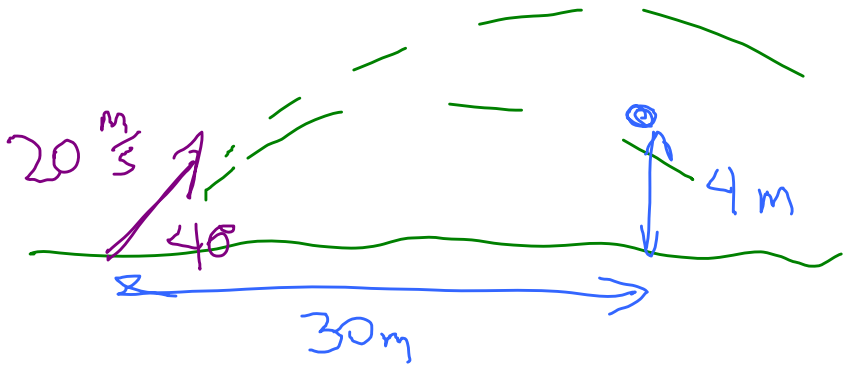
$x = 390\text{ m}$ $y = 270\text{ m}$

$\Rightarrow V_0 = 89.1 \frac{m}{s}$

Example

Shoot projectile at 40°, 20 $\frac{m}{s}$.

Does it go over the goal.



When ball gets to $x = 30$ m what is y?

What is t when $x = 30$ m

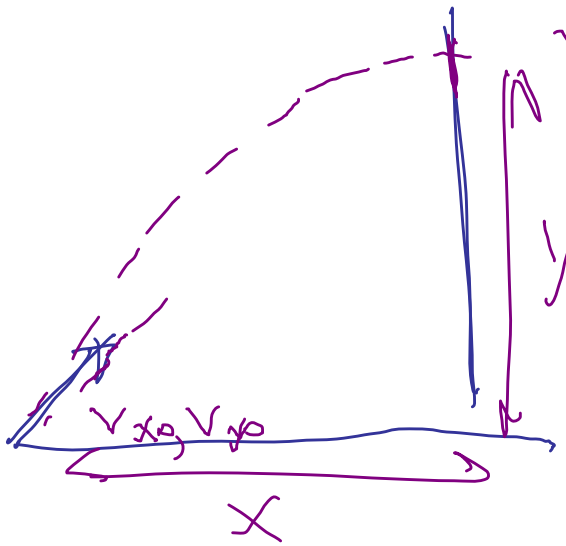
$v_{x0} = 15.3 \frac{m}{s}$

$v_{y0} = 12.9 \frac{m}{s}$

$x = 15.3 \frac{m}{s} t \quad t = 2.62 s$

$$y = v_{y0}t - \frac{1}{2}gt^2$$

$$= 6.36\ m$$



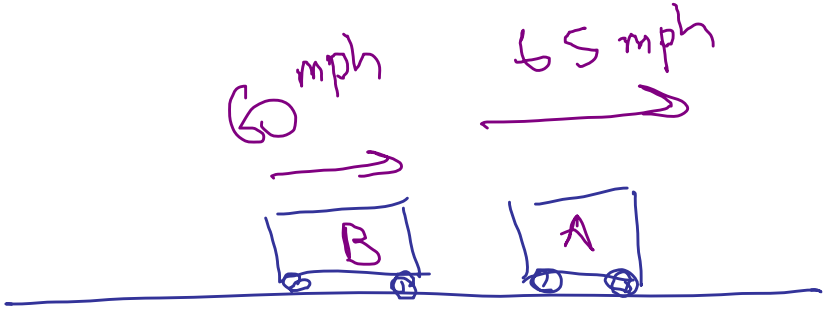
$$v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$$

$$v_y = v_{y0} + a_y t$$

$$x = v_{x0}t$$

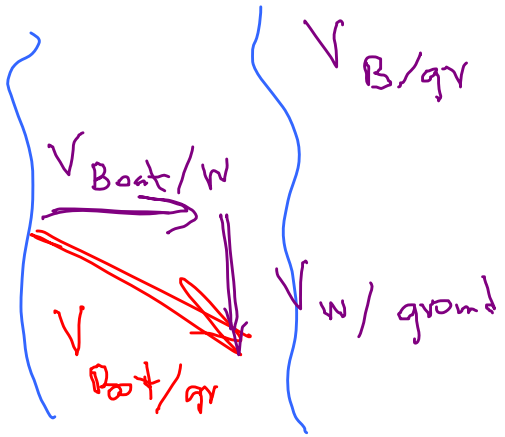
Relative Motion

Circular Motion



$V_{A/B} = 5$ mph

Velocities add & subtract

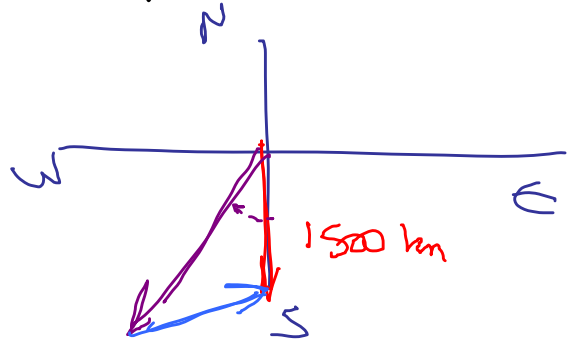


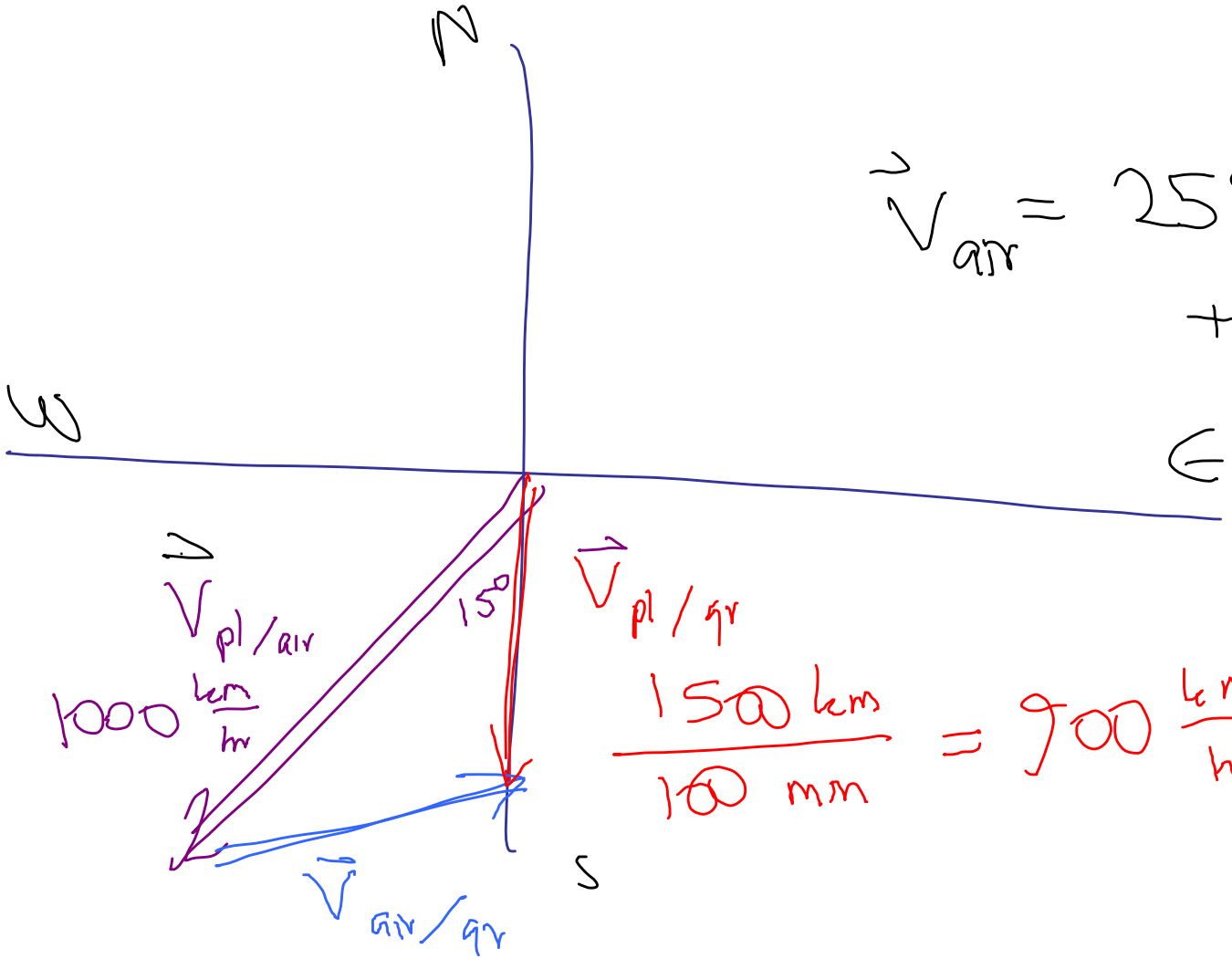
$$\vec{V}_{Boat/W} + \vec{V}_{W/gr} = \vec{V}_{Boat/gr}$$

$$\vec{V}_{A/B} + \vec{V}_{B/C} = \vec{V}_{A/C}$$

$$\vec{V}_{pl/air} + \vec{V}_{air/gr} = \vec{V}_{plane/gr}$$

3.26 You're a pilot, 1500 km flight. Plane speed (wrt air) 1000 km/h. ATC says you have to head 15° west of south to maintain southward course. Flight takes 100 min. What's the wind velocity?





$$\vec{V}_{air} = 259 \frac{km}{h} \hat{i} + 65.9 \frac{km}{h} \hat{j}$$

$\vec{V}_{pl/air}$

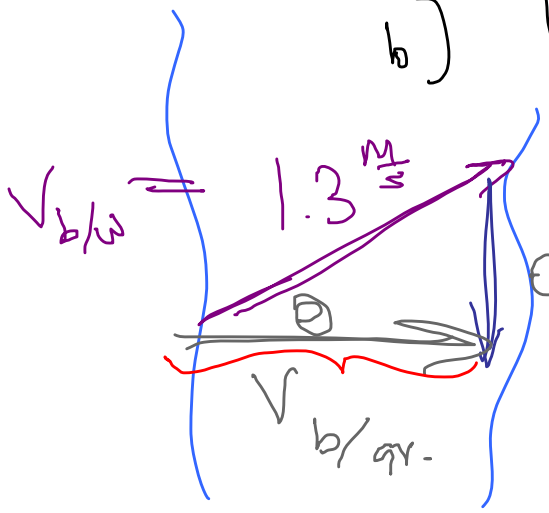
$1000 \frac{km}{hr}$

$\vec{V}_{pl/gr}$

$$\frac{150\ km}{10\ mn} = 900 \frac{km}{h}$$

$\vec{V}_{air/gr}$

3.27 Want to Row straight across 63-m wide river. You row at $1.3 \frac{m}{s}$ rel. to water and river flows at $0.57 \frac{m}{s}$ a) What dir you head? b) How long to cross river?



$0.57 \frac{m}{s} = V_{w/gr}$

$\theta = 26.0$

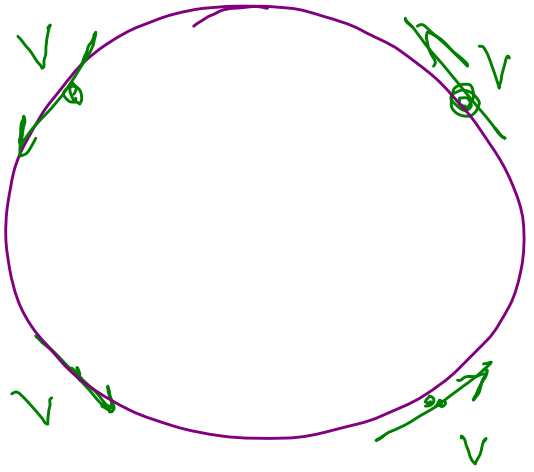
Find $V_{B/gr}$

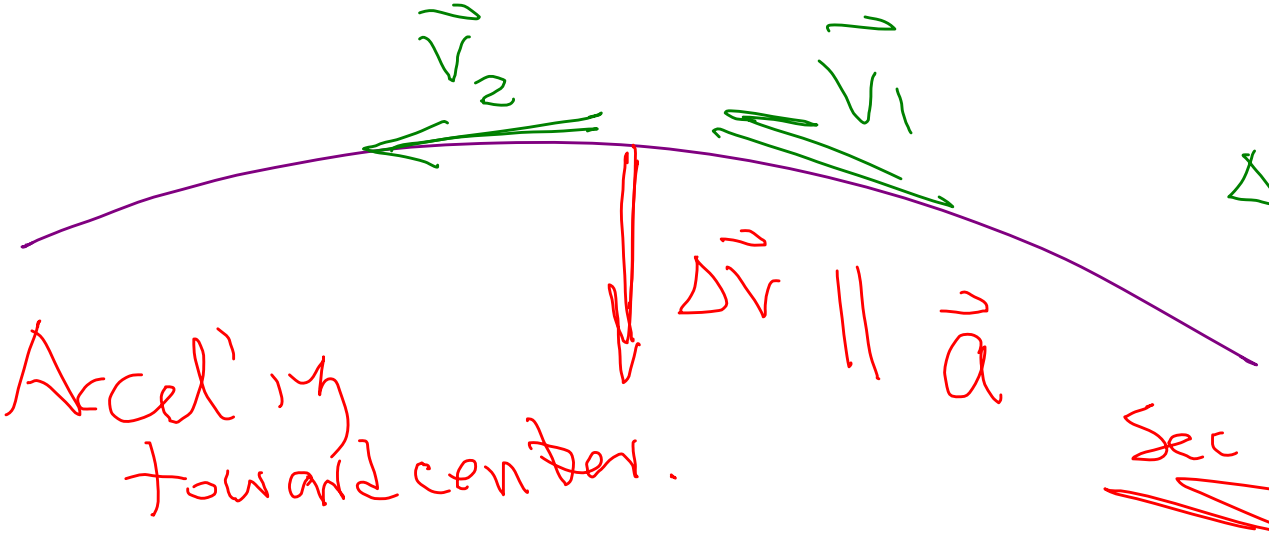
For 63 m $t = 53.9$ s

Circular Motion

Constant speed

$\vec{v}$ changes direction!



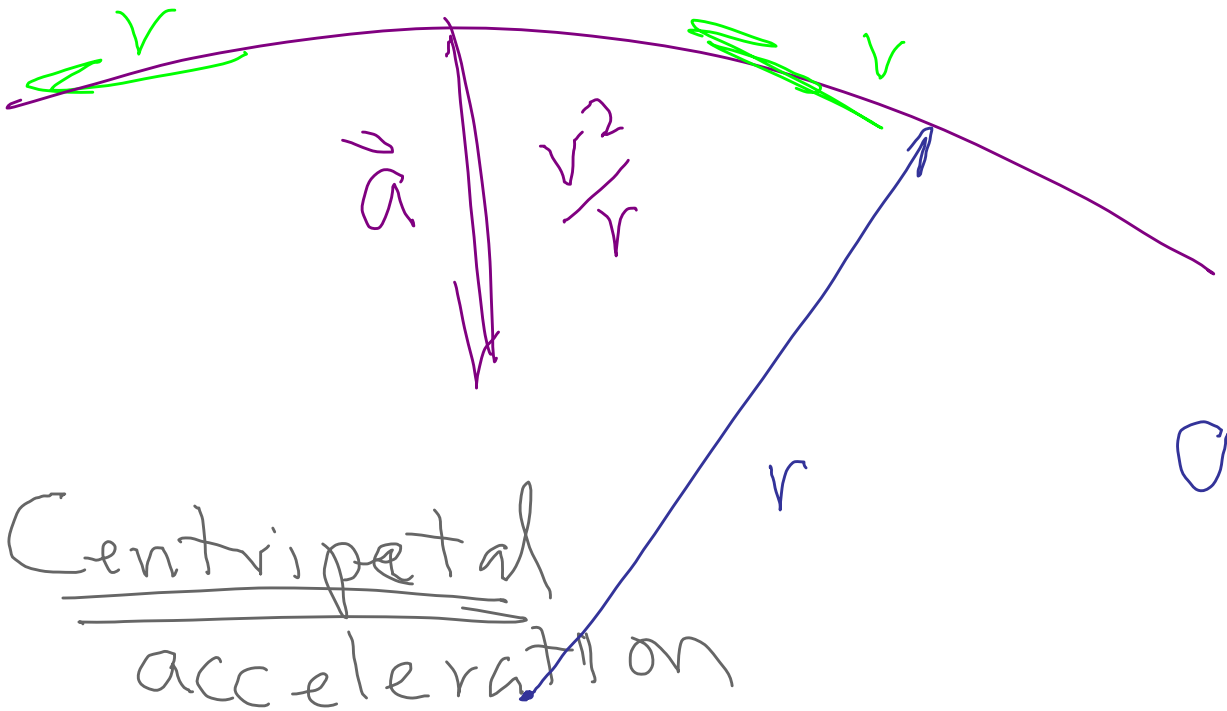


$\Delta\vec{v} = \vec{v}_2 - \vec{v}_1$

$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$

Accel'n toward center.

Sec 36



Centripetal acceleration

$\vec{a}$ is always inward

$$a = \frac{v^2}{r}$$

$$= \frac{\left(\frac{m}{s}\right)^2}{m}$$

$$= \frac{\frac{m}{s^2}}{m}$$

3.38 How fast would a car have to go on 75m-radius track for a to equal g?

$$a = \frac{v^2}{r} = 9.8 \frac{m}{s^2}$$

$r = 75\,m \quad v = 27.1 \frac{m}{s}$