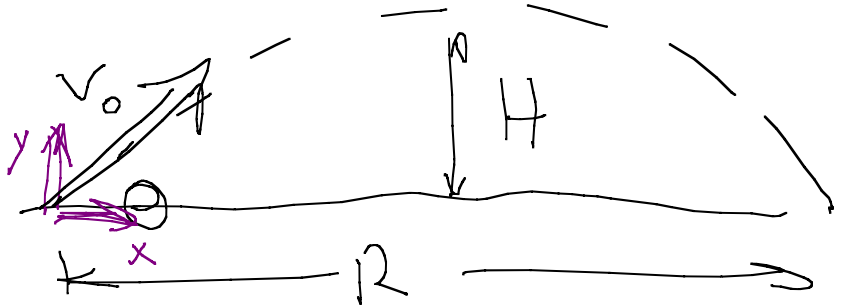
Phys 2110-3 9/17/10

Note Title 9/17/2010

2D Motion; Free-fall

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

$V_{0x} = V_0 \cos\theta \qquad V_{0y} = V_0 \sin\theta$



$$x = (V_0 \cos\theta)t$$

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

Find range R. Find time in flight

When does $y = 0$

$$0 = t\left[v_0 \sin\theta - \tfrac{1}{2} g t\right]$$

$t = 0$

$$v_0 \sin\theta = \tfrac{1}{2} g t \qquad t = \frac{2 v_0 \sin\theta}{g}$$

What is x at this time?

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

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

Biggest R is at $\theta = 45^\circ$

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

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

Max ht when

$v_y = 0$

Same range for compl pairs $20°, 70°$ $35°, 60°$

$$v_y = v_0 \sin\theta - gt$$

$$= 0 \qquad t = \frac{v_0 \sin\theta}{g}$$

What is y at this time $= \frac{1}{2} \frac{v_0^2 \sin^2\theta}{g}$

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

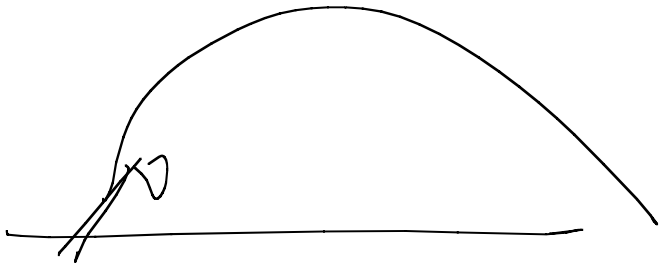
$$x = v_0 \cos\theta \, t \qquad t = \frac{x}{v_0 \cos\theta}$$

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

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

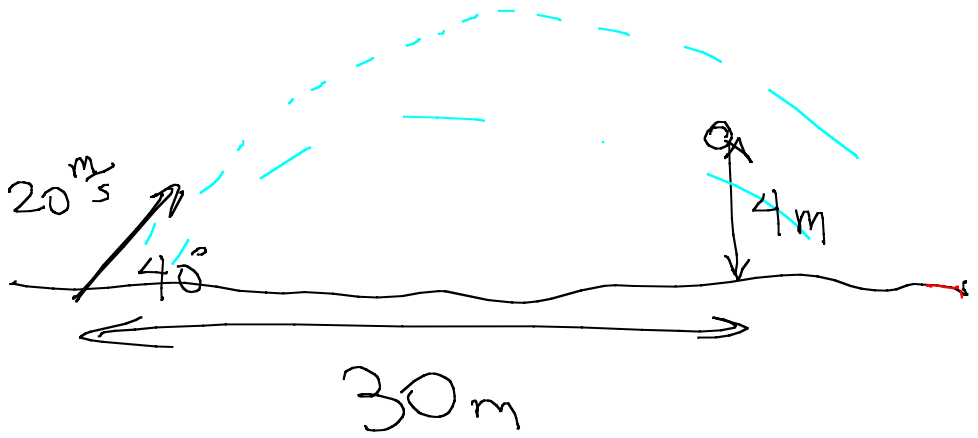
Relation between y, x for trajectory

Parabolic path



Problem: Projectile fired as shown. Goal thing 30 m away 4 m high?

$g = 9.8 \frac{m}{s^2}$



$$R = \frac{\left(20\frac{m}{s}\right)^2 \sin(80)}{g}$$

$$= 40.2\,m$$

When is $X = 30\,m$?

$$X = \left(20\frac{m}{s}\cos 40\right)t = 30\,m \qquad t = 1.96\,s$$

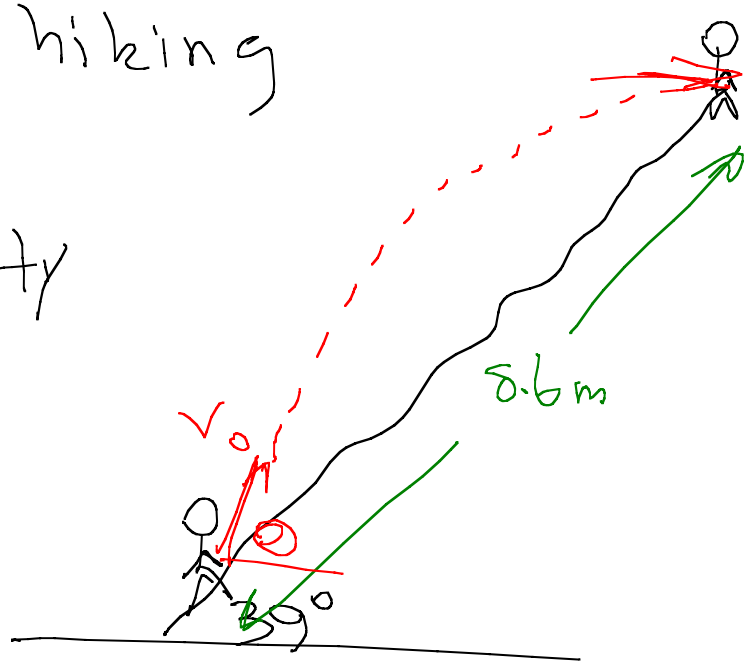
What is y at this time?

$$y = \left(20 \tfrac{m}{s} \sin 40^\circ\right)t - \tfrac{1}{2} g t^2$$ Plug in t

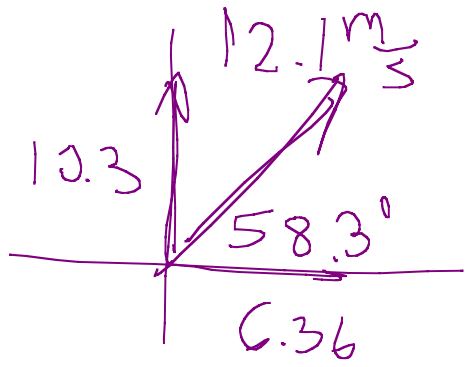
$$= 6.36\ m$$

This is $> 4m$ so makes goal.

3.66 You toss ch. bar to hiking companion as shown. Determine initial velocity so that it reaches friend traveling horizontal



V_{ox}, V_{oy} $\quad V_o, \theta$



$$V_y^2 = V_{oy}^2 + 2a_y(y - y_o)$$

$V_y = 0$ $\quad a_y = -9.8\ m/s^2$ $\quad \Delta y = 5.412\ m$

$$V_{oy} = 10.3\ m/s$$

Time in flight $\quad V_y = V_{oy} + a_y t$

$V_y = 0$

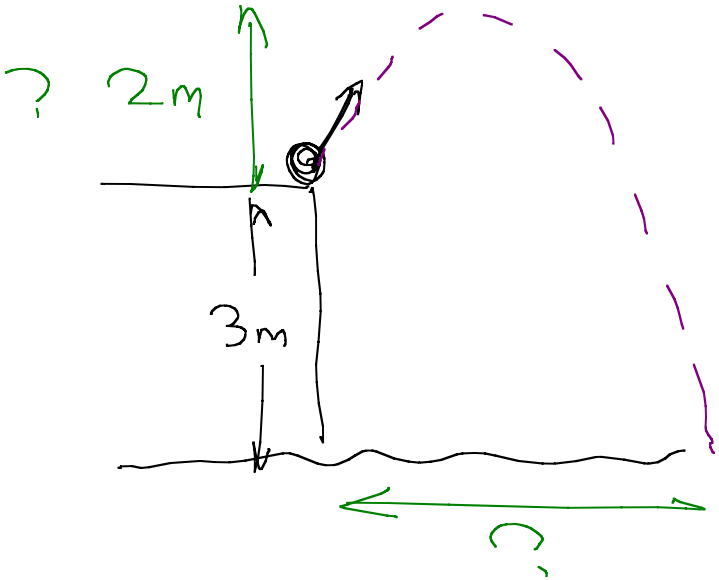
$$t = 1.05\ s \qquad \Delta x = 6.68\ m$$

$$V_{ox} = 6.365$$

$$x = v_{ox} t \qquad 6.68\ m = V_{ox}(1.05\ s)$$

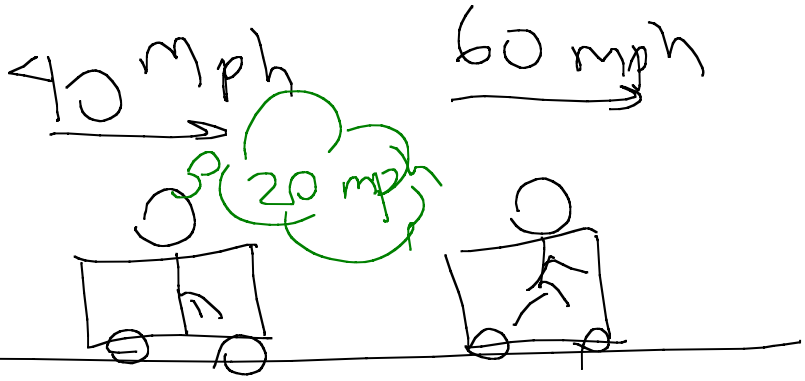
HW

Relative Motion
Circular Motion



Rel. Motion

You see fat cat going at 20 mph (relative to you)



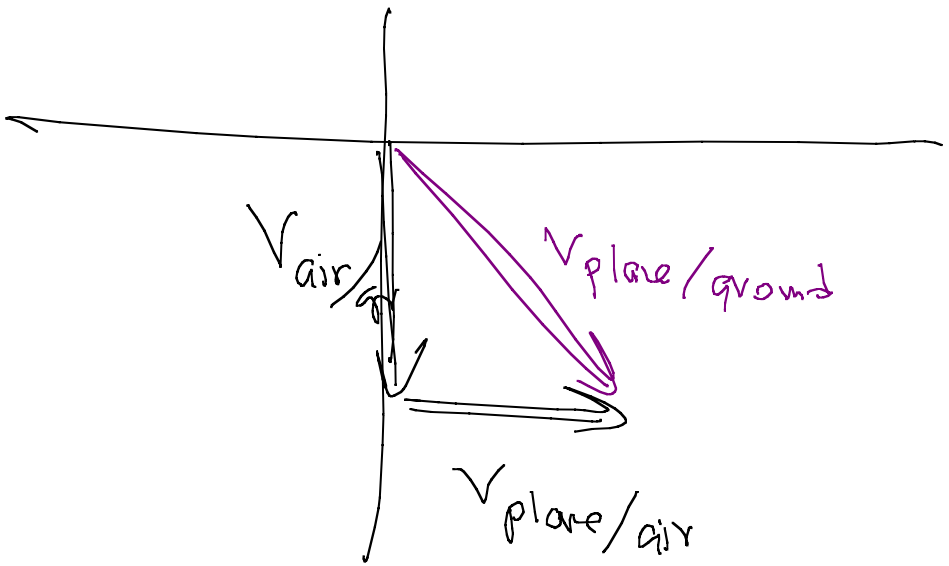
$\vec{V}_{fast/gr} = \vec{V}_{fast/you} + \vec{V}_{you/gr}$

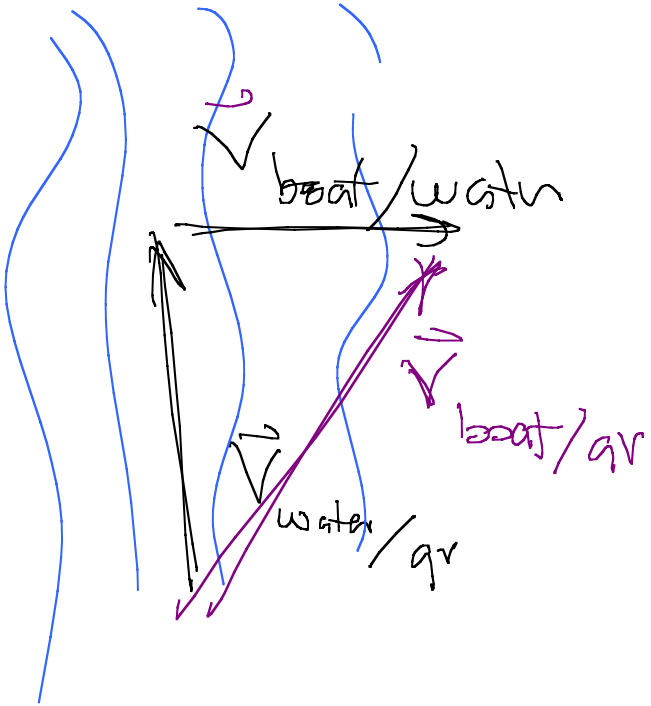
60 20 up

with resp to /

Hard part is when velocities are in diff directions

Addition of vectors.





3.33 Jetliner with airspeed of 1000 km/h sets on a 1500-km flight due south. To maintain southward direction plane must be pointed 15° west of south. Flight 100 min, what is wind velocity?