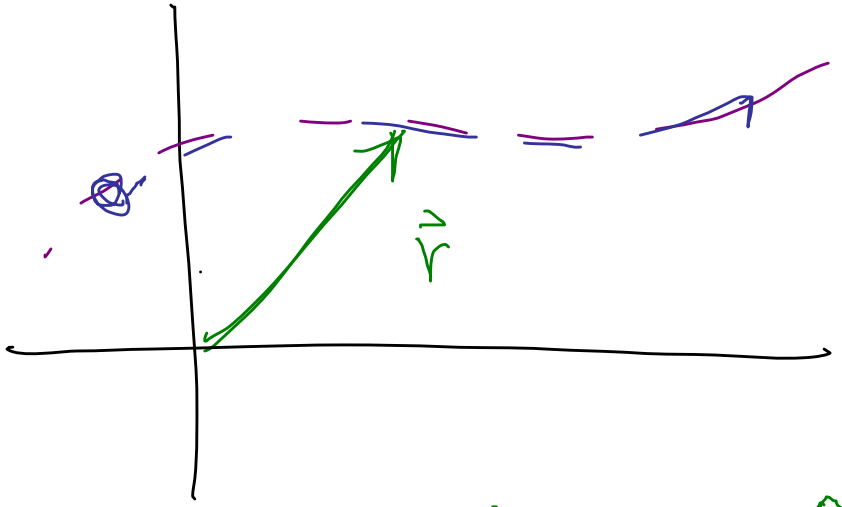
Phys 2110-4 1/27/12

Note Title 1/27/2012



$$\vec{r} = x\hat{i} + y\hat{j}$$

$$\vec{v} = v_x\hat{i} + v_y\hat{j}$$

$$v_x = \frac{dx}{dt} \qquad v_y = \frac{dy}{dt}$$

$$\vec{a} = a_x\hat{i} + a_y\hat{j}$$

$$a_x = \frac{dv_x}{dt} \qquad a_y = \frac{dv_y}{dt}$$

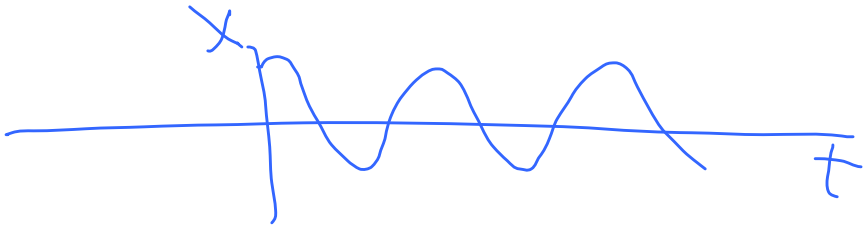
constant acceleration

$$x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2 \qquad y = y_0 + v_{y0}t + \frac{1}{2}a_y t^2$$

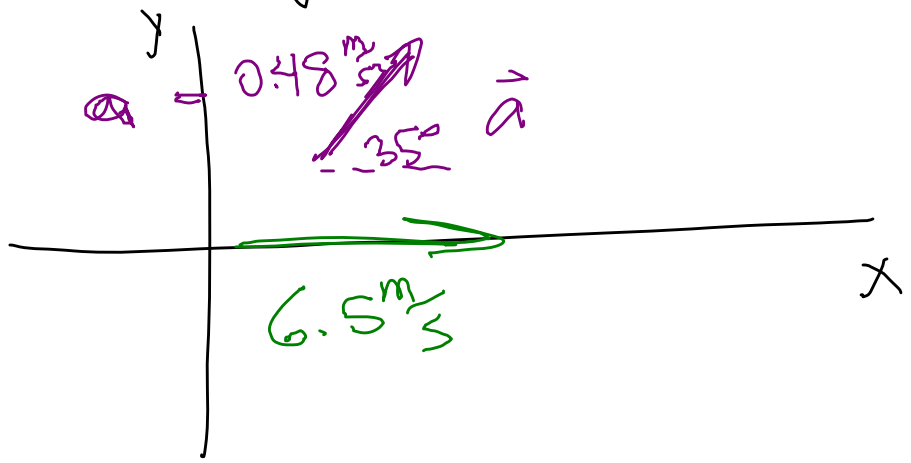
$$v_x = v_{x0} + a_x t \qquad v_y = v_{y0} + a_y t$$

$$v_x^2 = v_{x0}^2 + 2a_x(x - x_0) \qquad v_y^2 = v_{y0}^2 + 2a_y(y - y_0)$$

$$x = x_0 + \frac{1}{2}(v_x + v_{x0})t$$



3.31 You're sailboating at $6.5\ \frac{m}{s}$ when a wind gust hits lasting 6.3s accing board at $0.48\ \frac{m}{s^2}$ at 35° to orig. direction. Find mag. & dir. of your displacement during the gust.



$a_x = a\cos\theta$

$= 0.393\ \frac{m}{s^2}$

$a_y = a\sin\theta$

$\simeq 0.275\ \frac{m}{s^2}$

$V_{x_0} = 6.5 \frac{m}{s}$ $\quad V_{y_0} = 0$

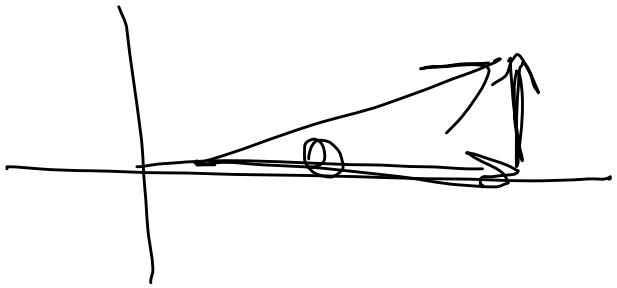
$x = 0 + 6.5 \frac{m}{s} t + \frac{1}{2}(0.458 \frac{m}{s^2}) t^2$

$y = 0 + 0 + \frac{1}{2}(0.142 \frac{m}{s^2}) t^2$

$t = 6.3\ s$

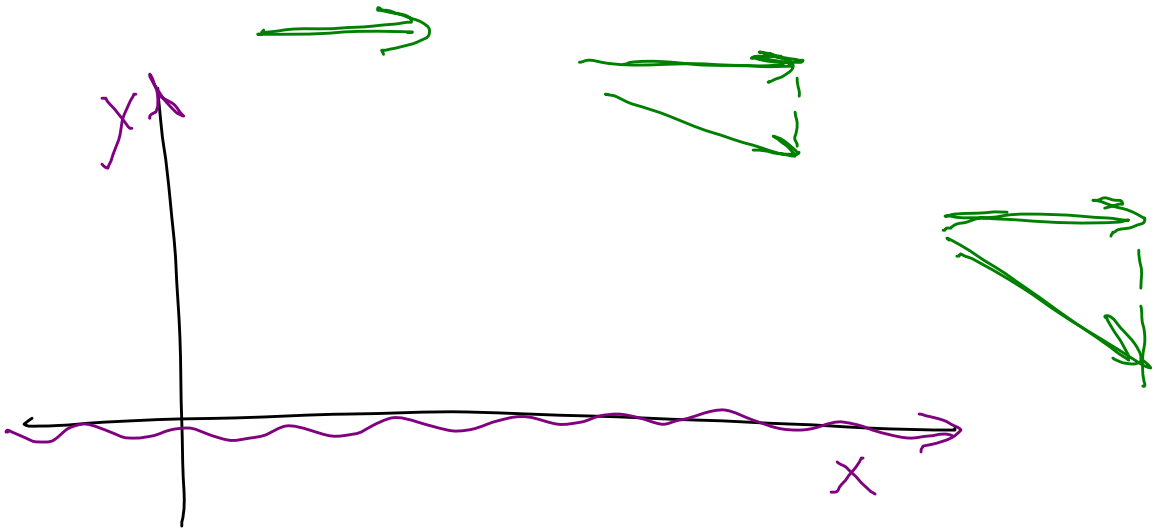
goofed!

$x = 50.0\ m$ $\quad y = 2.8\ m$



$mag = 50.1\ m$

$\theta = 3.2°$



Projectiles

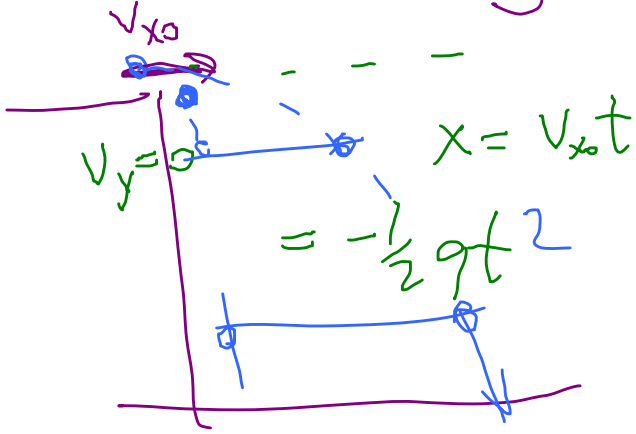
$a_x = 0$

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

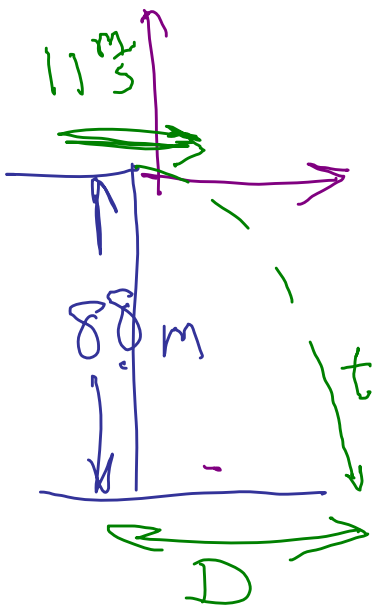
$= -g$

$x = x_0 + v_{x0} t$

$y = y_0 + v_{y0} t - \frac{1}{2} g t^2$



3.33 A carpenter tosses shingle horizontally off an 8.8m-roof at $11\ \frac{m}{s}$. a) How long does it take shingle to reach ground? b) How far does it move horizontally?



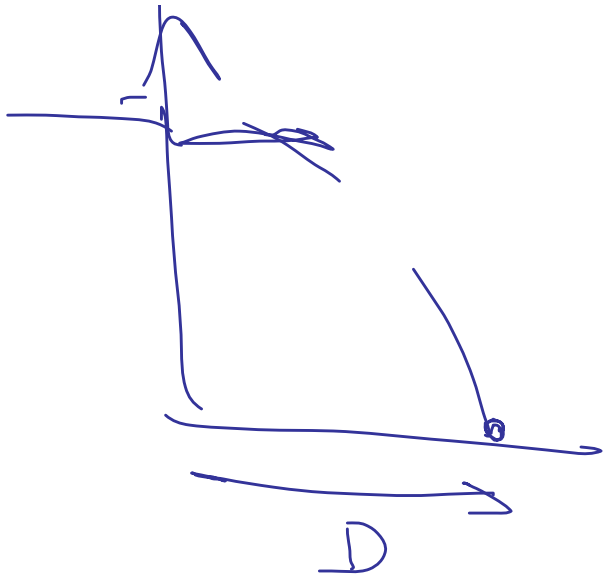
a) $x = 11\ \frac{m}{s}\, t$ $\quad a_x = 0$

$y = -\frac{1}{2} g t^2$ $\quad a_y = 0$

When does $y = -8.8\text{m}$?

$$-8.8\,m = -\frac{1}{2} g t^2$$

$$t = 1.3\,s$$



b) What is x at this time?

$$x = \left(11\,\tfrac{m}{s}\right) t = 15\,m$$

3.34 An arrow fired horizontally at $41\ \frac{m}{s}$ travels 23 m horizontally. From what height was it fired?

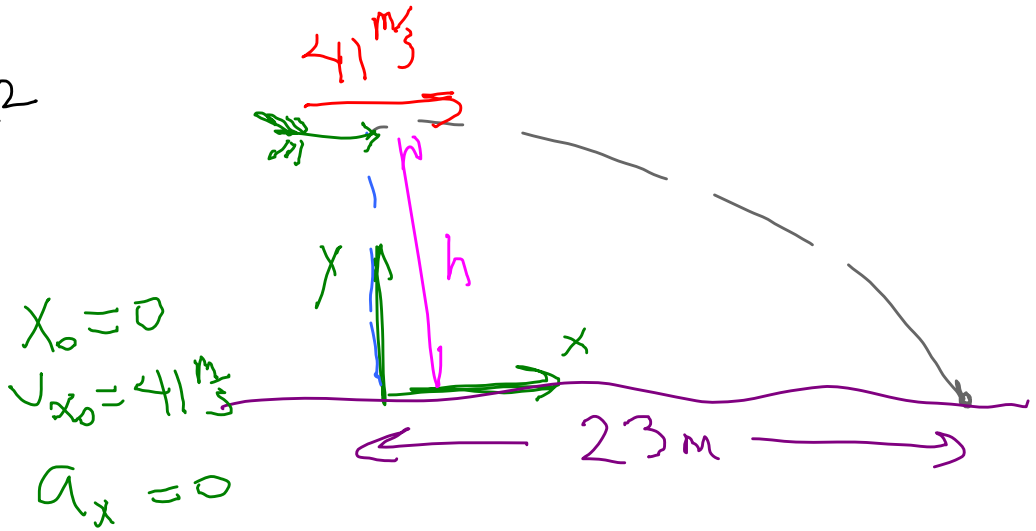
$$x = (41\ \tfrac{m}{s})\,t$$

$$y = h + 0 - \tfrac{1}{2}gt^2$$

Time when it hit ground

$$23\text{ m} = (41\ \tfrac{m}{s})\,t$$

$$= 0.561\text{ s}$$



At that time, $y = 0$

$$0 = h - \frac{1}{2} g (0.561\,s)^2$$

$$\boxed{h = 1.54\,m}$$

Big long example, projectile

Ball is fired from ground level at $30\ \frac{m}{s}$, 50°

How long does it spend in flight?
How far does it go (horiz?)
What was the max height?

$x_0 = y_0 = 0$

$V_{x_0} = \left(30 \frac{m}{s}\right)(\cos 50) = 19.28 \frac{m}{s}$

$V_{y_0} = \left(30 \frac{m}{s}\right)(\sin 50) = 22.98 \frac{m}{s}$

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

How long it spend in flight?

What is t when $y = 0$

$y = 0 + (22.98)t - \frac{1}{2}\left(9.8 \frac{m}{s^2}\right)t^2$

$$y = t\left[22.98 - \tfrac{1}{2}\left(9.8\tfrac{m}{s^2}\right)t\right]$$

$t = 0$

$$t = \frac{2(22.98)}{9.8} = 4.7\,s$$

What was Range?

What was value of x at that time?

$$x = \left(19.28\tfrac{m}{s}\right)(4.7) = 90.4\,m = R$$

What was max ht.

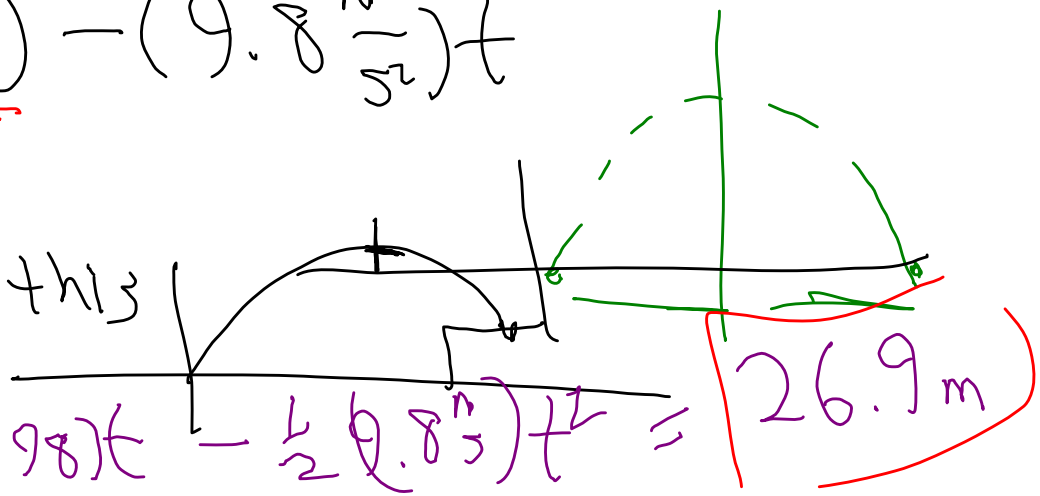
What was t when $v_y = 0$

$v_y = v_{y0} - gt$ $\qquad a_y = -g$

$0 = (22.98 \frac{m}{s}) - (9.8 \frac{m}{s^2})t$

$t = 2.34\ s$

H = what is y at this time? $y = (22.98)t - \frac{1}{2}(9.8)t^2 = 26.9\ m$



What is the range

what is the max height?

$$V_{x_0} = V_0 \cos\theta$$

$$V_{y_0} = V_0 \sin\theta$$

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

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

Time of flight.

When is $y = 0$

$$0 = (v_0 \sin\theta)\, t - \frac{1}{2} g t^2$$

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

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

Use it next time.