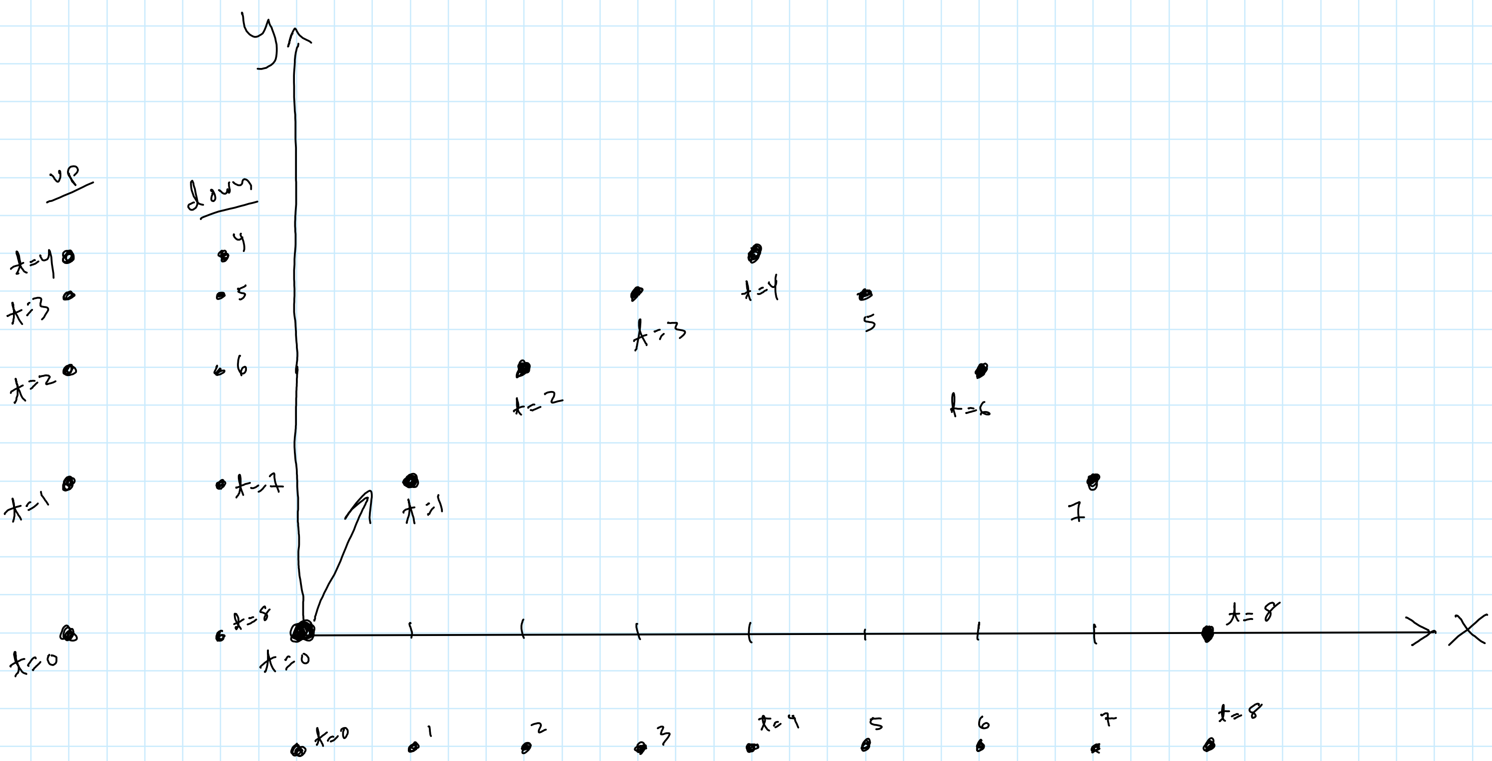
Phy 4A 10/3

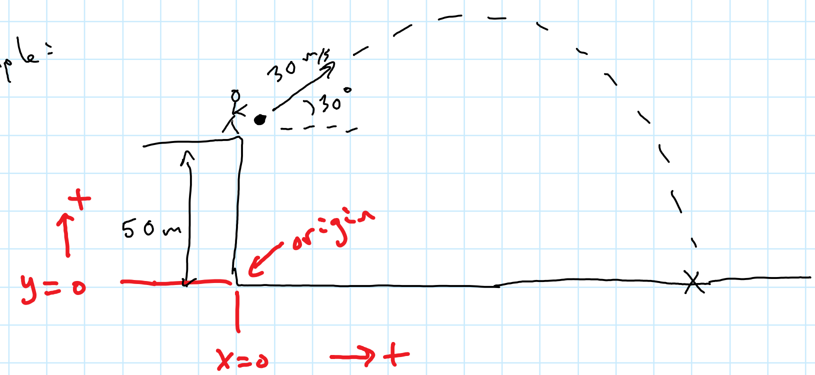
Monday, October 3, 2016 9:02 AM

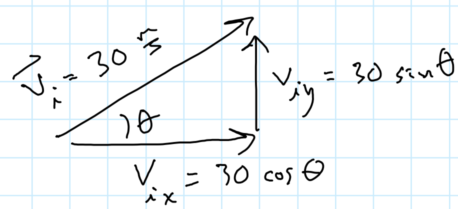
Goals for the Lecture:

1) Be able to solve 2-D kinematics problems (constant acceleration) using the equations and a graphical approach



Example:





x-motion

x_i	0
x_f	?
v_{ix}	$+30\cos 30^\circ$
v_{fx}	$30\cos 30^\circ$
a_x	0
t	?

Δx = { x_i, x_f }

y-motion

y_i	+50 m
y_f	0
v_{iy}	$+30 \sin 30^\circ = 15\ \frac{m}{s}$
v_{fy}	?
a_y	$-9.8\ \frac{m}{s^2}$
t	?

Δy = { y_i, y_f }

t	?

a_y	
t	?

use y-motion to find t

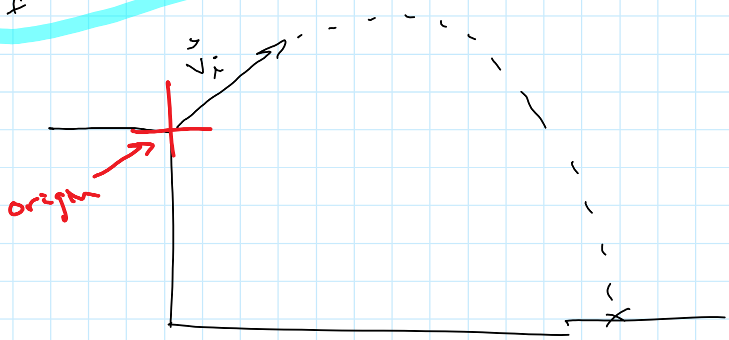
Plug in t to x-motion to find x_f

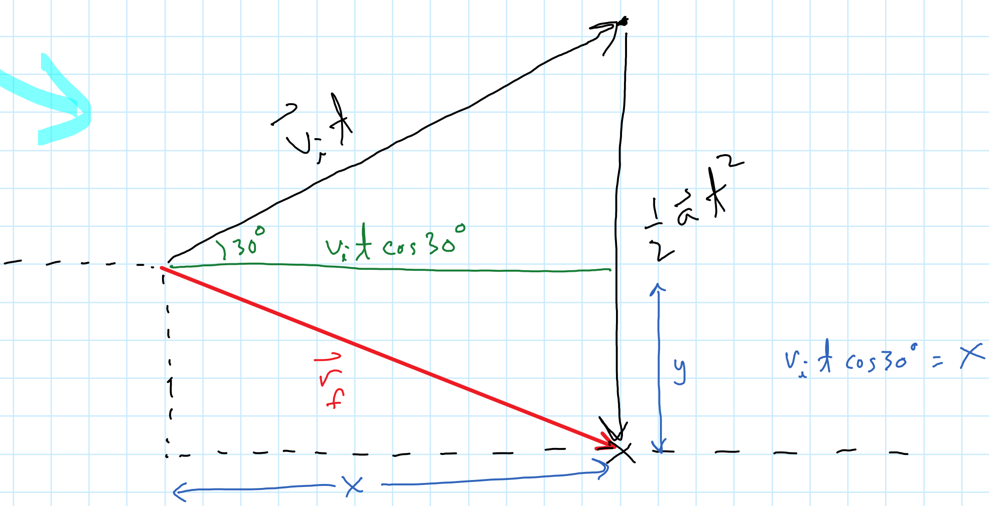
$$\boxed{\vec{v}_f = \vec{v}_i + \vec{a}t}$$

$$\vec{r}_f = \vec{r}_i + \vec{v}_i t + \frac{1}{2}\vec{a}t^2$$

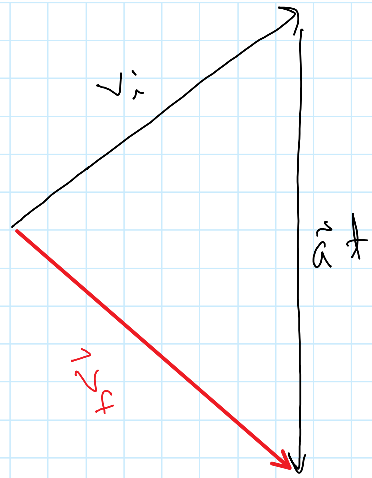
(if $\vec{r}_i = 0$ we start at the origin)

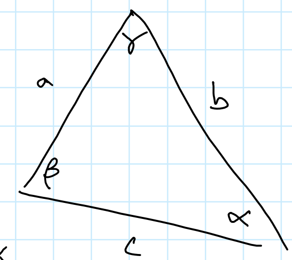
$$\boxed{\vec{r}_f = \vec{v}_i t + \frac{1}{2}\vec{a}t^2}$$





$$\vec{v}_f = \vec{v}_i + \vec{a}t$$





Law of cosines: $a^2 = b^2 + c^2 - 2bc\cos\alpha$

Law of sines: $\dfrac{a}{\sin\alpha} = \dfrac{b}{\sin\beta} = \dfrac{c}{\sin\gamma}$

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worksheet p. 73

i) V_H vs t $\rightarrow$ A

ii) a_H vs t $\rightarrow$ C

iii) V_V vs t $\rightarrow$ I

iv) a_V vs t $\rightarrow$ B

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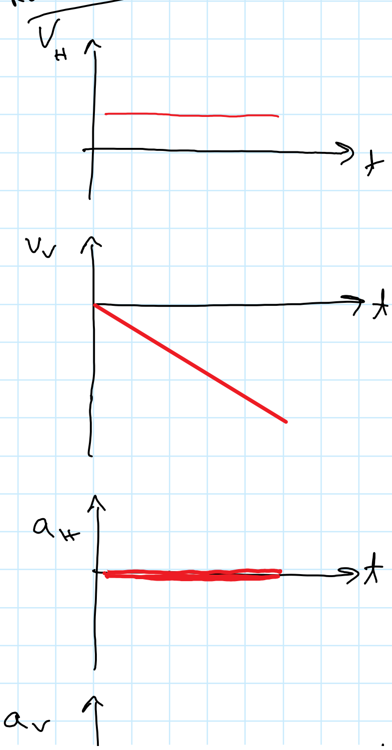
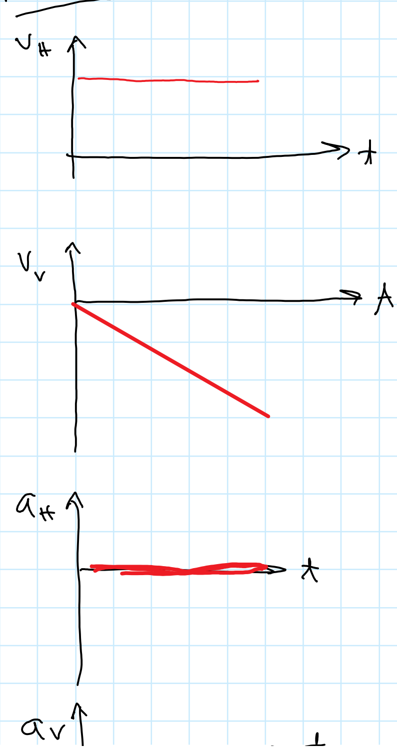
worksheet p. 74

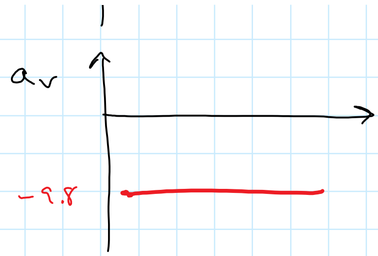
Top:

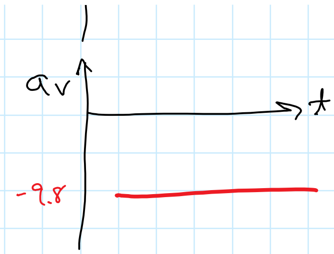
Rock A



Rock B



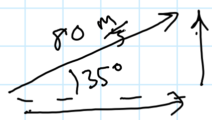




Bottom: acceleration at the top:
all the same $9.8\ \frac{m}{s^2}$ downward

Velocity at the top: $A > D > B = C > 0$

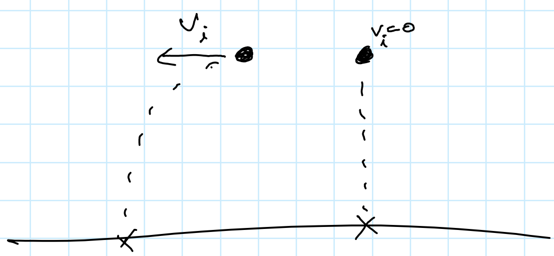
A)



$V_v = 80 \sin 35°$

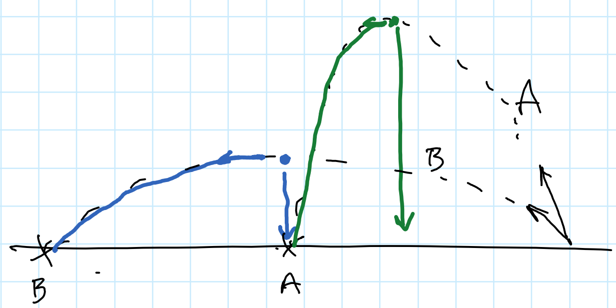
$V_H = 80 \cos 35°$

Demo



Both hit at the same time

Demo:



which hits the ground first?

B hits first

Application of the Day:

MLBAM introduces new way to analyze every play

Jason Heyward's spectacular game-ending catch against the Mets through the eyes of MLBAM's new tracking technology

By Mark Newman / MLB.com | March 1st, 2014

Major League Baseball Advanced Media on Saturday introduced a revolutionary plan for inballpark infrastructure designed to provide the first complete and reliable measurement of every play on the field and answer previously unanswerable analytics questions.

The goal is to revolutionize the way people evaluate baseball, by presenting for the first time the tools that connect all actions that happen on a field to determine how they work together. This new datastream will enable the industry to understand the whole play on the field -- batting, pitching, fielding and baserunning -- and enable new metrics for evaluation by clubs, scouts, players and fans.

For instance, on a brilliant, game-saving diving catch by an outfielder, this new system will let us understand what created that outcome. Was it the quickness of his first step, his acceleration? Was it his initial positioning? What if the pitcher had thrown a different pitch? Everything will be connected for the first time, providing a tool for answers to questions like this and more.

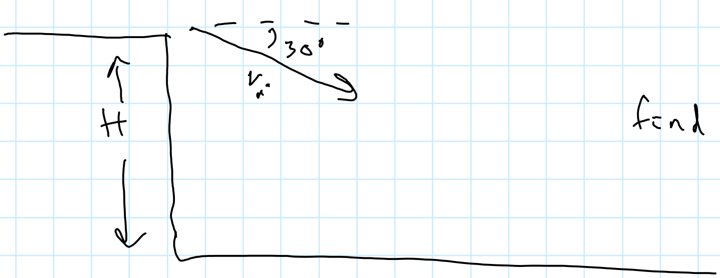
There will be something for everyone, far beyond what has been available in the past. Miller Park in Milwaukee, Target Field in Minnesota and Citi Field in New York will be operational for this tracking in 2014. The plan is to start rolling out the rest this season so that all 30 ballparks are operational by 2015 Opening Day.

It tracks the speed and efficiency of fielders, based on highly accurate readings on hit balls—batted ball speed, launch angle, distance, hang time—and then how fast and how well the defenders react, capturing 30 frames per second on players and 2000 fps on the ball. It's the Holy Grail, basically.
The cameras went through a pilot test last year at Citi Field, and track the trajectory and speed of a ball, and show the path it takes. Simultaneously, they recognize where defenders are on the field, and how far they are from where the ball will land; it then tracks their actual paths, and how optimal they were. One of the examples used was a fly ball hit to left-center: Jason Heyward tracked it and caught it, running at a top speed of over 18 miles per hour, accelerating at 15.1 feet per second, and taking a path that took 83.2 feet, compared to the 80.9-foot optimal path. This is a 97 percent-efficient path, and was far faster than that of the left fielder, whose stats we also see. (Also tracked: reaction time, which is both useful and cool.) This will happen for every single ball put into play.

Prob:

given: $v_i = 30 \ \frac{m}{s}$

$H = 50 \ m$



find: x_f , v_f

$$y_f = y_i + v_{iy}t + \frac{1}{2}a_y t^2$$

For: $-50 = 0 - 15t - 4.9t^2$

origin: top of cliff

+ direction: up

For: $0 = 50 - 15t - 4.9t^2$

origin: bottom of cliff

+ direction: up

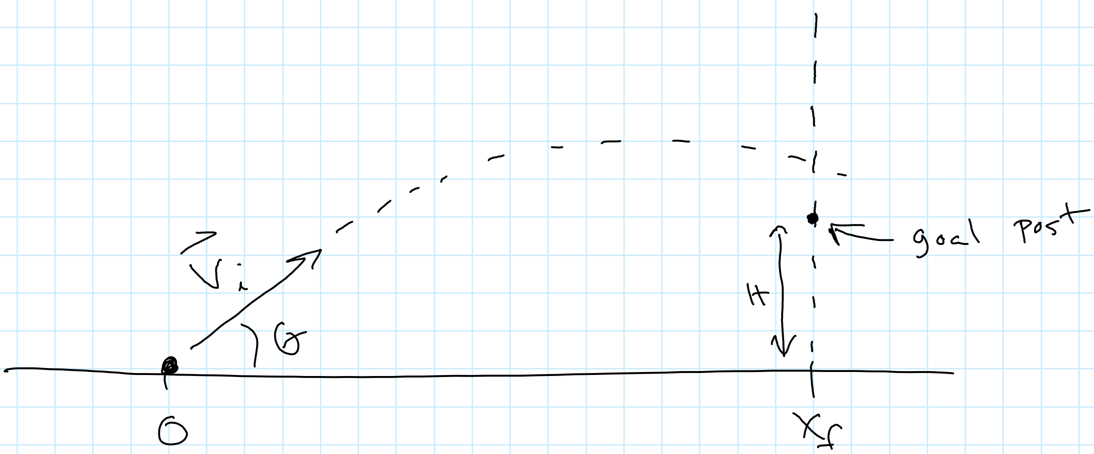
For: $50 = 0 + 15t + 4.9t^2$

origin: top of cliff

+ direction: down

$t = 2.02$ s

$$X_f = V_x t = 30 \cos 30^\circ (2.02) = 52.3 \text{ m}$$



1) Does the ball clear the goal post (over it) or go under it?

2) Is the ball going up or is it on its

way down when it gets to x_f ?

given: $V_i = 30 \frac{m}{s}$

$\theta = 30°$

$x_f = 4.0$ m

$H = .3$ m