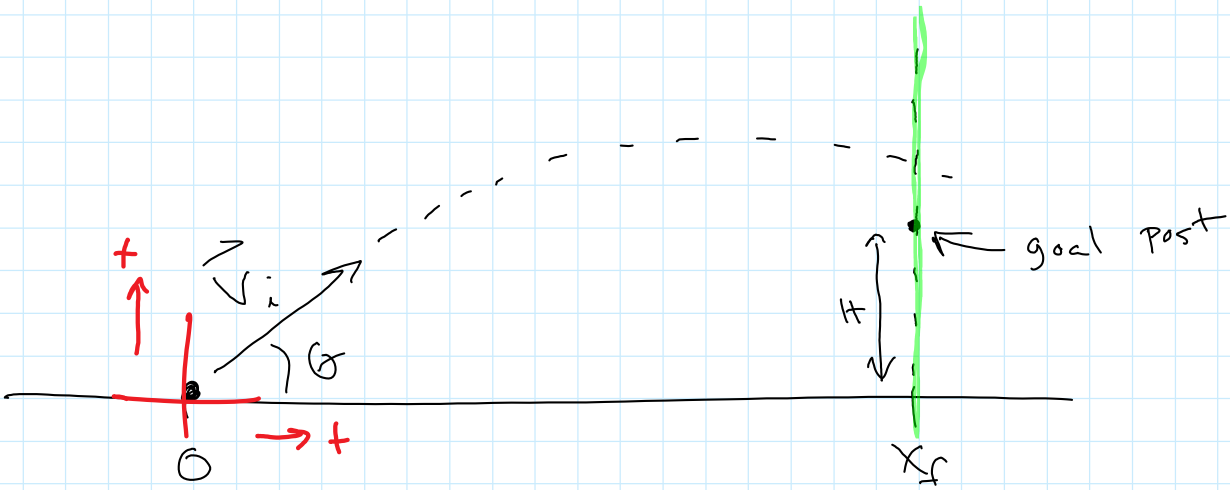
Phy 4A 10/5

Tuesday, October 4, 2016 6:30 PM

Goals for the Lecture:

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



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?

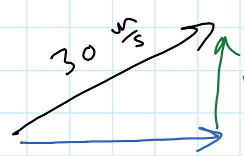
given:

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

$\theta = 30°$

$x_f = 40\ m$

$H = 3\ m$



$V_{iy} = 30 \sin 30 = 15 \frac{m}{s}$

$V_{ix} = 30 \cos 30° = 26.0 \frac{m}{s}$

x	
x_i	0
x_f	40 m

y	
y_i	0
y_f	11.5 m

x_i	0	
x_f	40 m	
v_{ix}	+26.0	$\frac{m}{s}$
v_{fx}	+26.0	
a_x	0	
t		

y_i	0	
y_f	11.5 m	
v_{iy}	+15.0	$\frac{m}{s}$
v_{fy}	X	
a_y	−9.8	$\frac{m}{s^2}$
t	1.54 s	

$$t = \frac{40 \text{ m}}{26 \frac{m}{s}} = 1.54 \text{ s}$$

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

$$= 0 + 15(1.54) + \frac{1}{2}(-9.8)(1.54)^2$$

$$= \underline{11.5 \text{ m}}$$

clears the bar by $11.5 - 3 = 8.5$ m

Find v_f:

$$v_{fy}^2 = v_{iy}^2 + 2 a_y \Delta y$$

$$= (15)^2 + 2(-9.8)(11.5 - 0)$$

$$= -6.4$$

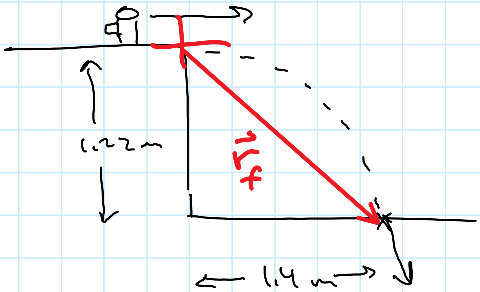
$$v_{fy} = v_{iy} + a_y t$$

$$= 15 - 9.8(1.54)$$

$$= -0.092 \ \frac{m}{s}$$

going down ↓

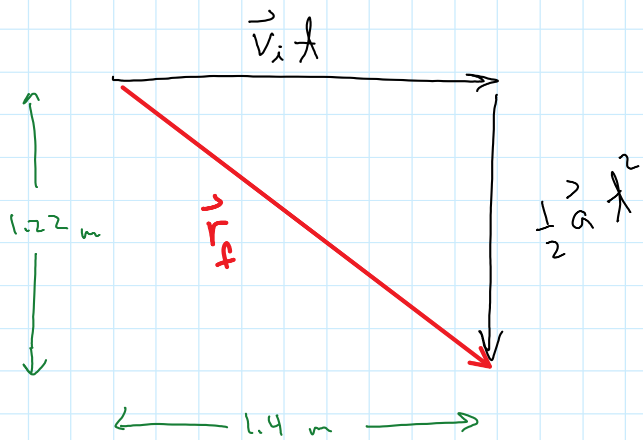
Book Prob 4-13



a) find $\vec{v}_i$

b) find $\vec{v}_f$

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



$v_i t = 1.4$ and $\frac{1}{2} a t^2 = 1.22$

$\frac{1}{2}(9.8)t^2 = 1.22$

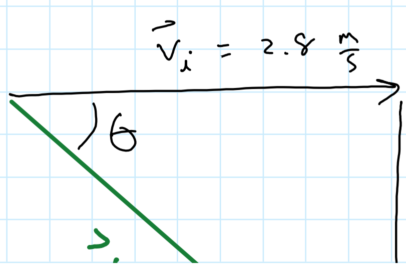
$t = 0.5$ s

$v_i(0.5) = 1.4$

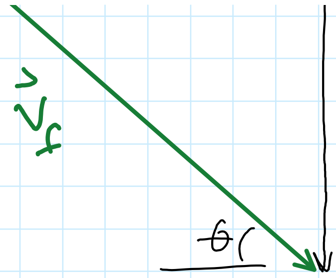
$v_i = 2.8 \frac{m}{s}$

Find $\vec{v}_f$:

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



$\vec{a}t = (9.8)(0.5) = 4.9 \frac{m}{s}$



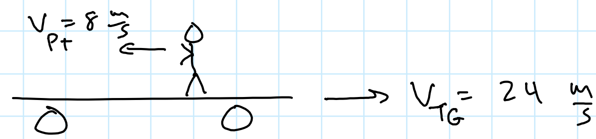
$\vec{a}t = (9.8)(0.5) = 4.$ …

$$v_f = \sqrt{2.8^2 + 4.9^2} = 5.64 \ \frac{m}{s}$$

$$\theta = \tan^{-1}\left(\frac{at}{v_i}\right) = \tan^{-1}\left(\frac{4.9}{2.8}\right) = 60.3^\circ$$

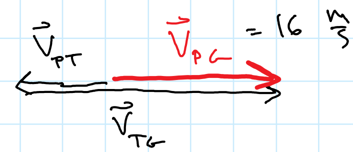
Velocity addition:

A)

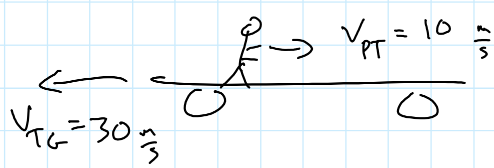


$V_{PG} = 16 \ \frac{m}{s} \rightarrow$

$$\vec{V}_{PG} = \vec{V}_{PT} + \vec{V}_{TG}$$

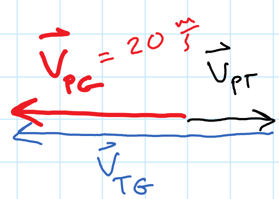


B)

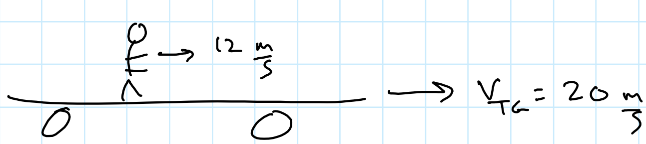


$V_{PG} = 20 \ \frac{m}{s} \leftarrow$

$$\vec{V}_{PG} = \vec{V}_{PT} + \vec{V}_{TG}$$

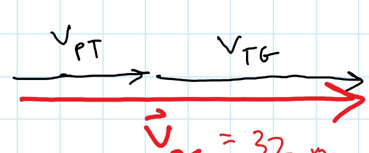


c)



$V_{PG} = 32 \ \frac{m}{s} \rightarrow$

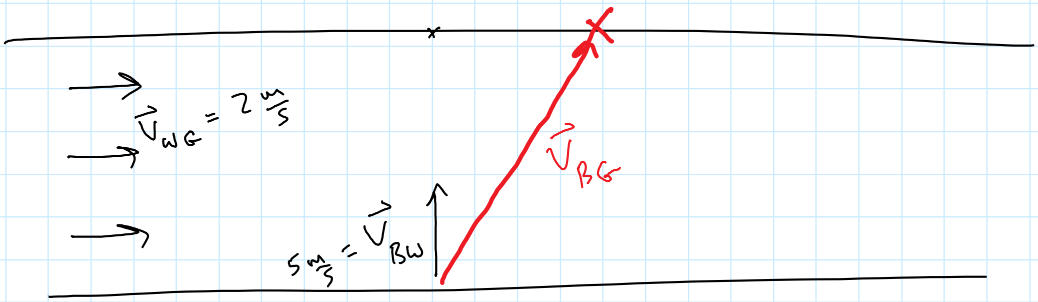
$$\vec{V}_{PG} = \vec{V}_{PT} + \vec{V}_{TG}$$



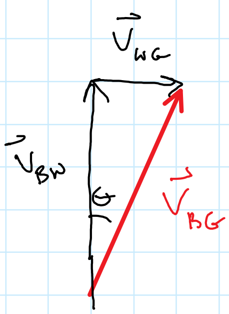
$\vec{V}_{PG} = \vec{V}_{PT} + \vec{V}_{TG}$

$\vec{V}_{PG} = 32 \frac{m}{s}$

Boat crossing a River



$$\vec{V}_{BG} = \vec{V}_{BW} + \vec{V}_{WG}$$



$$V_{BG} = \sqrt{5^2 + 2^2}$$

$$\theta = \tan^{-1}\left(\frac{2}{5}\right)$$

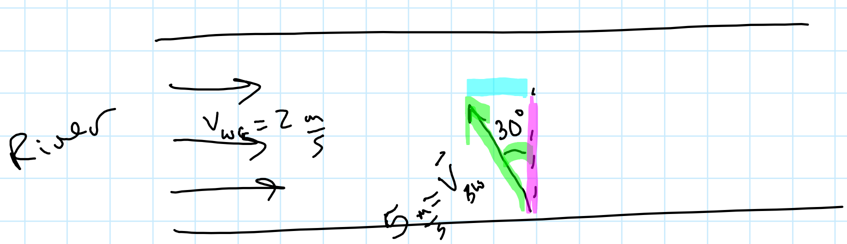
$\vec{V}_{AC}$ = velocity of A wRT C

$\vec{V}_{CB}$ = velocity of C wRT B

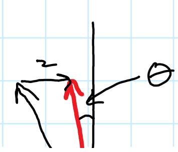
$\vec{V}_{AB}$ = velocity of A wRT B

$$\vec{V}_{AB} = \vec{V}_{AC} + \vec{V}_{CB}$$

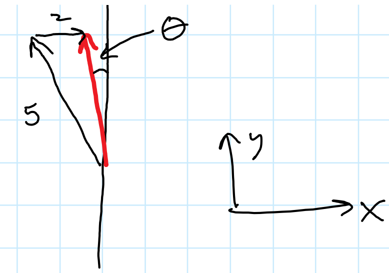
same



$$\vec{V}_{BG} = \vec{V}_{BW} + \vec{V}_{WG}$$

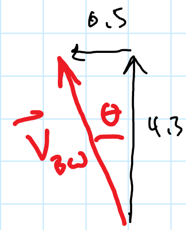


$$V_{BG} = V_{BW} + V_{WG}$$



use components:

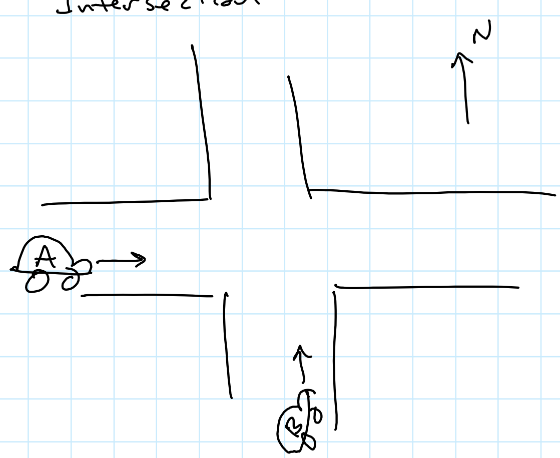
	x	y
V_{BW}	$-5\sin 30$	$+5\cos 30°$
V_{WG}	2	0
V_{BG}	$\underbrace{2 - 2.5}_{-0.5}$	$\underbrace{5\cos 30}_{4.3}$



$$V_{BG} = \sqrt{(0.5)^2 + (4.3)^2}$$

$$\theta = \tan^{-1}\left(\frac{0.5}{4.3}\right)$$

Intersection



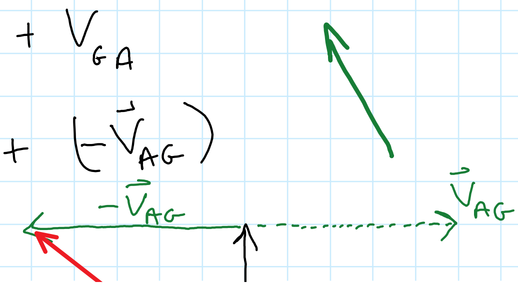
$\vec{V}_{AG} = 50$ mph due E

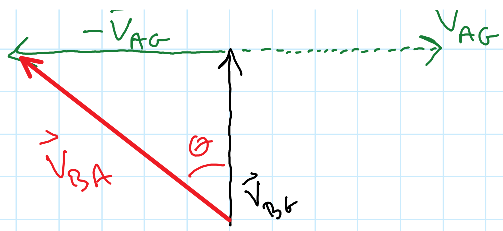
$\vec{V}_{BG} = 40$ mph due N

Find: $\vec{V}_{BA} = ?$

$$\vec{V}_{BA} = \vec{V}_{BG} + \vec{V}_{GA}$$

$$= V_{BG} + (-\vec{V}_{AG})$$





$$V_{BA} = \sqrt{40^2 + 50^2}$$

$$\theta = \tan^{-1}\left(\frac{50}{40}\right)$$

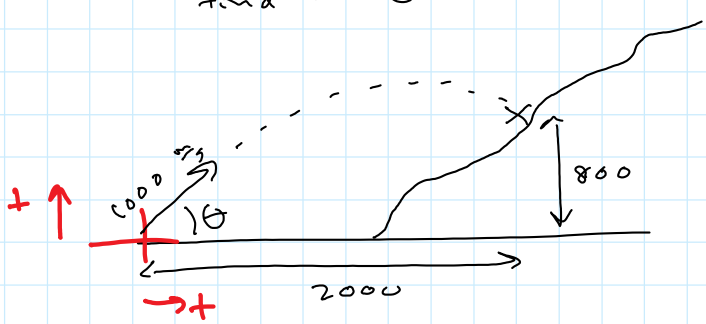
Book Prob 4-66

given: $V_i = 1000 \ \frac{m}{s}$

$x_f = 2000 \ m$

$y_f = 800 \ m$

find: θ



x-motion

x_i	0
x_f	2000
V_{ix}	$1000 \cos\theta$
V_{fx}	
a_x	0
t	?

y-motion

y_i	0
y_f	800
V_{iy}	$1000 \sin\theta$
V_{fy}	X
a_y	-9.8
t	?

$$x_f = x_i + V_{ix} t + 0$$

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

$2000 = 1000 \cos\theta \ t$

$800 = 0 + (1000 \sin\theta)(2 \quad) - 4.9 (2 \quad)^2$

$$2000 = 1000 \cos\theta \, t \qquad\qquad 800 = 0 + 1000 \sin\theta \left(\frac{2}{\cos\theta}\right) - 4.9 \left(\frac{2}{\cos\theta}\right)^2$$

$$\frac{2}{\cos\theta} = t \qquad\qquad \text{solve for } \theta$$

Find θ to get From A to B given: $\vec{V}_{wG}$ and $|\vec{V}_{BW}|$