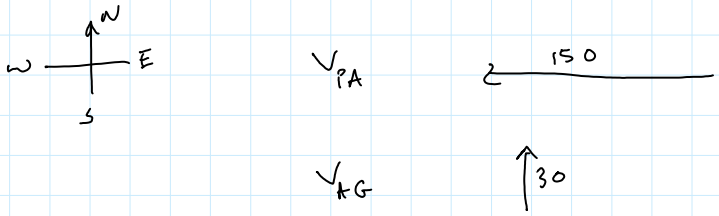
Phy 2A Review 4/21

Friday, April 21, 2017 9:54 AM

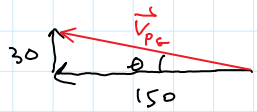
Some velocity addition problems:

1) An airplane compass reads due west. The plane's speed relative to the air is 150 km/hr. The air is moving at 30 km/hr due North. Find velocity of plane relative to the ground.



$\vec{V}_{PG} = \vec{V}_{PA} + \vec{V}_{AG}$ (same)

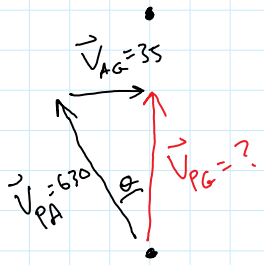
So, just add these two vectors:



$$|\vec{V}_{PG}| = \sqrt{30^2 + 150^2} = 153 \text{ km/hr}$$

$$\theta = \tan^{-1}\left(\frac{30}{150}\right) = 11.3^\circ$$

2) A plane has an airspeed of 630 km/hr and wants to go 750 km due North. How long will it take if there is a cross wind 35 km/hr due East.



$$630^2 = V_{PG}^2 + 35^2$$

$$V_{PG} = \sqrt{630^2 - 35^2}$$

$$= 629 \text{ km/hr}$$

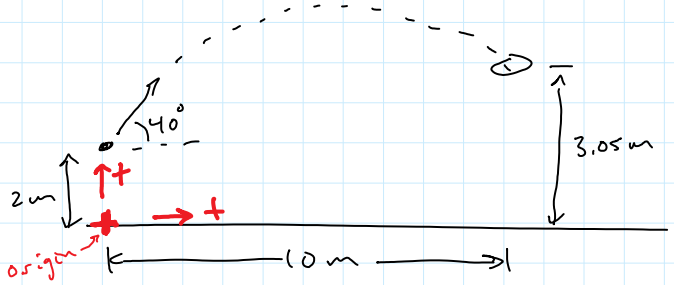
$$\theta = \sin^{-1}\frac{35}{630} = 3.18^\circ$$

time:

$$t = \frac{750 \text{ km}}{629 \frac{\text{km}}{\text{hr}}} = 1.19 \text{ hr}$$

2-D Kinematics Prob:

1) a ball is thrown from 2 m above ground and it goes through a hoop 10 m away and 3.05 m above ground. If it is released at 40° above the horizontal, what is the initial speed?



1st - define origin and + directions

2nd - Fill in tables

x-motion

x_i	0
x_f	10 m
v_{ix}	$v_i \cos 40$
v_{fx}	same
a_x	0
t	

y-motion

y_i	2 m
y_f	3.05 m
v_{iy}	$v_i \sin 40°$
v_{fy}	X
a_y	$-9.8 \frac{m}{s^2}$
t	

same

$$t = \frac{10}{v_i \cos 40°}$$

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

$$3.05 = 2 + v_i \sin 40° \left(\frac{10}{v_i \cos 40}\right) - 4.9 \left(\frac{10}{v_i \cos 40}\right)^2$$

$$\frac{10}{v_i \cos 40} = \sqrt{\frac{2 - 3.05 + 10 \tan 40°}{4.9}}$$

$$v_i = 10.7 \frac{m}{s}$$

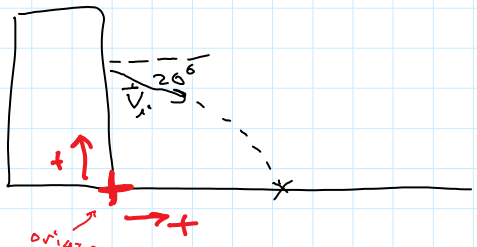
2) From an upper story window you throw a ball at 8 $\frac{m}{s}$ and an angle of 20° below the horizontal. It strikes the ground 3 s later.

a) How far horizontally did it travel?

b) What was the initial height?

c) How long does it take to reach a point 10 m below the release height?

1st - Draw a picture



2nd - Define origin and positive directions

3rd - Fill in tables for both x and y motion

x-motion

x_i	0
x_f	x_f
V_{ix}	$8\cos 20°$ $\frac{m}{s}$
V_{fx}	$8\cos 20°$
a_x	0
t	3 s

y- motion

y_i	y_i
y_f	0
V_{iy}	$-8\sin 20°$ $\frac{m}{s}$
V_{fy}	X
a_y	-9.8 $\frac{m}{s^2}$
t	3 s

a) $x_f = x_i + V_{ix}t + \frac{1}{2}\cancel{a_x^{0}}t^2$

$$x_f = v_{ix} t$$

$$= (8 \cos 20^\circ)(3)$$

$$= 22.6 \text{ m}$$

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

$$0 = y_i + (-8 \sin 20^\circ)(3) + \frac{1}{2}(-9.8)(3)^2$$

$$y_i = 52.3 \text{ m}$$

c) Now:

y-motion

y_i	52.3	m
y_f	42.3	m
v_{iy}	$-8 \sin 20^\circ$	$\frac{m}{s}$
v_{fy}	x	
a_y	-9.8	$\frac{m}{s^2}$
t	?	

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

$$42.3 = 52.3 + (-8 \sin 20^\circ)(t) + \frac{1}{2}(-9.8) t^2$$

$$t = \begin{cases} -1.74 \text{ s} \\ 1.18 \text{ s} \quad \leftarrow t \text{ must be positive} \end{cases}$$

$$t = 1.18 \text{ s}$$