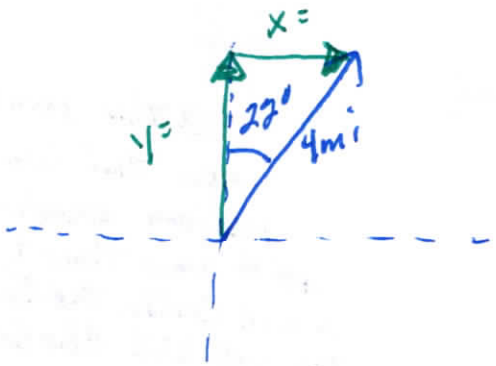
«First_Name» «Last_Name» Pd:«Period» group: «group»

VECTORS

AT Vectors (20)

Directions: Solve the following problems showing all work.

1) Resolve the following vector: 4miles at 22 degrees east of north



X

$\sin\theta = \frac{x}{4mi}$

$4mi \sin 22° = 1.498 \sim 1.5mi = x$

Y

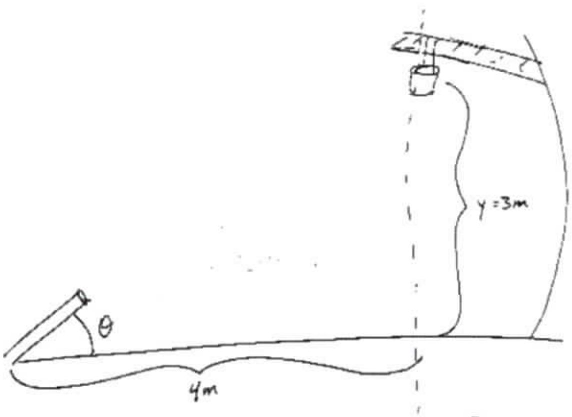
$\cos\theta = \frac{Adj}{hyp}$

$hyp \cos\theta = Adj$

$(4mi)(\cos 22°) = 3.7mi = Y$

«First_Name» «Last_Name» Pd:«Period» group: «group»

2) There is a "can" hanging from a tree that will fall at the same moment the gun is fired. The can is initially 3m above the ground, and the gun is 4 m from the line of fall of the can, as is shown in the diagram. Determine the angle of the gun so that the ball fired from the gun hits the can on its way down to the ground. Assume the speed of the ball will be such that it gets to the can before it hits the ground. (*note* this is a CLASSIC demo! It's possible that you may be familiar with the "Monkey & Hunter." If you are not, search it on YouTube {recommend **Physics Force of the School of Physics and Astronomy, University of Minnesota.**} when you are finished with the test. Rare is the mathematical justification, which is why we ask it here...)



"Monkey" (Can)

$Y_0 = 3m$

$y =$

$a = g$

$v_0 = \text{zero}$

$t = t$

$y = Y_0 + v_0 t + \frac{1}{2}at^2$

$y = Y_0 + \frac{1}{2}at^2$

@ This point, now that we have position equations, ~~At~~ At Some Time t, the 2 Will Collide. The Can & The Ball Will Also Collide when $Y_{can} = Y_{Ball}$. Go To #2

Ball

$x = x$

$v_x = v_0 \cos\theta$

$t = t$

$a = \text{zero}$

$x = v_{0x} t + \frac{1}{2}at^2$

$x = v_0 \cos\theta\, t$

Y

y

$v_{0y} = v_0 \sin\theta$

$t = t$

$a = g$

$Y_0 = \text{zero}$

$y = v_{0y} t + \frac{1}{2}at^2$

$y = v_0 \sin\theta\, t + \frac{1}{2}at^2$

#2

$y = y$

$v_0 \sin\theta\, t + \frac{1}{2}at^2 = Y_0 + \frac{1}{2}at^2$

$v_0 \sin\theta\, t = Y_0$ [That's Interesting...]

Sub t From $Ball_x$...

$x = v_0 \cos\theta\, t$

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

$v_0 \sin\theta\, t = Y_0$

$v_0 \sin\theta \frac{x}{v_0 \cos\theta} = Y_0$ (Clean it up)

$\frac{x\, v_0 \sin\theta}{v_0 \cos\theta} = Y_0$

$x \frac{\sin\theta}{\cos\theta} = Y_0$

$\tan\theta = \frac{Y_0}{x}$

$\theta = \tan^{-1}\left[\frac{3m}{4m}\right] = 37°$.. Or Basically At the Monkey

«First_Name» «Last_Name» Pd:«Period» group: «group»

(Work space for #2)

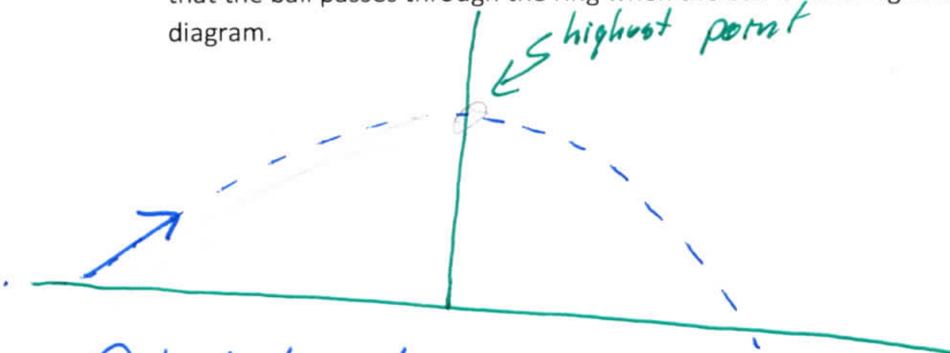
«First_Name» «Last_Name» Pd:«Period» group: «group»

3) A small cannon in the classroom fires a small metal ball 5m/s. Determine where to place a ring so that the ball passes through the ring when the ball is at its highest point. It may be easier to include a diagram.

Need Angle

62°

(Check Individ. Angles)



@ highest point

$v_{o_y} = v_0 \sin\theta$

$v_y = \text{zero}$

$a = -9.8 \, m/s^2$

$y = ?$

$t = ?$

$v_y^2 = v_{0y}^2 + 2ay$

$\frac{v_y^2 - v_{0y}^2}{2a} = y$

$\frac{0 - (v_0 \sin\theta)^2}{2a} = y$

$\frac{0 - [(5 m/s)\sin(62°)]^2}{-(2)(9.8 m/s^2)} = .99 m \approx \boxed{1m \text{ High}}$

$v_y = v_{0y} + at$

$\frac{v_y - v_{0y}}{a} = t$

$\frac{0 - v_0 \sin\theta}{a} = \frac{-(5 m/s)(\sin 62°)}{-9.8 m/s^2} = .45 s$

x Highest point

$x = ?$

$t = .45 s$

$a = \text{zero}$

$v_x = v_0 \cos\theta$

$x = v_0 t + \frac{1}{2}at^2$

$x = v_{0x} t$

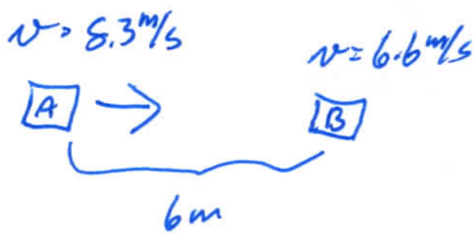
$x = v_0 \cos\theta \, t$

$x = (5 m/s) \cos(62°)(.45 s)$

$\boxed{x = 1.06 m \text{ Out}}$

«First_Name» «Last_Name» Pd:«Period» group: «group»

4) Pat and «First_Name» are playing tag with a large group of people. Pat runs at 6.6m/s and «First_Name» runs at 8.3 m/s. At one point, «First_Name» spots Pat at an approximate close and targetable distance of 6 m and gives chase. How far will «First_Name» need to run to catch Pat. Assume acceleration time is negligible, all speeds are constant.



$\underline{v_A \text{ WRT } B}$

$v_A = 1.7 \, m/s$

$x = 6m$

$t = ?$

$x = v_0 t$

$\frac{x}{v_0} = t = \frac{6m}{1.7 \, m/s} = \underline{3.5 s}$ To Catch

$\underline{\text{WRT Ground}}$

$v = 8.3 \, m/s$

$x = ?$

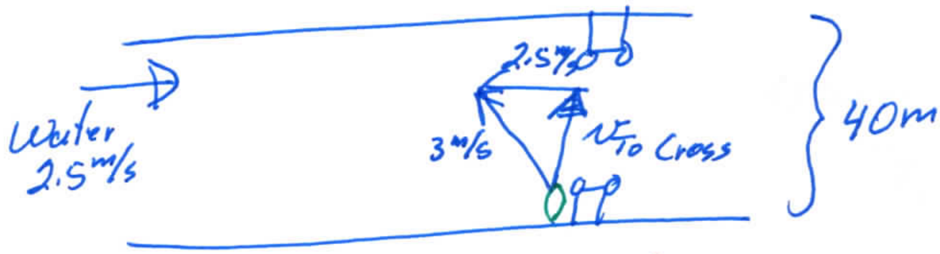
$t = 3.5s$

$x = v_0 t + \frac{1}{2} a t^2$

$x = (8.3 \, m/s)(3.5s) = 29.3m$

«First_Name» «Last_Name» Pd:«Period» group: «group»

5) You paddle your canoe at 3 m/s WRT water. A creek is 40 m wide and flows at 2.5 m/s. Determine how long it will take you to paddle to a point on the far bank directly across the creek.



$$c^2 = A^2 + B^2$$

$$\sqrt{c^2 - A^2} = B$$

$$x = v_0 t$$

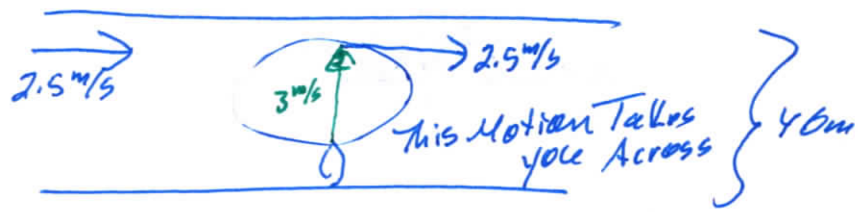
$$\frac{x}{v_0} = t$$

$$\frac{40\,m}{\sqrt{c^2 - A^2}} = \frac{40\,m}{\sqrt{(3\,m/s)^2 - (2.5\,m/s)^2}} = 24\,s$$

«First_Name» «Last_Name» Pd:«Period» group: «group»

6) You paddle your canoe at 3 m/s WRT water. A creek is 40 m wide and flows at 2.5 m/s. Determine far down stream you will end up if the canoe is paddled across the creek such that the canoe is perpendicular to the bank.

To Cross



Time To Cross

$x = v_0 t$

$\frac{x}{v_0} = t$

$\frac{40m}{3 m/s} = 13s$

Distance Downstream

$x = v_0 t$

$x = (2.5 m/s)(13s)$

$x = 32.5m$

«First_Name» «Last_Name» Pd:«Period» group: «group»

7) Using the "Range Equation" $x=v_o^2 Sin(2\theta)/g$, determine the angle you would need to "fire the cannon" to hit a target that is 42 m away. The cannon fires a projectile at 20m/s. Defend your response if necessary.

$$x = \frac{v_o^2 \sin(2\theta)}{g}$$

$$\frac{\sin^{-1}\left[\frac{xg}{v_o^2}\right]}{2} = \text{Undefined; Can't Shoot that Far... Need More Speed}$$

$$\frac{\sin^{-1}\left[\frac{(42m)(9.8 m/s^2)}{(20 m/s)^2}\right]}{2}$$