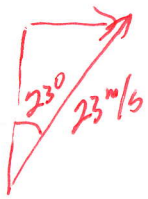
Vector Test

AT Vector(09)

Directions: Solve the following problems, showing all work and circling your answer. Each is worth 5 points.

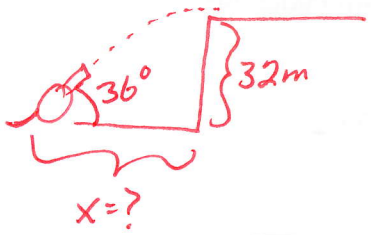
1) Resolve the following vector: 23 m/s @ 23 degrees east of north.



8.9 m/s East

21.2 m/s North

2) A cannon is positioned at the bottom of a cliff that is 32 m high. The cannon is aimed at 36 degrees above the horizontal. The cannon will launch the projectile at 43 m/s, and attempt to have the projectile land on the top of the cliff. Determine how far from the base of the cliff the cannon should be placed to ensure the projectile lands on the top edge of the cliff.



$v_0 = 43\ m/s$

y

$y = 32m$

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

$t = ?$

$v_y = \text{Zero}$

$a = g$

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

$v_y = v_{0y} + at$

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

$\frac{0 - v_0 \sin\theta}{g} = t$

$\frac{0 - (43\ m/s)\sin(36^\circ)}{-9.8\ m/s^2} = 2.5s$ Time To peak

peak height

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

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

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

$y = (43\ m/s)(\sin\theta)(2.5s) + \left(\frac{1}{2}\right)(-9.8\ m/s^2)(2.5s)^2$

$y = 32.5m$ max height

Cannon must Be
A Distance from the C
Such that the Edge of
Cliff Is At the Pe

x

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

$a = \text{Zero}$

$t = 2.5s$

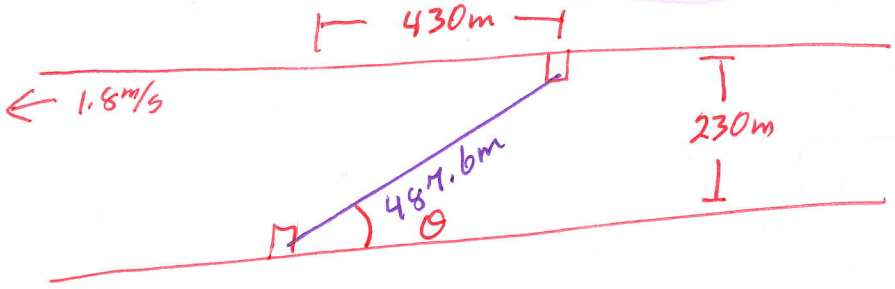
$v_{0x} = (v_0 \cos\theta)$

$x = (43\ m/s)\cos(36^\circ)(2.5s)$

$x = 87m$ From Base

3) A river is flowing at 1.8 m/s WRT land. You are with your boat on the near shore hoping to cross the river to the far shore in a time of 5 minutes. The river is 230m wide, and you plan to land on the far side 430 m upstream. Determine the required velocity of the boat WRT the bank of the river.

Error writing Problem, should state "Angle measured From the Bank WRT water"



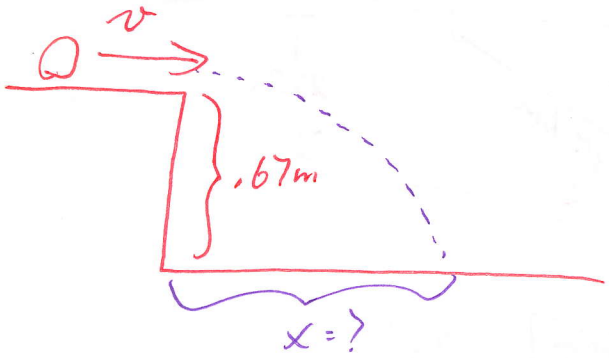
$\theta = \tan^{-1}\left[\frac{230m}{430m}\right] = 28^\circ$

5min = 300s

$\frac{487.6m}{300s} = 1.63 m/s$

1.63 m/s @ 28° From Bank WRT Land

4) A ball rolls off a table that is 67 cm above the floor. If the ball lands 0.7m out from the edge of the table, determine how fast the ball was rolling on the table.



y

$y = -.67m$

$a = -9.8 m/s^2$

$t = ?$

$v_{0y} = \text{Zero}$

x

$t = t_y$

$x = .7m$

$a = \text{Zero}$

$v_0 = ?$

y

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

$y = \frac{1}{2} a t^2$

$\sqrt{\frac{2y}{a}} = t = \sqrt{\frac{(2)(-.67m)}{-9.8 m/s^2}} = .37s$

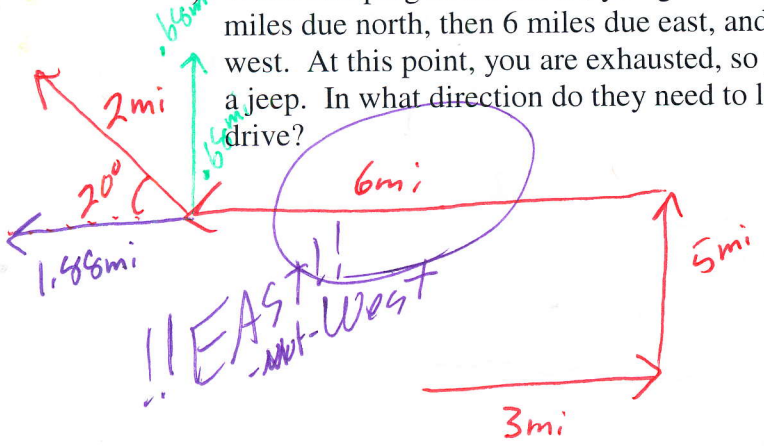
x

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

$x = v_0 t$

$\frac{x}{t} = v_0 = \frac{.7m}{.37s} = 1.89 m/s$

5) While camping in the desert, you go on a hike. You walk 3 miles due east, then 5 miles due north, then 6 miles due east, and finally 2 miles at 20 degrees north of west. At this point, you are exhausted, so you call your friend to come get you in a jeep. In what direction do they need to leave camp, and how far must they drive?



X

+3mi
+6mi
-1.88mi

~~-4.88~~mi 7.12mi

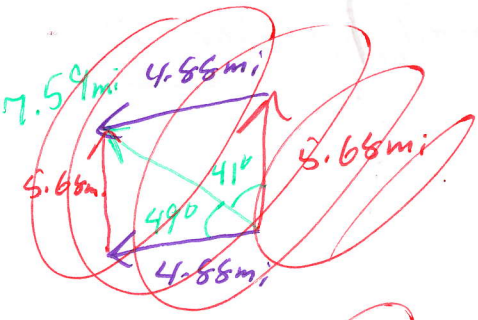
-or-

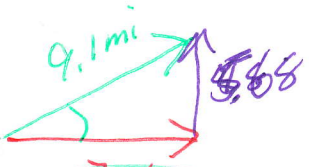
~~4.88~~mi ~~West~~ East
7.12

Y

+5mi
+.68mi

5.68mi
-or-
5.68mi North

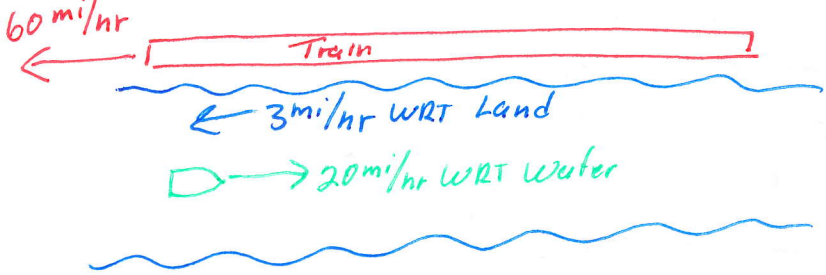




9.1mi @ 38° North of East

7.59mi @ 41° West of North
-or-
7.59mi @ 49° North of West

6) A mile long train is traveling along a river valley, heading downhill at 60 miles per hour. The fast moving water is traveling at 3 miles per hour. While in your boat, you are heading upstream at 20 miles per hour WRT water when you pass the engine of the 1-mile long train. How long does it take for you to pass the back end of the train?



Boat

WRT water 20 mi/hr

WRT Land 17 mi/hr

WRT Train 77 mi/hr

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

$t = \frac{x}{v} = \frac{1\text{mi}}{77\text{mi/hr}} = .013\text{hr} = .77\text{min} = 46\text{s}$

7) A cannon fires a projectile at 34 m/s. Determine the angle needed to hit a target that is 45 m away.

$$x = \frac{v_0^2 \sin(2\theta)}{g}$$

$$\frac{\sin^{-1}\left[\frac{xg}{v_0^2}\right]}{2} : \frac{\sin^{-1}\left[\frac{(45m)(9.8m/s^2)}{(34m/s)^2}\right]}{2} : 11^0$$

8) You are preparing to cross a river that is 840 m wide. As you stand on the bank of the river, you notice the river is flowing at 2.3 m/s WRT land. You are able to paddle your kayak at 3.2 m/s WRT water. You are planning to cross this river to get to the other side in less than 5 minutes. Determine the speed of the water WRT the boat prior to leaving the shore.

2.3 m/s