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key Level I Physics Pd2 with shoe

Vector Test

A7 Vector(09)

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

1) During a silly stunt in a Disney comedy movie, a crazed person is screaming (literally) down a hill and across a boat dock on a skateboard. (The board is 0.6 m long). Of course, the screaming person then flies off the end of the dock, which is 1.2 m above the water, into the water. The person landed in the water 3.4 m from the end of the dock.
    a. How long was the person in mid-air from the moment they left the dock until they hit the water?

$y = {}^{-}1.2m$ $\quad y = \frac{1}{2}at^2$

$a = {}^{-}9.8 m/s^2$ $\quad \sqrt{\frac{2y}{a}} = t$

$v_{0y} = 0$

$t = ?$ $\quad \sqrt{\frac{(2)(1.2m)}{9.8\frac{m}{s^2}}} = .49s$

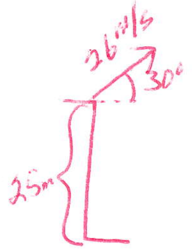
    b. How fast was the person traveling on the skateboard?

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

$\frac{x}{t} = v_0 = \frac{3.4m}{.49s} = 6.9 m/s$

2) You design a frame to hold a water balloon launcher so you are assured of a constant launch velocity of 26 m/s, and a fixed launch angle of 30 degrees. You are perched at the top of the cliff with your water balloon launcher. A pick-up truck is parked at the base of the cliff, 25 m below you. You desire to land a water balloon in the back of the pick-up truck as they drive away. The pick-up truck leaves the area directly below the cliff and drives away from the cliff at a steady 30 mph, which is about 14m/s (assume the time to accelerate to 30 mph is negligible).

a. How long after the water balloon is released do you have to wait to see if you hit it? (How long is it in the air?)



Y

$v_{0y} = v_0 \sin 30$

$y = -25m$

$a = -9.8 m/s^2$

$t = ?$

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

$-25m = (26\frac{m}{s})\sin(30°)t + (\frac{1}{2})(-9.8\frac{m}{s^2})t^2$

$0 = -4.9t^2 + 13t + 25$

[Using Quad. Solving Program]

$t = 3.9s$

b. Determine how far out from the base of the cliff the water balloon lands.

X

$v_x = v_0 \cos\theta$

$t = 3.9s$

$x = ?$

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

$x = (26 m/s)(\cos 30°)(3.9s)$

$x = 87.8m$

c. How long after the truck leaves the base of the cliff do you have to wait to release the water balloon to hit the truck?

time For Truck To Get 87.8m Out

$v = 14 m/s$

$x = 87.8m$

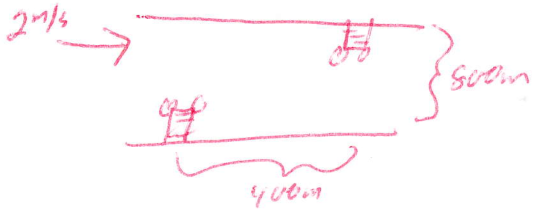
$t = ?$

$t = \frac{x}{v} = \frac{87.8m}{14 m/s} = 6.2s$

Truck Time	6.2s
− Water Balloon Time	3.9s
	2.3s

3) A river is ½ mile (800m) wide and flows at a constant rate of 2m/s (Yes, this is a little "ideal," but would you really want to solve for a "real" situation?) You leave the dock in your canoe, and wish to reach another dock that is 400m downstream in a time of 3 minutes.

a. Determine your speed WRT water CROSSING the river.

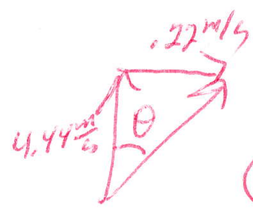


$v = \frac{800m}{180s} = 4.44\frac{m}{s}$

b. Determine your speed WRT land going downstream.

$v = \frac{400m}{180s} = 2.2\, m/s$

c. When leaving the dock, determine the angle needed as measured from a line perpendicular from the river bank.



$\theta = 2.54°$

4) (be careful with this one!!! It's easy, but a little tricky). A river is 1 mile wide, and flows at a constant 2 m/s. You are in a boat that runs at 6 m/s WRT water. You desire to travel upstream for a time of 30 minutes. Assume that you travel close to the edge of the bank, as to not waste time traveling across the water. Another boater approaches you heading downstream at a rate of 12 m/s WRT you. Determine the speed of the water WRT land.

2 m/s

5) Two baseball players are warming up prior to a game. The players are standing about 10 meters apart, and each are throwing the ball so that it leaves their hand at about a 20 degree angle above the horizontal. If they both consistently catch the ball just above their head, determine the speed the ball leaves their hand with each throw,

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

$$\sqrt{\frac{xg}{\sin(2\theta)}} = v_0 = \sqrt{\frac{(10m)(9.8 m/s^2)}{\sin[2(20)]}} = 12.3 m/s$$