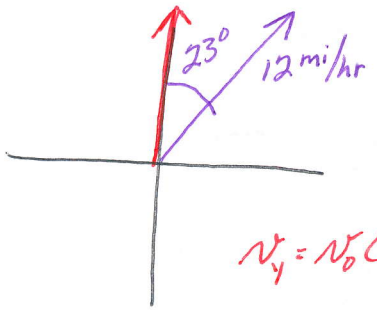
Level I Key Pd 1

VECTORS

AT VECTORS(1 1)

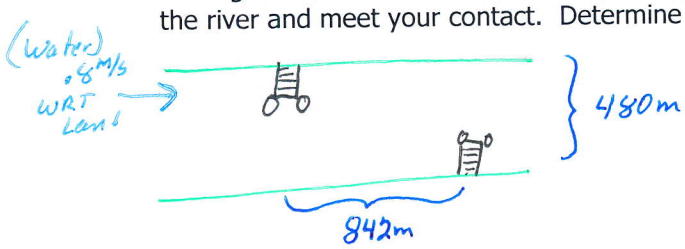
Directions: Solve the following problems. Show all work in a neat orderly fashion so that your response can be "read." Please circle your answer. Each problem is worth 5 points.

1. A 12 mi/hr wind is blowing at 23 degrees east of north. Determine the northern component of the wind.



$v_y = v_0 \cos(23°) = (12\ mi/hr)\cos(23°) = 11\ mi/hr$

2. It's a dark, foggy night with a new moon, and no ambient light from the distant city. As an agent with a top secret organization, you are instructed to silently cross a 480 m wide river in a kayak and land 842m upstream with only a compass and a "water speed" measuring instrument. No radio receivers or transmitting devices may be used (No GPS, cell phone, etc.). The river is flowing at a constant rate of 0.8 m/s WRT land. From the launch, you have 10 minutes to cross the river and meet your contact. Determine your speed and heading for an accurate landing.



time = 10 min = 600s

Crossing WRT Land

$\frac{480m}{600s} = .8\ m/s$ ↑

Crossing WRT Water (Same)

.8 m/s

Upstream WRT Land

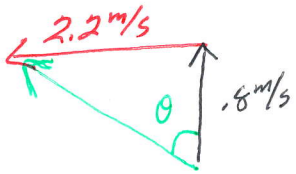
$\frac{842m}{600s} = 1.4\ m/s$ ←

Upstream WRT Water

$\leftarrow 1.4\ m/s + .8\ m/s$ ←

(To Counter Current)

$\leftarrow 2.2\ m/s$



$\tan\theta = \frac{2.2\ m/s}{.8\ m/s}$

$\theta = \tan^{-1}\left[\frac{2.2\ m/s}{.8\ m/s}\right]$

$\theta = 70^{\circ}$ From Straight Across

2.34 m/s

Level I Key Pd 1

3. While watching an RC car buzzing around, you wonder just how fast the car is traveling. There is a ramp that the car has been going over, and you notice the car consistently lands 2.4 m from the end of the ramp. The top of the ramp is 22 cm above the floor, and the ramp has an angle of incline of 28 degrees. How fast is the RC car traveling? Assume the speed of the car is constant.

y

$y = -.22m$

$t = ?$

$a = -9.8 m/s^2$

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

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

$y = v_0(\sin\theta)t + \frac{1}{2} a t^2$

x

$x = 2.4m$

$t = ?$

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

$a = \text{zero}$

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

$x = (\cos\theta)(v_0)t + \text{zero}$

$x = (v_0 \cos\theta)t$

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

$y = v_0 \sin(\theta)\left[\frac{x}{v_0 \cos\theta}\right] + \frac{1}{2} a \left[\frac{x}{v_0 \cos\theta}\right]^2$

$y = \frac{v_0 \sin\theta\, x}{v_0 \cos\theta} + \frac{a x^2}{2 v_0^2 \cos^2\theta}$

$y = x \tan\theta + \frac{a x^2}{2 v_0^2 \cos^2\theta}$

$y - x\tan\theta = \frac{a x^2}{2 v_0^2 \cos^2\theta}$

$(2 v_0^2 \cos^2\theta)(y - x\tan\theta) = a x^2$

$2 v_0^2 \cos^3\theta = \frac{a x^2}{(y - x\tan\theta)}$

$v_0^2 = \frac{a x^2}{2\cos^2\theta(y - x\tan\theta)}$

$v_0 = \sqrt{\frac{(-9.8 m/s^2)(2.4m)^2}{(2)(\cos^2(28°))(-.22m - (2.4m)\tan(28°))}}$

$\tan(28°)$

$v_0 = 4.92 m/s$