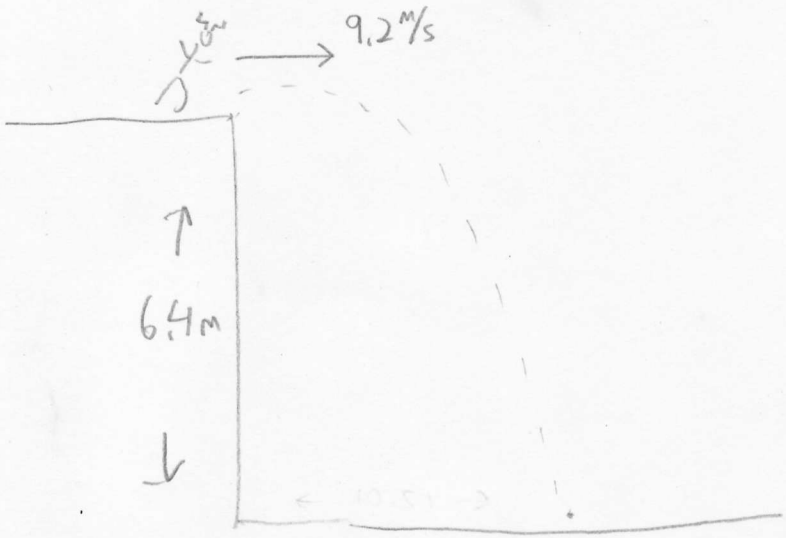
Projectile Motion Quizlette #1 – Simple Cliff Problem

Red Elk runs at a speed of 9.2 m/s horizontally off a cliff that is 6.4 m above the water.

I will carry 2 extra sig figs

A) Set up your horizontal/vertical table, fill it with known quantities, and solve for everything you don't know. (You know horizontally: both velocities and the acceleration, and vertically: the displacement, the initial velocity, and the acceleration)



H	V
$s = 10.51$	$s = -6.4\,m$
$u = 9.2\,m/s$	$u = 0$ (cliff problem)
$v = 9.2\,m/s$	$v = -11.21\,m/s$
$a = 0$	$a = -9.81$
$t = 1.142$ ②	$t = 1.142\,s$ ①

③ $v^2 = u^2 + 2as$

$|v| = \sqrt{0^2 + 2(-9.81)(-6.4)}$

$v = -11.21\,m/s$ (Going down)

④ $s = ut$

$s = (9.2)(1.142)$

$= 10.51\,m$

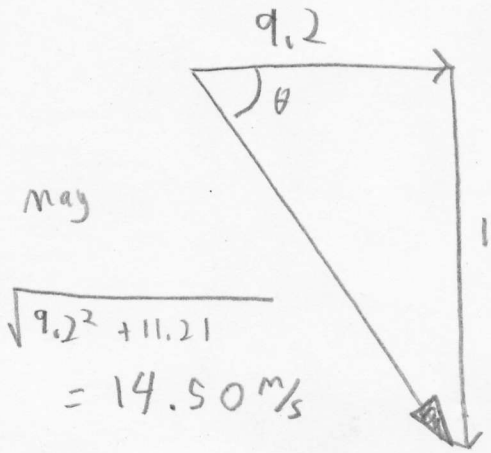
① $s = \frac{1}{2}at^2$

$-6.4 = \frac{1}{2}(-9.81)t^2$

$t = 1.142\,s$

B) What time is he in the air?	C) What is his final vertical speed of impact?	D) How far from the base of the cliff does he hit the water?
Uses vertical stuff: $s = \frac{1}{2}at^2$ $t = 1.142\,s$	$V = -11.21\,m/s$ Velocity $v^2 = u^2 + 2as$ Vertical	$s = ut$

E) Draw a picture of his velocity of impact, and turn it into an angle-magnitude velocity vector. Find the angle with the horizontal, and label both the angle and the magnitude.



$\theta = \tan^{-1}\left(\frac{11.21}{9.2}\right)$

$50.62°$

mag

$\sqrt{9.2^2 + 11.21^2}$

$= 14.50\,m/s$

$14.5\,m/s$ $50.6°$ below Horiz

F) What is his speed of impact with the water?

Speed is hypotenuse

$\sqrt{9.2^2 + 11.21^2}$

$= 14.50\,m/s$

$15\,m/s$ with 1 SF

When Red Elk is 3.1 m above the water, inspiration strikes him. (set up another H|V table and solve)

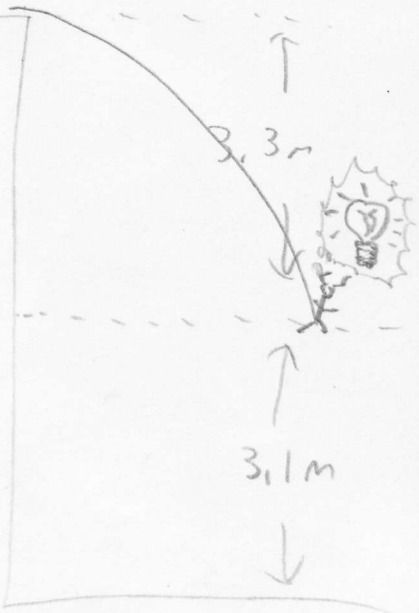
- What is Red Elk's position (relative to the cliff edge) when he is 3.1 m above the water? (how far over, how far down from the edge)
- What is Red Elk's velocity in Vector Components and Angle Magnitude notation when he is 3.1 m above the water?

H	V
$s = 7.546$	$s = -3.3$ $(6.4 - 3.1 = 3.3)$
$u\}$ $v\}$ $= 9.2$	$u = 0$
$a = 0$	$v = -8.046\ m/s$
t .8202	$a = -9.81$
	$t = .8202s$ $s = \frac{1}{2}at^2$
	$-3.3 = \frac{1}{2}(-9.81)t^2$
	$= .8202$
	$v^2 = u^2 + 2as$
	$\lvert v \rvert = \sqrt{2(-9.81)(-3.3)}$
	$v = -8.046\ m/s$ $(- = down)$

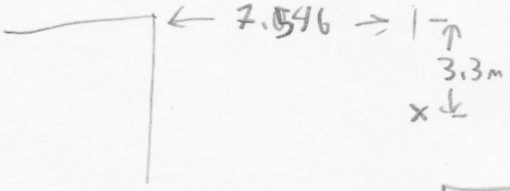
$s = ut$

$= (9.2)(.8202)$

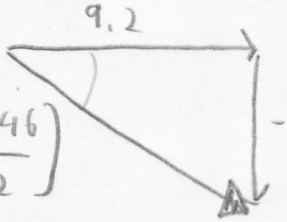
$= 7.546$



So he is 7.546 m over and 3.3 m down



his velocity is $9.2\ m/s\ \hat{x} + -8.046\ m/s\ \hat{y} = V_C$



$\theta = \tan^{-1}\left(\frac{8.046}{9.2}\right)$

$= 41.17°$

$Mag = speed = \sqrt{9.2^2 + 8.046^2}$

$= 12.22\ m/s$