Projectile Motion Quizlette #2 – Arc Problem

Red Elk shoots an air rocket at an angle of 57° above the horizontal at a speed of 25 m/s on a very level field.
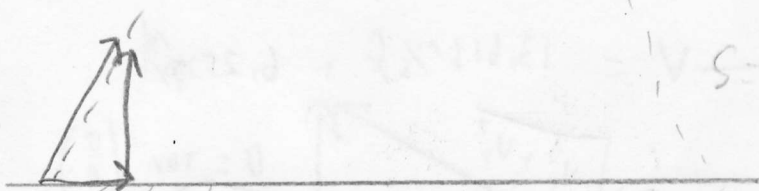
A) Break the velocity vector into components. (These become your initial velocities for x and y) Set up your horizontal/vertical table, fill it with known quantities, and solve for everything you don't know. (You know horizontally: both velocities and the acceleration, and vertically: the displacement, both velocities, and the acceleration)

To ground:

H	V
$S = 58.203$	$S = 0$
$u = 13.616$	$u = 20.967$
$V = 13.616$	$V = -20.967$
$a = 0$	$a = -9.81$
$t = 4.2746$	$t = 4.2746$

$S = ut$
$= (13.616)(4.2746)$
$= 58.203$ t 4.2746

$V = u + at$
$-20.967 = 20.967 + (-9.81)t$
$t = 4.2746$

To the top

H	V
$S = ?$	$S = ?$ (22.4m)
$u = 13.616$	$u = 20.967$
$V = 13.616$	$V = 0$ ("Top")
$a = 0$	$a = -9.81$
t	t

$V^2 = u^2 + 2as$

$S = \dfrac{V^2 - u^2}{2a}$

$25 \cos 57 = 13.616 \,^m/_s \,\hat{x}$

$25 \sin 57 = 20.967 \,^m/_s \,\hat{y}$

@ Highest Point

$V = 13.616 \,\tfrac{m}{s}\,\hat{x} + 0 \,\tfrac{m}{s}\,\hat{y}$

Speed $= 13.616 \,\tfrac{m}{s}$ Yes!

B) What are the initial horizontal and vertical velocity components?	C) What time is the rocket in the air?	D) How far does the rocket go before hitting the ground?
$13.616\tfrac{m}{s}\hat{x} + 20.967\tfrac{m}{s}\hat{y}$ (14 $^m/_s\hat{x}$ + 21 $^m/_s\hat{y}$)	4.2746 s (4.3 s)	58.203 m (58 m)

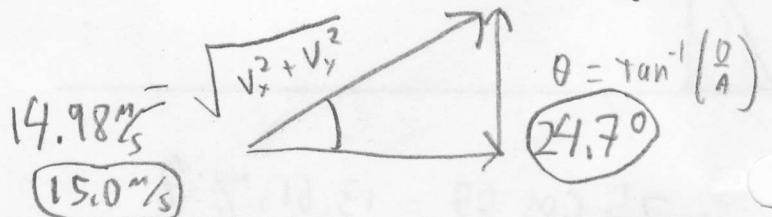| E) What is the greatest height the rocket reaches?	F) What is the speed of the rocket at the highest point?
22.4 m (Set v = 0) Vmm (22 m)	13.616 (14 $^m/_s$)

Varsity Questions:

What is the position (in VC notation, how far over, how far up) and velocity (AM notation) at 1.50 seconds?

@ 1.50 s
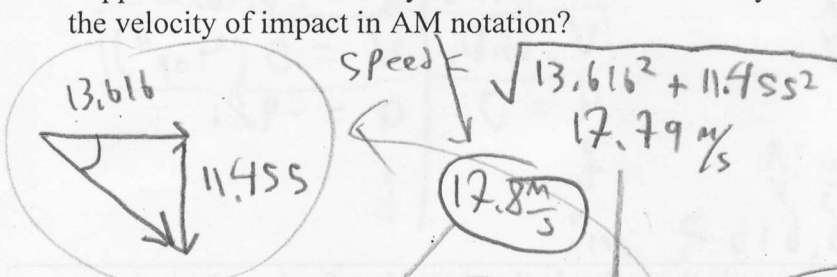
So it is
20.4m over and
20.4m up
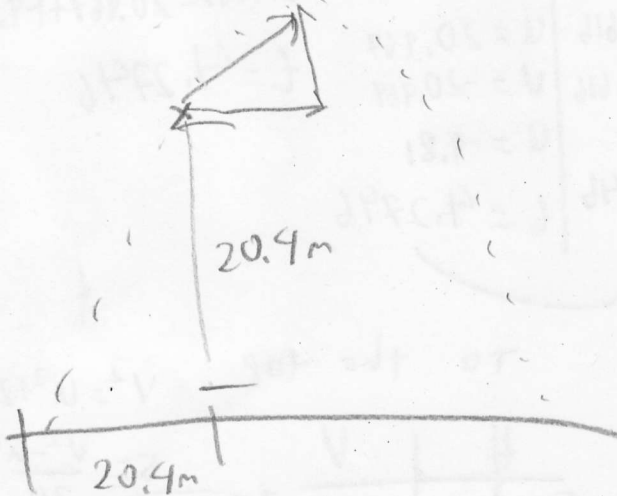
	H	V
	S 20.42	S 20.4m = $ut + \frac{1}{2}at^2$
	u 13.616	u = 20.967
	V 13.616	V = 6.252 = u + at
	a = 0	a = -9.81
	t = 1.50	t = 1.50

20.4m

20.4m

$V = 13.616 \text{ m/s } \hat{x} + 6.252 \frac{m}{s} \hat{y}$

$\sqrt{V_x^2 + V_y^2}$

14.98 m/s

15.0 m/s

$\theta = \tan^{-1}\left(\frac{O}{A}\right)$

24.7°

Suppose the ball hits a very tall wall that is 45 m away. How high up on the wall does it hit, and what is the velocity of impact in AM notation?

13.616

11.455

Speed = $\sqrt{13.616^2 + 11.455^2}$

17.79 m/s

12.8 m/s

15.7 m up the wall

$\theta = \tan^{-1}\left(\frac{11.455}{13.616}\right)$

= 40.07°

40.1°

Below Horiz

	H	V
	S = 45m	S = 15.71 = $ut + \frac{1}{2}at^2$
	U = 13.616	U = 20.967
	V = 13.616	V = ? -11.45 $\hat{}$ u + at
	a = 0	a = -9.81
	t = 3.30s	t 3.30s

use
S = ut
to find
time

45m