Physics 10154 - Exam #1b

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (35 pts) A car starts from rest and accelerates uniformly to a final velocity of 13 m/s in 5.5 seconds, then the driver realizes that the road will abruptly end in a cliff. The driver hits the brakes and decelerates at a rate of -8.5 m/s^2. If the end of the road is 52 meters from the starting point, can the driver stop before the end of the road?

Part 1

$\Delta x = ?$

$v_0 = 0$

$v = 13$

$a = ?$

$t = 5.5$

$\Delta x = \frac{1}{2}(v + v_0)t = 35.75$

Part 1 : 35.75 ← → 16.25m left

← 52 m →

Part 2

$\Delta x = ?$

$v_0 = 13$

$v = 0$

$a = -8.5\ m/s^2$

$t = ?$

Find Δx, compare to 16.25m

$(52 - 35.75 = 16.25)$

$v^2 = v_0^2 + 2a\Delta x$

$0 = 13^2 + 2(-8.5)\Delta x$

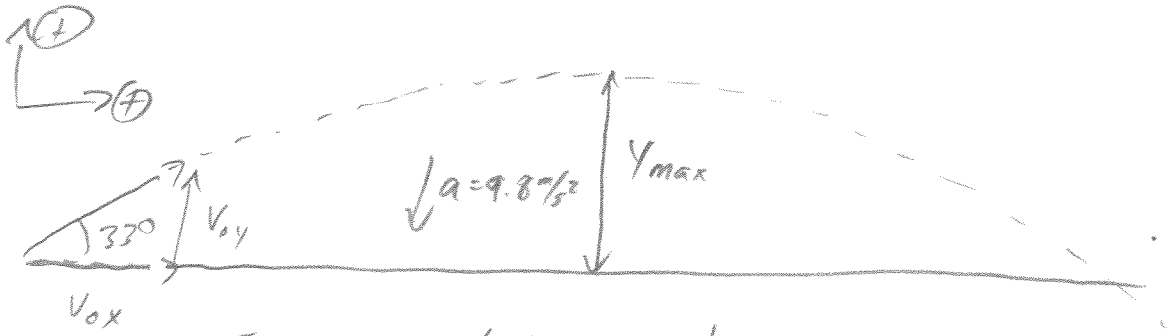
$\Delta x = \frac{-13^2}{2(-8.5)} = 9.94\ m$

Yes, stops in time (6.31 m to spare)

2. (30 pts) A ball is kicked from ground level and leaves the ground in a direction 33° above the horizontal. The ball reaches its maximum height in 2.4 seconds.

a) What is the initial speed of the ball upon leaving the ground?

b) What is the magnitude and direction of the ball's velocity when the ball is at its maximum height?



From ground to max. height:

x	y
$\Delta x = ?$	$\Delta y = ?$
$V_{ox} = V_0 \cos 33°$	$V_{oy} = V_0 \sin 33°$
$V_x = V_0 \cos 33°$	$V_y = 0$
$a_x = 0$	$a_y = -9.8\ m/s^2$
$t = 2.4$	$t = 2.4\ s$

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a) $V_y = V_{oy} + a_y t$

$0 = V_{oy} + (-9.8)(2.4)$

$V_{oy} = 23.52$

$23.52 = V_0 \sin 33°$

So $V_0 = \frac{23.52}{\sin 33°} = 43.2\ m/s$

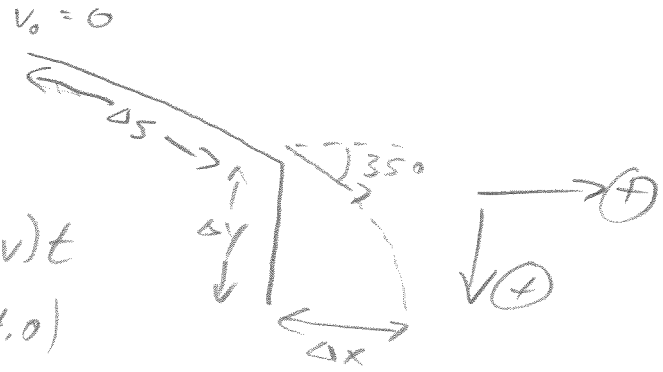
$V_0 = 43\ m/s$

b) $V_x = V_0 \cos 33° = 36.2\ m/s$

$V_y = 0$

$V = 36\ m/s,\ +x\ dir$

3. (35 pts) A puck starts from rest and slides down a 2.1-meter ramp at an angle 35° below the horizontal in 4.0 seconds. Upon leaving the ramp, the puck is in the air for 1.5 seconds before hitting the ground. What is the magnitude and direction of the puck's velocity the instant before it hits the ground?



Part 1

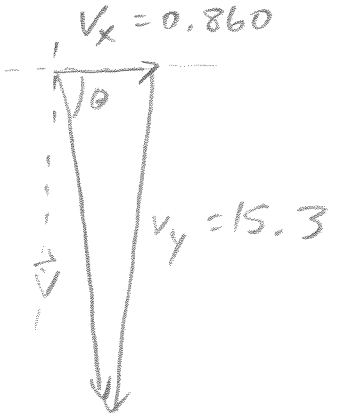
$\Delta s = 2.1\ m$
$v_0 = 0$
$v = ?$
$a = ?$
$t = 4.0\ s$

$\Delta s = \frac{1}{2}(v_0 + v)t$
$2.1 = \frac{1}{2}(v)(4.0)$
$v = 1.05\ s$

Part 2 (free fall)

x	y
$\Delta x =$	$\Delta y = ?$
$v_{0x} = 1.05\cos 35° = 0.860$	$v_{0y} = 1.05\sin 35° = 0.602$
$v_x = 0.860$	$v_y = ?$
$a_x = 0$	$a_y = 9.8$
$t = 1.5\ s$	$t = 1.5\ s$

$v_y = v_{0y} + a_y t = 0.602 + (9.8)(1.5) = 15.3\ m/s$



$v = \sqrt{v_x^2 + v_y^2} = \boxed{15\ m/s}$

$\theta = \tan^{-1}\left(\frac{15.3}{.860}\right) = \boxed{87° \text{ below } +x}$