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. (30 pts) A driver makes a trip, driving with a constant speed of 67 miles/hour the whole time except for a 12 minute rest stop. The overall average speed for the trip works out to 57 miles/hour. How far does the driver travel during the entire trip?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_T = ?$
$\bar{v}_1 = 67$ mi/hr	$\bar{v}_2 = 0$	$\bar{v}_T = 57$ mi/hr
$t_1 = ?$	$t_2 = 0.20$ hr	$t_T = ?$

$\Delta x_1 = 67 t_1 \qquad \Delta x_2 = 0 \qquad \Delta x_T = \bar{v}_T t_T$

$$\bar{v}_T = \frac{\Delta x_1 + \Delta x_2}{t_1 + t_2} = \frac{67 t_1 + 0}{t_1 + 0.20}$$

$$57(t_1 + 0.20) = 67 t_1$$

$$57 t_1 + 11.4 = 67 t_1$$

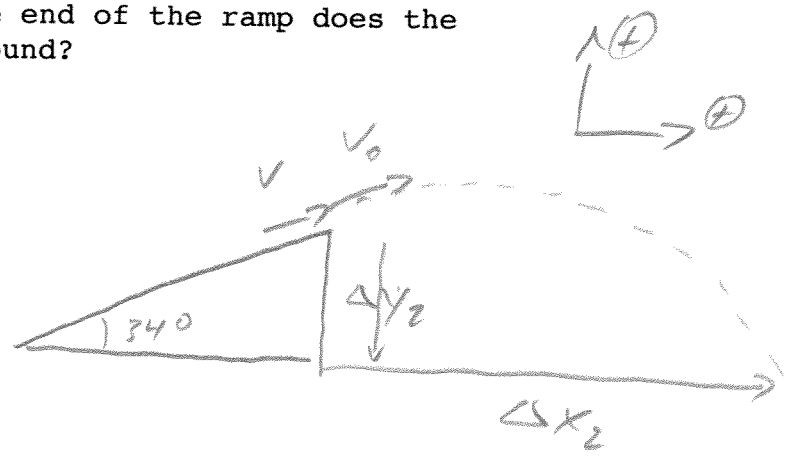
$$11.4 = 10 t_1$$

$$t_1 = 1.14 \text{ hrs}$$

$\Delta x_1 = 67(1.14) =$ 76 miles $= \Delta x_{TOT}$

2. (40 pts) A motorcycle is at ground level at the bottom of a 25-meter long ramp, angled 34° above the horizontal. The initial speed of the motorcycle is 27 meters/sec, and it accelerates along the ramp at a rate of 21 meters/sec2. When the motorcycle leaves the ramp, it enters free-fall (ballistic) motion.

How far, horizontally, from the end of the ramp does the motorcycle land back on the ground?



Part 1 (ramp)

$\Delta s = 25$

$V_0 = 27\ m/s$

$V = ?$

$a = 21\ m/s^2$

$t = ?$

$V^2 = V_0^2 + 2a\Delta s$

$= 27^2 + 2(21)(25)$

$V = 42.18\ m/s$

$\Delta y_1 = 25 \sin 34° = 13.98\ m$

$V_{1,x} = V \cos 34° = 34.97\ m/s$

$V_{1,y} = V \sin 34° = 23.59\ m/s$

Part 2 (free fall)

note signs!

$\Delta x = ?$

$V_{0x} = 34.97$

$V_x = 34.97$

$a_x = 0$

$t = ?$

$\Delta y = -13.98$

$V_{0y} = 23.59$

$V_y = ?$

$a_y = -9.8$

$t = ?$

$V_y^2 = V_{oy}^2 + 2a_y\Delta y$

$= (23.59)^2 + 2(-9.8)(-13.98)$

$V_y = \pm 28.82$

$= -28.82$

$V_y = V_{oy} + a_y t$

$-28.82 = 23.59 + (-9.8)t$

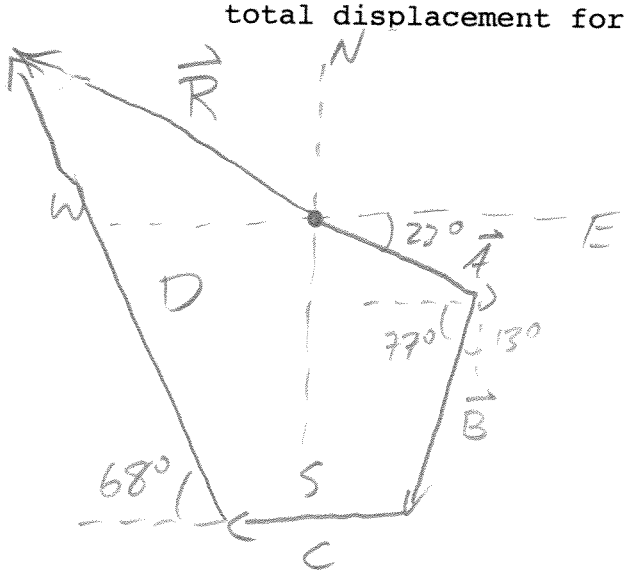
$t = 5.35\ s$

$\Delta x = V_{ox}t + \frac{1}{2}a_x t^2$

$= (34.97)(5.35)$

$= \boxed{190\ m}$

3. (30 pts) A hiker walks 1.75 miles in a direction 23° South of East, then 2.43 miles in a direction 13° West of South, then 1.44 miles due West, then 5.22 miles in a direction 68° North of West. What is the magnitude and direction of the total displacement for this hike?



$A_x = 1.75 \cos 23° = 1.611$

$A_y = -1.75 \sin 23° = -0.684$

$B_x = -2.43 \cos 77° = -0.547$

$B_y = -2.43 \sin 77° = -2.368$

$C_x = -1.44$

$C_y = 0$

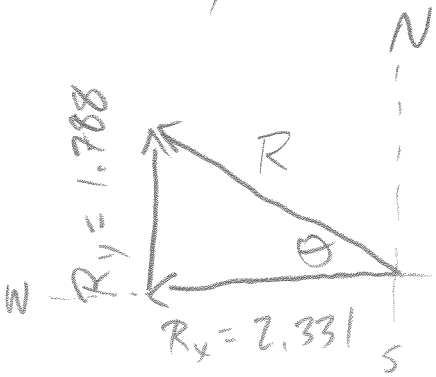
$D_x = -5.22 \cos 68° = -1.955$

$D_y = 5.22 \sin 68° = 4.840$

$R_x = A_x + B_x + C_x + D_x$

$= 1.611 - 0.547 - 1.44 - 1.955 = -2.331$

$R_y = -0.684 - 2.368 + 0 + 4.840 = 1.788$



$|\vec{R}| = \sqrt{R_x^2 + R_y^2} =$ **2.9 miles**

$\theta = \tan^{-1}\left(\frac{1.788}{2.331}\right) =$ **37° N of W**