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 car drives at a constant speed of 77 miles/hour for some time. During the trip, the driver takes a 12 minute rest break, during which time the car is stopped. When the trip is over, the driver calculates his average speed for the entire trip and gets 68 miles/hour. How much distance did the driver cover on the trip?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_{TOT} = ?$
$\bar{v}_1 = 77$ mi/hr	$\bar{v}_2 = 0$	$\bar{v}_{TOT} = 68$ mi/hr
$t_1 = ?$	$t_2 = 0.20$ hr	$t_{TOT} = ?$

$$\bar{v}_{TOT} = \frac{\Delta x_1 + \Delta x_2}{t_1 + t_2}$$

$$68 = \frac{\bar{v}_1 t_1 + \bar{v}_2 t_2}{t_1 + t_2}$$

$$68 = \frac{77 t_1 + 0}{t_1 + 0.20}$$

$$68(t_1 + 0.20) = 77 t_1$$

$$13.6 = 9 t_1$$

$$t_1 = 1.51 \text{ hrs}$$

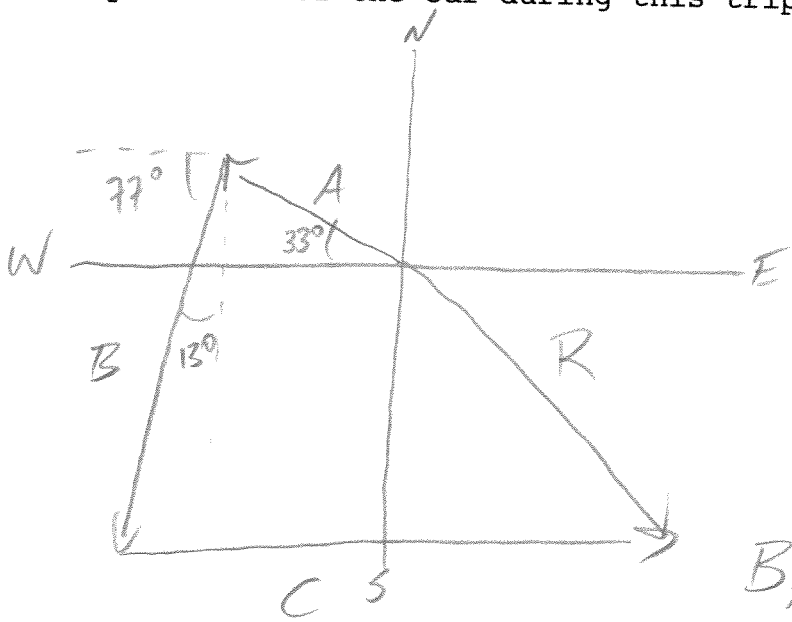
$$\Delta x_1 = \bar{v}_1 t_1 = (77)(1.51) = 116.4 \text{ mi}$$

$$\Delta x_{TOT} = \Delta x_1 + \Delta x_2$$

$$= 116.4 + 0$$

$$= \boxed{120 \text{ miles}}$$

2. (30 pts) A car drives 23 miles in a direction 33° North of West, then 41 miles in a direction 13° West of South, then 77 miles due East. What is the magnitude and direction of the total displacement of the car during this trip?



$A_x = -23 \cos 33°$

$= -19.29$

$A_y = 23 \sin 33°$

$= 12.53$

$B_x = -41 \cos 77°$

or $-41 \sin 13°$

$= -9.22$

$B_y = -41 \sin 77°$

or $-41 \cos 13°$

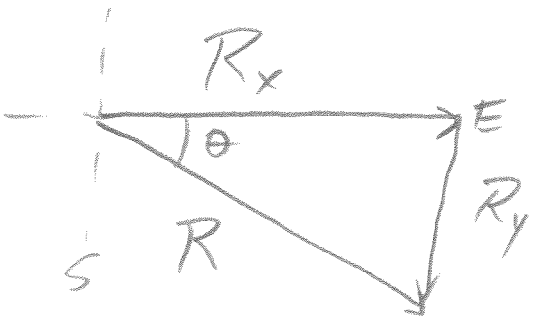
$= -39.95$

$C_x = 77$

$C_y = 0$

$R_x = -19.29 - 9.22 + 77 = 48.49$

$R_y = 12.53 - 39.95 + 0 = -27.42$



$|\vec{R}| = \sqrt{R_x^2 + R_y^2} = 56$ mi

$\theta = \tan^{-1}\left(\frac{27.42}{48.49}\right) = 29°$ S of E

3. (40 pts) Starting from rest, a ball rolls down a ramp inclined 22° below the horizontal for 3.0 seconds with a constant acceleration of 2.2 m/s^2. At the end of the ramp, it goes into free fall, and from that point until it hits the ground, 1.7 seconds elapses.

a) How high above ground level is the ~~end~~ top of the ramp?

b) What is the magnitude and direction of the ball's final velocity just before it hits the ground?

Part 1

$\Delta s = ?$

$v_0 = 0$

$v = ?$

$a = 2.2\ m/s^2$

$t = 3.0\ s$

$v = v_0 + at$

$= 0 + (2.2)(3.0)$

$= 6.6\ m/s$

$\Delta s = v_0 t + \frac{1}{2} a t^2$

$= 9.9\ m$

Part 2

$\Delta x = ?$

$v_{0x} = 6.6 \cos 22°$

$v_x = 6.6 \cos 22°$

$a_x = 0$

$t = 1.7\ s$

$\Delta y = ?$

$v_{0y} = -6.6 \sin 22°$

$v_y = ?$

$a_y = -9.8\ m/s^2$

$t = 1.7\ s$

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

$= -4.20 - 14.16 = -18.36\ m$

From part 1, $\Delta y = -\Delta s \sin 22° = -3.71\ m$

$\Delta y_{TOT} = -18.36 - 3.71 = -22\ m$

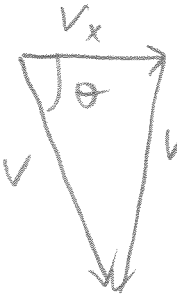
top of ramp is 22m high

$v_y = v_{0y} + at$

$= -2.47 - 16.66$

$= -19.13$

$v_x = 6.12$



$|\vec{v}| = \sqrt{v_x^2 + v_y^2} = 20\ m/s$

$\theta = \tan^{-1}\left(\frac{19.13}{6.12}\right) = 72°$ below $+x$