Physics 10154 - Exam #1d

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) Adam starts a straight-line race and drives with a constant speed of 85 miles/hour, but then he has a mechanical breakdown and has to stop for 12 minutes to fix it. Adam resumes driving with the same 85 mi/hr speed and finishes the race with an average speed of 77 mi/hr.

What is the total time and total distance covered for the race?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_{TOT} = ?$
$\bar{v}_1 = 85\ mi/hr$	$\bar{v}_2 = 0$	$\bar{v}_{TOT} = 77\ mi/hr$
$t_1 = ?$	$t_2 = .20\ hr$	$t_{TOT} = ?$

$$\bar{v}_{TOT} = \frac{\Delta x_1 + \Delta x_2}{t_1 + t_2} = \frac{\bar{v}_1 t_1 + \bar{v}_2 t_2}{t_1 + t_2}$$

$$77 = \frac{85 t_1 + 0}{t_1 + .20}$$

$$77(t_1 + .20) = 85 t_1$$

$$15.4 = 8 t_1 \qquad (t_2)$$

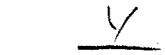
$$t_1 = 1.925\ hr + .2 = \boxed{2.1\ hr}$$

$$\Delta x_1 = (85)(1.925) = \boxed{160\ mi}$$

2. (30 pts) A projectile is launched at an angle of 63° above the horizontal and reaches a maximum height of 220 meters above the ground.

a) What is the initial speed of the ball?

b) What is the speed of the ball when it reaches maximum height?



$\Delta y = 220$

$v_{oy} = v_0 \sin 63^\circ$

$v_y = 0$

$a_y = -9.8$

$t = ?$

$v_y^2 = v_{oy}^2 + 2a_y \Delta y$

$0 = v_{oy}^2 + 2(-9.8)(220)$

$v_{oy} = \pm 65.67 \text{ m/s}$

$65.67 = v_0 \sin 63$

$\boxed{v_0 = 74 \text{ m/s}}$

At max ht, $v_y = 0$

$v_x = v_{ox} = v_0 \cos 63$

$= \boxed{33 \text{ m/s}}$

3. (40 pts) Starting from rest, a ball rolls down a 32 meter long ramp inclined at 15° below the horizontal. While on the ramp, the ball has a constant acceleration of 1.8 m/s^2. After leaving the ramp, the ball is in free fall for 3.4 seconds before hitting the ground.

a) How far above ground level is the end of the ramp?

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

On ramp

$\Delta s = 32$

$v_0 = 0$

$v = ?$

$a = 1.8\ m/s^2$

$t = ?$

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

$= 0^2 + 2(1.8)(32)$

$v = 10.73\ m/s$

$v_x = 10.73 \cos 15° = 10.37\ m/s$

$v_y = -10.73 \sin 15° = -2.78\ m/s$

Free fall $v_x = v_{ox} = 10.37\ m/s$

y

$\Delta y = ?$

$v_{oy} = -2.78\ m/s$

$v_y = ?$

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

$t = 3.4\ s$

$v_y = v_{oy} + a_y t$

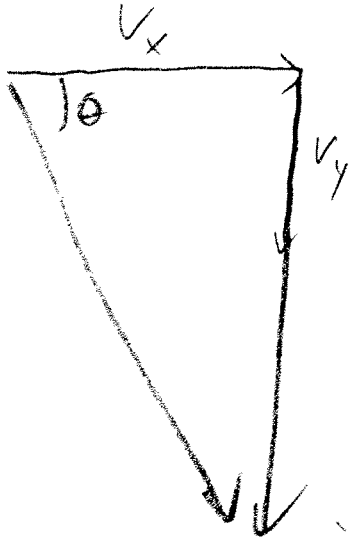
$= -2.78 + (-9.8)(3.4)$

$v_y = -36.1$

$\Delta y = v_{oy} t + \frac{1}{2} a_y t^2$

$= (-2.78)(3.4) - 4.9(3.4)^2$

$= -66.1\ m$ = 66 m high



$|v| = \sqrt{10.37^2 + 36.1^2}$ = 38 m/s

$\theta = \tan^{-1}\left(\frac{36.1}{10.37}\right)$ = 74° below +x