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. (20 pts) A rocket is thrown directly downward with a speed of 5.5 m/s, and it hits the ground after 2.1 seconds has elapsed.

a) From what height above ground was the rock thrown?
b) What is the magnitude and direction of the average velocity of the rock during the 2.1 second interval while it is in the air?

$\Delta y = ?$
$V_{oy} = 5.5$
$v_y = ?$
$a_y = 9.8$
$t = 2.1$

$\Delta y = (5.5)(2.1) + \frac{1}{2}(9.8)(2.1)^2$
$= 11.55 + 21.61$
$= \boxed{33\ m}$

$\bar{V} = \frac{\Delta y}{t} = \frac{33}{2.1} = \boxed{16\ m/s,\ down}$

2. (30 pts) A car travels at a speed of 47 mi/hr during a trip except for a 17 minute rest stop somewhere along the way. At the end of the trip, the average velocity for the trip is calculated to be 38 mi/hr.

What is the total distance covered on the trip?

$\Delta x_1 = ?$ $\quad \Delta x_2 = 0$ $\quad \Delta x_{TOT} = ?$

$t_1 = ?$ $\quad t_2 = .283\,hr$ $\quad t_{TOT} = ?$

$V_1 = 47\ mi/hr$ $\quad V_2 = 0$ $\quad \bar{V}_{TOT} = 38\ mi/hr$

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

$$38 = \frac{V_1 t_1 + 0}{t_1 + t_2} = \frac{47 t_1}{t_1 + .283}$$

$$38(t_1 + .283) = 47 t_1$$

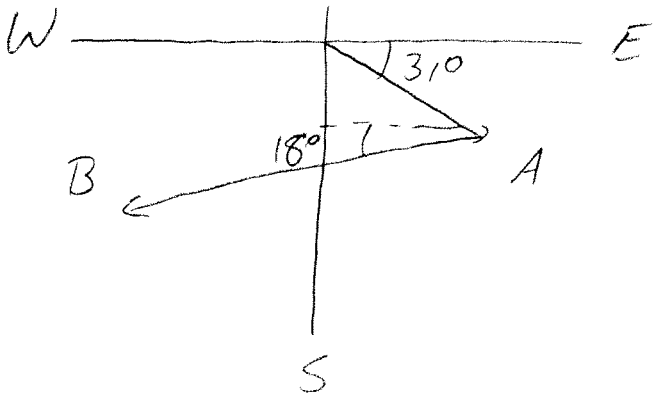
$$38(.283) = 9 t_1$$

$$t_1 = 1.19\ hr$$

$$\Delta x_{TOT} = \Delta x_1 = (47)(1.19)$$

$$= \boxed{56\ mi}$$

3. (20 pts) A person walks 240 meters in a direction 31° South of East, then 510 meters in a direction 18° South of West. What is the magnitude and direction of the person's total displacement?



$A_x = 240 \cos 31° = 205.7$

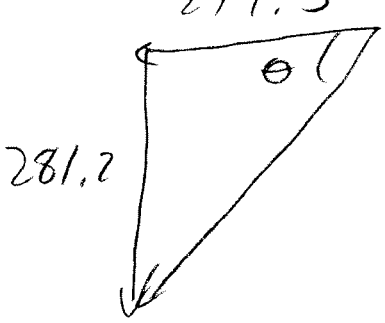
$A_y = -240 \sin 31° = -123.6$

$B_x = -510 \cos 18 = -485$

$B_y = -510 \sin 18 = -157.6$

$R_x = 205.7 - 485.0 = -279.3$

$R_y = -123.6 - 157.6 = -281.2$



$R = \sqrt{279.3^2 + 281.2^2}$

$= \boxed{400 \text{ m}}$

$\theta = \tan^{-1}\left(\frac{281.2}{279.3}\right) = \boxed{45° \text{ S of W}}$

4. (30 pts) A book slides from rest down an 11° slope of a tilted table for 1.2 meters. While on the table, the book has an acceleration parallel to the table's surface of 1.4 m/s^2. The table edge is 1.5 meters above the ground. Once the book leaves the table, it is in free fall.

What is the horizontal distance from the table of the book when it first makes contact with the ground?

Part 1

$\Delta s = 1.2$ m

$V_0 = 0$

$V = ?$

$a = 1.4$ m/s^2

$t = ?$

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

$= 0 + 2(1.4)(1.2)$

$V = 1.83$ m/s

Free Fall

$\Delta x = ?$ $\quad \Delta y = +1.5$

$V_{ox} = 1.83\cos 11 = 1.80$ $\quad V_{oy} = +1.83\sin 11 = +.35$

$V_x = 1.80$ $\quad V_y = ?$

$a_x = 0$ $\quad a_y = +9.8$ m/s^2

$t = ?$ $\quad t = ?$

Find t: $1.5 = .35t + 4.9t^2$

$4.9t^2 + .35t - 1.5 = 0$

$t = \dfrac{-.35 \pm \sqrt{.35^2 - 4(4.9)(-1.5)}}{9.8}$ Use + soln

$= -.0357 + .5544 = .519$ s

$\Delta x = V_{ox} t = (1.80)(.519) =$ **0.93 m**