Physics 10154 - Exam #1c

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 stone is thrown directly upwards from ground level and reaches its maximum height above the ground in 2.2 seconds.

a) What is the initial speed of the stone?

b) What is the average velocity of the stone during the 2.2 second interval between launch and maximum height?

c) What is the average velocity of the stone during the 4.4 second interval between launch and return to ground level?

a) $\Delta y =$ $\quad v_y = v_{oy} + a_y t$

$v_{oy} =$

$v_y = 0 \quad 0 = v_o + (-9.8)(2.2)$

$a = -9.8\ m/s^2$ $\quad \boxed{v_o = 22\ m/s}$

$t = 2.2\ s$

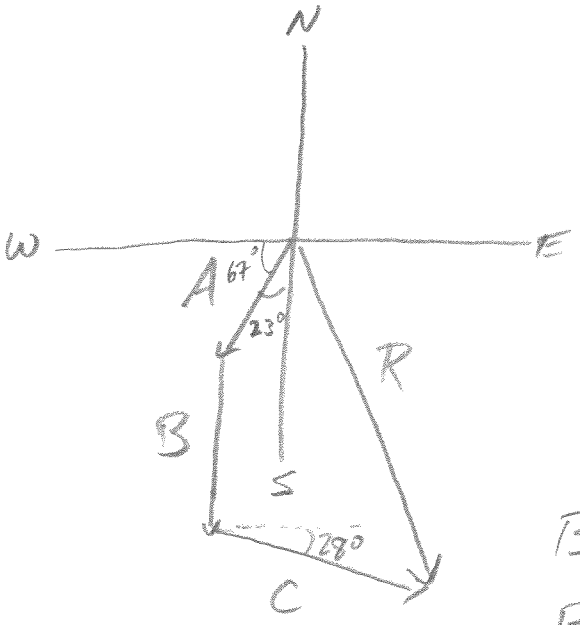
b) Since a = constant $\bar{v} = \frac{1}{2}(v + v_o) = \boxed{11\ m/s}$

or $\Delta y = v_y t - \frac{1}{2} a t^2 = 23.72\ m \quad \bar{v} = \frac{\Delta y}{t} = 11\ m/s$

c) Since $\Delta y = 0$

$$\boxed{\bar{v} = \frac{\Delta y}{t} = 0}$$

2. (30 pts) A hiker walks 2.2 miles in a direction 23° West of South, then 3.2 miles South, then 3.8 miles in a direction 28° South of East. What is the magnitude and direction of the total displacement for this hike?



$A_x = -2.2 \cos 67°$

or $-2.2 \sin 23° = -0.860$

$A_y = -2.2 \sin 67°$

or $-2.2 \cos 23° = -2.025$

$B_x = 0$

$B_y = -3.2$

$C_x = 3.8 \cos 28° = 3.355$

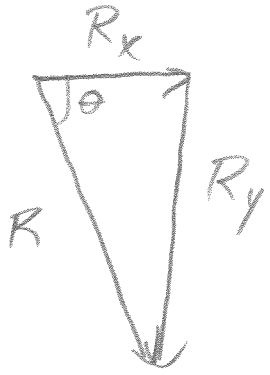
$C_y = -3.8 \sin 28° = -1.784$

$R_x = A_x + B_x + C_x = -0.860 + 0 + 3.355$

$= 2.495$

$R_y = A_y + B_y + C_y = -2.025 - 3.2 - 1.784$

$= -7.009$



$|\vec{R}| = \sqrt{R_x^2 + R_y^2} = \boxed{7.4 \text{ miles}}$

$\theta = \tan^{-1}\left(\frac{7.009}{2.495}\right) = \boxed{70° \text{ S of E}}$

3. (40 pts) A stunt driver starts from rest at ground level. He accelerates a car up a 25 meter long ramp inclined 18° above the horizontal. Upon reaching the end of the ramp, the car follows a ballistic (free fall) trajectory until its hits the ground. The total time of flight from the end of the ramp until hitting the ground is 2.3 seconds.

a) What is the magnitude and direction of the car's velocity the instant after it leaves the ramp?

b) What was the car's acceleration along the ramp?

Ramp:

$\Delta s = 25$

$v_0 = 0$

$v = ?$

$a = ?$

$t = ?$

$\Delta y = 25 \sin 18° = 7.725$

Free fall:

$\Delta y = -7.725$

$v_{oy} = ?$

$v_y = ?$

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

$t = 2.3\ s$

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

$-7.725 = 2.3 v_{oy} - 4.9(2.3)^2$

$18.20 = 2.3 v_{oy}$

$v_{oy} = 7.9\ m/s$

a) $v_{oy} = v_0 \sin 18°$ $\quad v_0 = \frac{7.9}{\sin 18°} = 25.6\ m/s$

$\boxed{\vec{v_0} = 26\ m/s,\ 18° \text{ above } +x}$ $= \vec{v}$ for part 1

b) On ramp, $v^2 = v_0^2 + 2a\Delta s$

$(25.6)^2 = 0 + 2a(25)$ $\quad \boxed{a = 13\ m/s^2}$