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) In a 400-meter long race, Swimmer A has a 0.650 second lead over swimmer B after swimming at a constant speed of 3.80 meters/sec for the first 300 meters. What must be swimmer B's average velocity from this moment on if swimmer B is to catch up to the leader by the end of the race? Answer with 3 SF.

1st part A has covered $\Delta x_A = 300\,m$

lead is $(3.80)(.650) = 2.47\,m$

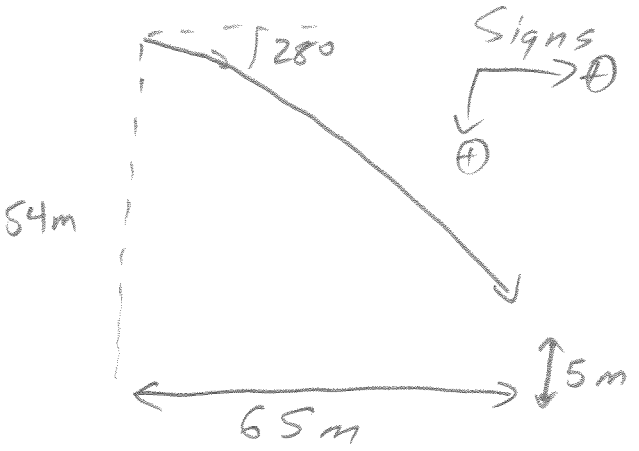
time remaining is $t_2 = \frac{\Delta x_2}{v_2} = \frac{100\,m}{3.80\,m/s} = 26.316\,s$

so B has to cover $\Delta x = 102.47\,m$

in time $t = 26.316\,s$

$$\vec{v}_{B,Avg} = \frac{\Delta x}{t} = \frac{102.47}{26.316} = \boxed{3.89\ m/s}$$

2. (35 pts) A rock is thrown from the top of a 54 meter building with an initial speed of 35 m/s directed 28° below the horizontal. There is a wall 65 meters from the base of the building, and the wall is 5.0 meters high. Does the rock hit the wall, pass over the wall or fall short of the wall? Justify your answer mathematically.



For $\Delta x = 65m$, find Δy & compare it to wall height 5.0m.

x	y
$\Delta x = 65$	$\Delta y = ?$
$v_{ox} = 35\cos 28°$	$v_{oy} = 35\sin 28°$
$v_x = 35\cos 28°$	$v_y = ?$
$a_x = 0$	$a_y = 9.8$
$t = ?$	$t = ?$

↖ down is (+) ↙

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

$65 = (35\cos 28°)\, t$

$t = 2.10\,s$

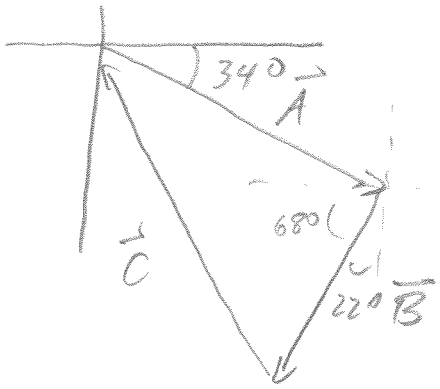
$\Delta y = v_{oy} t + \frac{1}{2} a_y t^2$

$= (35\sin 28°)(2.10) + \frac{1}{2}(9.8)(2.10)^2$

$= 56.1m$

So rock will hit ground at $\Delta y = 54m$ before reaching wall

3. (35 pts) A hiker walks from a trailhead 750 meters in a direction 34° South of East, then 420 meters in a direction 22° West of South to reach a historical marker. From the marker, what is the magnitude and direction of the displacement necessary to return to the trailhead?



$\vec{A} + \vec{B} + \vec{C} = 0$

Find resultant $\vec{R} = \vec{A} + \vec{B}$

$\vec{C}$ has same magnitude as $\vec{R}$ but in opposite direction

$A_x = 750 \cos 34° = 621.78$

$A_y = -750 \sin 34° = -419.39$

$B_x = -420 \cos 68° = -157.33$
or $\sin 22°$

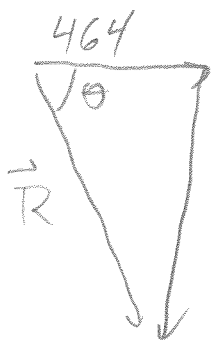
$B_y = -420 \sin 68° = -389.42$
or $\cos 22°$

$R_x = A_x + B_x = 464.45$

$R_y = A_y + B_y = -808.81$

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

$= 930\ m$



$\theta = \tan^{-1}\left(\frac{808.81}{464.45}\right)$

$= 60.1°$ S of E

same magnitude

opposite direction

$\vec{C} = 930\ m$
$60.°$ N of W