Physics 10154 - Exam #1a

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 jogger runs at a constant speed of 3.20 m/s during a race except for a 2.50 minute rest stop. If the jogger's average speed for the entire duration of the trip is 2.94 m/s, how long is the race, in km?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_{TOT} = ?$
$\bar{v}_1 = 3.20\ m/s$	$\bar{v}_2 = 0$	$\bar{v}_{TOT,AVG} = 2.94\ m/s$
$t_1 = ?$	$t_2 = 150\ s$	$t_{TOT} = ?$

$$\Delta x_1 = \bar{v}_1 t_1 = 3.20 t_1$$

$$\Delta x_2 = 0$$

$$\bar{v}_{TOT,Avg} = \frac{\Delta x_1 + \Delta x_2}{t_1 + t_2} = \frac{3.20 t_1 + 0}{t_1 + 150}$$

$$2.94 = \frac{3.20 t_1}{t_1 + 150}$$

$$2.94 t_1 + 441 = 3.20 t_1$$

$$441 = 0.26 t_1$$

$$t_1 = 1696$$

$$\Delta x_1 = 3.20 t_1$$

$$= 5428\ m$$

$$\Delta x_2 = 0$$

$$\Delta x_{TOT} = 5.4\ km$$

2. (35 pts) A diver falls from rest from a diving board that is 17 meters above the surface of a pool. Once the diver hits the water, the diver decelerates at a rate of 15 m/s^2. Will the diver stop before reaching the bottom of the pool, 9.7 meters below the surface? Justify your answer.

Part 1 (free fall)

Signs ↓ = (+)

$\Delta y = 17$

$v_{0y} = 0$

$v_y = ?$

$a_y = 9.8\ m/s^2$

$t = ?$

$v_y^2 = v_{0y}^2 + 2a_y \Delta y$

$v_y^2 = 0^2 + 2(9.8)(17)$

$v_y = \pm 18.25$

use $v_y = +18.25$ as v_0 for part 2

Part 2 (water)

$\Delta y = ?$ ← Find Δy, compare to 9.7m

$v_0 = 18.25$

$v = 0$

$a = -15\ m/s^2$ ← a points up

$t = ?$

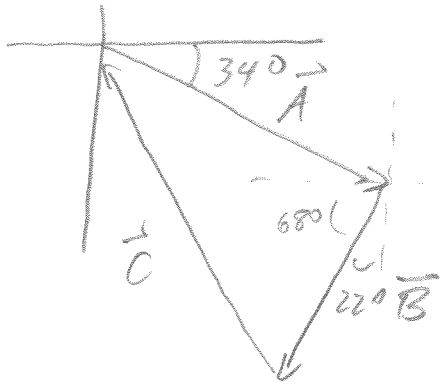
$v^2 = v_0^2 + 2a\Delta y$

$0^2 = (18.25)^2 + 2(-15)\Delta y$

$\Delta y = 11.1\ m > 9.7\ m$,

so diver does not stop in time

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

$\vec{A}_x = 750 \cos 34° = 621.78$

$\vec{A}_y = -750 \sin 34° = -419.39$

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

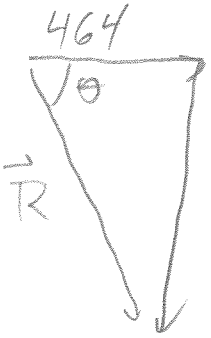
$B_y = -420 \sin 68° = -389.42$
or $\cos 22°$

$R_x = A_x + B_x = 464.45$

$R_y = A_y + B_y = -808.81$

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

$= 930\ m$



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

$= 60.1°$ S of E

same magnitude

opposite direction

$\vec{C} = 930\ m$
$60.1°$ N of W