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) A car drives at a constant speed of 72 miles/hour for some time. During the trip, the driver takes a 15 minute rest break, during which time the car is stopped. When the trip is over, the driver calculates his average speed for the entire trip and gets 66 miles/hour. How much distance did the driver cover on the trip?

Part 1	Part 2	Total
$\Delta x_1 = ?$	$\Delta x_2 = 0$	$\Delta x_{TOT} = ?$
$\bar{v}_1 = 72$ mi/hr	$\bar{v}_2 = 0$	$\bar{v}_{TOT} = 66$ mi/hr
$t_1 = ?$	$t_2 = 0.25$ hr	$t_{TOT} = ?$

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

$$66 = \frac{(72)t_1 + 0}{t_1 + .25}$$

$$66(t_1 + .25) = 72t_1$$

$$16.5 = 6t_1 \qquad t_1 = 2.75 \text{ hr}$$

$$\Delta x_{TOT} = \Delta x_1 = \bar{v}_1 t_1 = 198 \text{ mi}$$

$$= \boxed{200 \text{ miles}}$$

2. (30 pts) A ball is kicked from one edge of a deep ditch toward the other side. The initial speed is 8.5 m/s at an angle 23° above the horizontal. The two edges of the ditch are at equal vertical positions and 6.0 meters apart horizontally. Does the ball make it to the other side or does it fall short and hit the wall of the ditch? Support your answer mathematically.

$\Delta x = ?$ $\qquad$ $\Delta y = 0$

$v_{0x} = 8.5 \cos 23°$ $\qquad$ $v_{0y} = 8.5 \sin 23°$

$v_x = 8.5 \cos 23°$ $\qquad$ $v_y = ?$

$a_x = 0$ $\qquad$ $a_y = -9.8\ m/s^2$

$t = ?$ $\qquad$ $t = ?$

Find t using y information:

$$\Delta y = v_{0y} t + \tfrac{1}{2} a_y t^2$$

$$0 = 3.32t - 4.9t^2$$

$$0 = t(3.32 - 4.9t) \quad t = 0 \text{ or } \underline{0.678\ s}$$

$$\Delta x = v_{0x} t + \tfrac{1}{2} a_x t^2$$

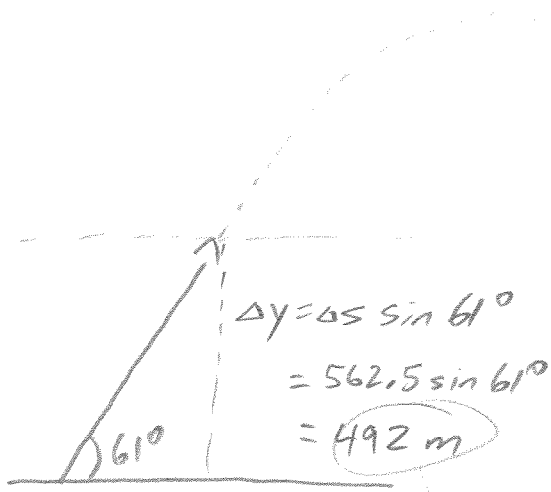
$$= (7.82)(0.678) = 5.3\ m < 6.0\ m$$

so falls short

3. (40 pts) A rocket is launched from rest at an angle of 61° above the horizontal. The rocket moves in a straight line along its initial launch direction with an acceleration of 45 m/s^2 for 5.0 seconds. At that time, the engines cut off, and the rocket is in ballistic (free fall) motion until it hits the ground.

a) To what maximum height above ground level does the rocket rise?

b) At that maximum height, what is the magnitude and direction of the rocket's velocity?



Part 1

$\Delta s = ?$
$v_0 = 0$
$v = ?$
$a = 45$
$t = 5$

$\Delta s = v_0 t + \frac{1}{2} a t^2$
$= 0 + \frac{1}{2}(45)(5)^2$
$= 562.5\ m$

$v = v_0 + at$
$= 0 + (45)(5)$
$= 225\ m/s$

a)

Part 2

$\Delta y = ?$
$v_{oy} = 225 \sin 61°$
$v_y = 0$
$a_y = -9.8$
$t = ?$

$v_y^2 = v_{oy}^2 + 2 a_y \Delta y$
$0 = (196.8)^2 + 2(-9.8)\Delta y$
$\Delta y = 1975.8\ m$

$\Delta y_{TOT} = 492 + 1976 = \boxed{2500\ m}$

b) At max ht, $v_y = 0$

$v_x = 225 \cos 61° = 110\ m/s$

$\boxed{\vec{v} = 110\ m/s,\ +x\ dir}$