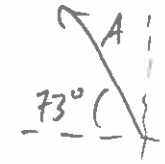
# Physics 10154 - Fall 2018 Exam #1A

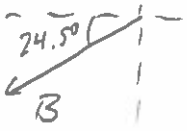
Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) A car drives from the origin to point A, 45.0 miles in a direction 73.0° North of West, then to point B, 37.4 miles in a direction 24.5° South of West. If the car is to drive a straight line distance from point B back to the origin, what would be the magnitude and direction of the necessary displacement?




$A_x = -45 \cos 73.0° = -13.157$

$A_y = +45 \sin 73.0° = 43.034$

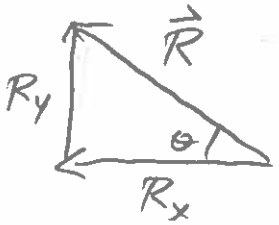



$B_x = -37.4 \cos 24.5° = -34.033$

$B_y = -37.4 \sin 24.5° = -15.510$

$R_x = A_x + B_x = -47.19$

$R_y = A_y + B_y = +27.524$

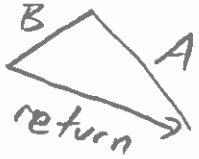



$|\vec{R}| = \sqrt{R_x^2 + R_y^2} = 54.63$ mi

$\theta = \tan^{-1}\left(\frac{27.524}{47.19}\right) = 30.25°$ above $-x$

To return, need same $|\vec{R}|$ but opposite direction

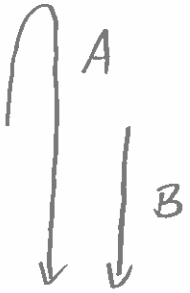
**54.6 miles, 30.3° below +x**




or S of E

2. (35 pts) Two identical pellet guns are fired simultaneously from the edge of a cliff of unknown height above the ground. Both guns impart a speed of 35.5 m/s to the pellet. Gun A is fired straight up, with the pellet going up and then falling back down, eventually hitting the ground beneath the cliff. Gun B is fired directly downward.

How long after pellet B hits the ground does pellet A hit the ground?




Motions of A + B pellets are identical once A falls through its original elevation, so the delay will be the time it takes for A to go up + back down so that $\Delta y_A = 0$. After that, cliff height is irrelevant.

$\Delta y = 0$

$v_{oy} = 35.5\ m/s$

$v_y = ?$

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

$t = ?$

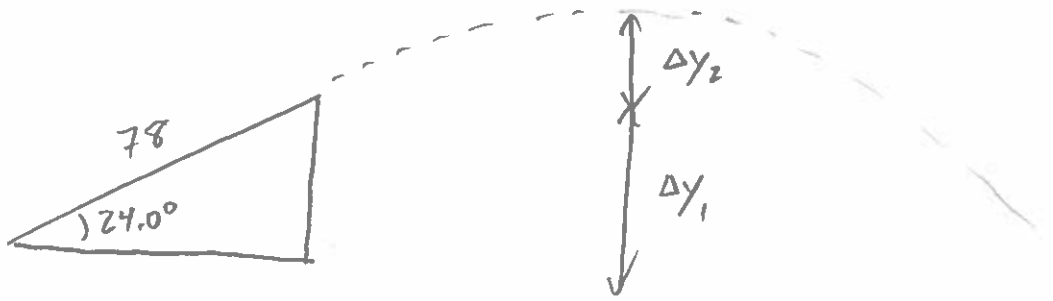
$0 = 35.5t - 4.9t^2$

$0 = t(35.5 - 4.9t)$

$t = 0$ or $\frac{35.5}{4.9} = \boxed{7.24\ s}$

3. (35 pts) Starting from rest and ground level at the base of a ramp, a car accelerates up a ramp that is 78.0 meters long and inclined 24.0° above the horizontal. The acceleration is 12.5 m/s² directed up the ramp. Upon leaving the ramp, the car is in free fall.

a) To what maximum height above the ground does the car rise? Don't neglect to include the height of the ramp.
b) What is the magnitude and direction of the car's velocity when it is at its maximum height?




$\Delta y_1 = 78 \sin 24° = 31.725$ m

On ramp:

$\Delta s = 78.0$
$v_0 = 0$
$v = ?$
$a = 12.5$ m/s²
$t = ?$

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

$v^2 = 1950$

$v = 44.159$ directed 24.0° above +x

↑ use this as $v_0$ for free fall

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Free fall $v_{0x} = 44.159 \cos 24.0° = 40.341$ m/s

$v_{0y} = 44.159 \sin 24.0° = 17.961$ m/s

$\Delta y_2 = ?$
$v_{0y} = 17.961$
$v_y = 0$
$a_y = -9.8$
$t = ?$

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

$0^2 = 322.598 + 2(-9.8)\Delta y$

$\Delta y_2 = 16.459$ $\Rightarrow \Delta y_1 + \Delta y_2 = \boxed{48.2 \text{ m}}$

At max ht $v_x = 40.3$
$v_y = 0$

$\Rightarrow \boxed{v = 40.3 \text{ m/s}, +x \text{ dir}}$