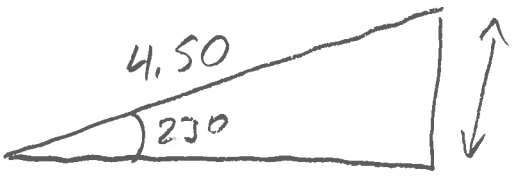
Physics 10154 - Quiz 3C

A remote-controlled car starting from rest accelerates up a 4.50 meter long ramp that is inclined 23.0° above the horizontal with an acceleration of 15.0 m/s². Once it reaches the end of the ramp, it is in "free fall" for the remainder of its motion until it hits the ground again.

a) What is the maximum height <u>above ground level</u> reached by the car?
b) What is the magnitude and direction of the car's velocity at maximum height?



$\Delta y_1 = 4.50 \sin 23° = 1.758\,m$

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

$v^2 = 0^2 + 2(15)(4.5) \Rightarrow v = 11.6\ m/s$

So v_0 for "free fall" is $11.6\ m/s$, $23°$ above $+x$

$v_{0y} = 11.6 \sin 23° = 4.54\ m/s$

$a_y = -9.8$

$v_y = 0$ at y_{max}

$\Rightarrow v_y^2 = v_{0y}^2 + 2a_y \Delta y_2$

$0 = (4.54)^2 + 2(-9.8)\Delta y_2$

$\Rightarrow \Delta y_2 = 1.05\ m$

$\Delta y_{TOT} = 1.758 + 1.052 = \boxed{2.81\ m}$

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b) v_{0x} for free fall $= 11.6 \cos 23° = 10.7\ m/s$

At y_{max}, $v_y = 0$, $v_x = v_{0x} = 10.7$

$\Rightarrow \boxed{v = 10.7\ m/s,\ +x \text{ dir}}$