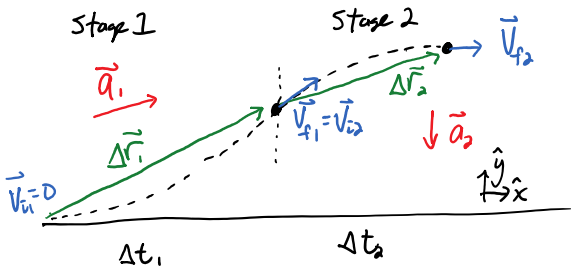
Week 5 Quiz

Thursday, October 22, 2020 12:34 PM

In another atmospheric science experiment, Benny launches an improved model rocket from rest on the Earth's surface. For the first 5.00 seconds of its flight, assuming a standard coordinate system, Benny measures the rocket's acceleration to be < 2 , 15 > m/s². At exactly 5.00 seconds into the flight, the thrusters on the rocket turn off. The rocket continues upwards until reaching its maximum height, when it sends a location signal back to Benny.

What is the **horizontal** distance travelled by the rocket between launch and the moment it reaches its maximum height? (assume no wind and no air resistance)



[1] K: $V_{ix_1} = 0$ m/s; $a_{x_1} = 2$ m/s²; $\Delta t_1 = 5$ s — UK: Δx?, V_{fx_1}

[2] K: $a_{x_2} = 0$ m/s² — UK: $V_{ix_1} = V_{fx_2} = V_{fx_1}$, Δt_2, Δx_2?

[y] $V_{iy_1} = 0$ m/s; $a_{y_1} = 15$ m/s²; $\Delta t_1 = 5$ s — V_{fy_1}, Δy_1

[y] $a_{y_2} = -9.8$ m/s²; $V_{fy_2} = 0$ m/s — $V_{iy_2} = V_{fy_1}$, Δt_2, Δy_2

[1] eq(i) $\Delta x_1 = \cancel{V_{ix_1}}^{0}\Delta t_1 + \frac{1}{2}a_{x_1}\Delta t_1^2$

$\Delta x_1 = 25$ m

eq(ii) $V_{fx_1} = \cancel{V_{ix_1}}^{0} + a_{x_1}\Delta t_1$

$V_{fx_1} = 10$ m/s $= V_{ix_2}$

eq(ii) $V_{fy_1} = \cancel{V_{iy_1}}^{0} + a_{y_1}\Delta t_1$

$V_{fy_1} = 75$ m/s $= V_{iy_2}$

[2] eq(ii) $\cancel{V_{fy_2}}^{0} = V_{iy_2} + a_{y_2}\Delta t_2$

$\Delta t_2 = 7.653$ s

eq(i) $\Delta x_2 = V_{ix_2}\Delta t_2 + \frac{1}{2}\cancel{a_{x_2}}^{0}\Delta t_2^2$

$\Delta x_2 = 76.531$ m

$\Delta x_{tot} = \Delta x_1 + \Delta x_2 = 101.5$ m

Rubric

2 pts - physical representation
1 pt - knowns and unknowns
1 pt - realizing it is a 2 stage problem
~~ Stage 1 ~~
0.5 pt - kinematic equation (i)
1 pt - finding deltaX_1
~~ Stage 2 ~~
1 pt - connections - Vf_1 = Vi_2
0.5 pt - kinematic equation (ii) for Vf_1
1 pt - finding delta_t_2
1 pt - finding deltaX_2
0.5 pt - deltaX_total = deltaX_1 + deltaX_2
0.5 pt - correct answer + units