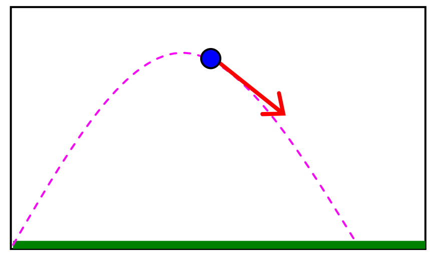
Assignment #8: Using Excel for Graphical Simulations: Due in my inbox on April 21, 2023.

Make an Excel simulation of 2D trajectory motion of a ball without air resistance. You'll have to save it as a .xlsm. Start with the template provided on the assignments web page.

You must enter a formula into each orange cell. I've already added some formulae for you in the blue cells. Your "customer" enters values into the green cells. You must also add three controls near cells C5 to E7:

a. A "play simulation" button.
b. A "reset simulation" button which returns the ball to its starting point at the origin.
c. A slider to allow the user to control the playback speed of the simulation (1 to 100).

The ball will always start at the origin $(x, y) = (0, 0)$. You will have 101 frames ranging from 0 to 100.



Here is some physics that you've forgotten:

$$g = +9.8 \text{ m/s}^2$$

$$T = \frac{2V_0 \sin(\theta_0)}{g} \text{ (duration of the simulation)}$$

$$\Delta t = T/100$$

$$R = \frac{V_0^2 \sin(2\theta_0)}{g} \text{ (expected horizontal range of the motion, so you can check your results)}$$

$$H = \frac{V_0^2 \sin^2(\theta_0)}{2g} \text{ (expected maximum height of the motion, so you can check your results)}$$

$t_i = i \cdot \Delta t$ $\quad x_i = t_i \cdot V_0 \cos(\theta_0)$ $\quad y_i = t_i \cdot V_0 \sin(\theta_0) - \frac{1}{2} g \cdot t_i^2$

$v_{xi} = V_0 \cos(\theta_0)$ $\quad v_{yi} = V_0 \sin(\theta_0) - g \cdot t_i$

In the currently selected frame section, $\theta_i = \tan^{-1}\left(\frac{v_{yi}}{v_{xi}}\right)$.

The main scatter plot should have a horizontal scale ranging from 0 m to 60 m, and a vertical scale (ranging from 0m to 45 m). It should not be allowed to auto-scale! The plotted region should therefore have an aspect ratio of 4:3… I advise you to measure it with a ruler, because I will do that when I grade it! Some permitted trajectories will disappear off of the edge of the plot.

The main scatter plot should have multiple series:

a. A solid green line (thick, no markers) showing the ground (i.e., cells M30 to N31)
b. A dashed magenta line (no markers) showing the entire trajectory (i.e., columns H and I)
c. A single dark blue point (i.e., a scatter plot with one large round marker but no line) to represent the ball (i.e., "x" is cell C21, and "y" is cell C22).
d. A red arrow (straight lines, no markers), attached to the center of the ball, showing the "current" velocity. (i.e., cells M22 to N36) The arrow should be in the direction of the velocity, and it should scale with the velocity. Specifically, a velocity of 30 m/s should be drawn as being about 10 m long (remembering that your plot scale is in meters!). Adjust cell C17 until this works.