Physics with Mathematica Fall 2019 Exercise #2 4 Sep 2019

Projectile Motion and Range

A projectile is fired with initial speed v_0 from the edge of a cliff, at an angle θ with respect to the horizontal (x) direction. The cliff is a height $y = h$ above the ground. The equations describing the motion of the projectile are therefore, with $(x, y) = (0, h)$ being the edge of the cliff,

$$x = v_0 t \cos\theta \qquad \text{and} \qquad y = h + v_0 t \sin\theta - \frac{1}{2} g t^2$$

Using $g = 9.8$ m/sec^2 and choosing some appropriate value for v_0, make a parametric plot of the trajectory, that is y versus x. Make it so that you can easily reproduce the plot for different values of h and θ. Try different values of h and θ and convince yourself that the trajectories look reasonable.

Then, solve the equation $y(t) = 0$ for the time when the projectile hits the ground. Use this time to find the range $x(t)$, and make a plot of the range versus either θ for a fixed h, or versus h for a fixed θ. In fact, it would be most slick if you used Manipulate to allow the fixed value to be easily changed.

Send the grader an email with your notebook as an attachment.