

We begin by defining a system

θ is the angle by which the shooter is aimed, the shooter shoots at v_0 , the projectile travels a distance of R .

So, define a function $R(\theta) = R$.

Hence, the goal of this project is to find local max, min points (critical points that aren't inflection points), which means — at a minimum...

vs

$$\frac{dR}{d\theta} = 0 \quad (1)$$

which would therefore indicate a θ such that the distance would be the longest.

Hence, to get the longest distance, solve.

There was apparently my old notes on this. But not sure if its helpful.

$$y(t), y_0 = 0, y_f = 0 \quad (2)$$

$$x(t), x_0 = 0, y_f = R \quad (3)$$

$$y(t) = -\frac{1}{2}gt^2 + V_{0y}t + y_0, V_{0y} = V_0 \sin \theta \quad (4)$$

$$y(t) = -\frac{1}{2}gt^2 + V_0 \sin \theta t + y_0 \quad (5)$$

$$x(t) = 0(g=0) + V_{0x}t + x_0, V_{0x} = V_0 \cos \theta \quad (6)$$

$$x(f) = 0(g=0) + V_0 \cos \theta t + x_0 \quad (7)$$

$$0 \text{ (end up on ground)} = y_f = y(t_f) = -\frac{1}{2}gt_f^2 + (v_0 \sin \theta)t_f \quad (8)$$

$$R \text{ (want to travel } R) = x_f = x(t_f) = (v_0 \cos \theta)t_f \quad (9)$$

$$(10)$$