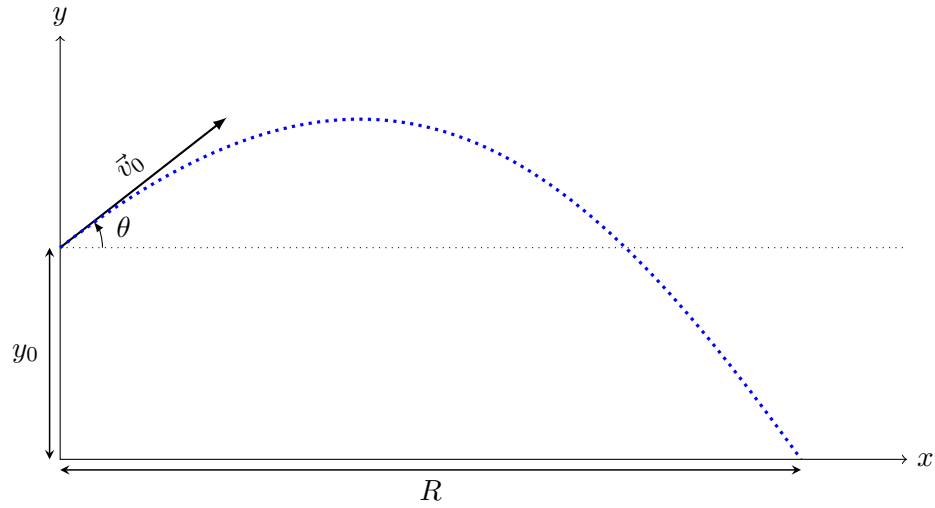


The Range of a Projectile

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Consider the equations of motion of a projectile, launched at an elevation θ from a height y_0 , experiencing uniform acceleration $-g$ along the y -axis.

$$x(t) = v_0 \cos \theta \quad (1)$$

$$y(t) = y_0 + v_0 \sin \theta - \frac{1}{2}gt^2 \quad (2)$$

When the projectile hits the ground, we see that $y(t_{flight}) = 0$.

$$\begin{aligned} 0 &= y_0 + v_0 \sin \theta - \frac{1}{2}gt^2 \\ t &= \frac{1}{g}(\sin \theta + \sqrt{v_0^2 \sin^2 \theta + 2gy_0}) \end{aligned}$$