Warm Up: Objects in Free-Fall, Projectiles

Prof. Jordan C. Hanson

September 23, 2022

1 Memory

1. $y(t) = -\frac{1}{2}gt^2 + v_{i,y}t + y_i$ ... Vertical displacement.

2. $v_y(t) = -gt + v_{i,y}$ ... Vertical velocity.

2 Objects in Free-Fall, Projectiles

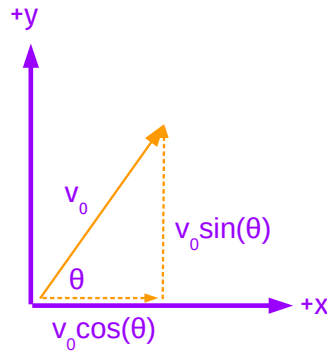1. Note in Fig. 1 the initial velocity is broekn into the vertical and horizontal components.

Figure 1: The initial velocity $\vec{v}_0$ launched at an angle θ with respect to the x-axis.

2. Suppose an object is launched into the air from the origin at an angle θ with respect to the horizontal, with an initial velocity $\vec{v}_i$, eventually landing back at $y = 0$. Use the *second* equation in the Memory bank to show that the total time spent in the air is

$$T = \frac{v_i \sin\theta}{g} \tag{1}$$

3. Use the *first* equation in the Memory Bank to show that T is given by Eq. 1.

4. *Hints: for the first exercise, ask yourself what the velocity is at the apex of the trajectory? For the second exercise, solve the quadratic for the times that make $y = 0$.*