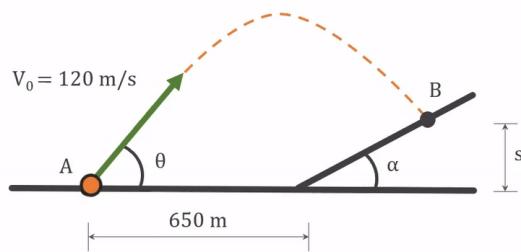


Trajectory of Ball



A ball is launched from point A with the initial conditions shown. Find an expression for the vertical displacement $y(t)$.

Using known expressions:

$$a = \frac{dv}{dt} \Rightarrow dv = adt \quad (1)$$

$$\int_{v_0}^v dv = a \int_0^t dt \quad (2)$$

$$v(t) = a \cdot t + v_0 \quad (3)$$

$$v = \frac{ds}{dt} \Rightarrow ds = v dt = (a \cdot t + v_0) dt \quad (4)$$

$$\int_{s_0}^s ds = \int_0^t (a \cdot t + v_0) dt \quad (5)$$

$$s(t) = \frac{1}{2} a \cdot t^2 + v_0 \cdot t + s_0 \quad (6)$$

For the vertical displacement in y-direction, this results in:

$$y(t) = \frac{1}{2} a_y \cdot t^2 + v_{y,0} \cdot t + s_{y,0} \quad (7)$$

Given:

Initial velocity: $v_0 = 120m/s$

Angle: θ

Since $s_{y,0}$ is zero and $a_y = -g$, the resulting equation becomes:

$$y(t) = -\frac{1}{2}g \cdot t^2 + v_{y,0} \cdot t \quad (8)$$

Where $v_{y,0} = v_0 \cdot \sin \theta$. Combining gives the final answer:

$$y(t) = -\frac{1}{2}g \cdot t^2 + v_0 \cdot \sin \theta \cdot t \quad (9)$$

Or

$$y(t) = \frac{1}{2}a_y \cdot t^2 + v_0 \cdot \sin \theta \cdot t \quad (10)$$