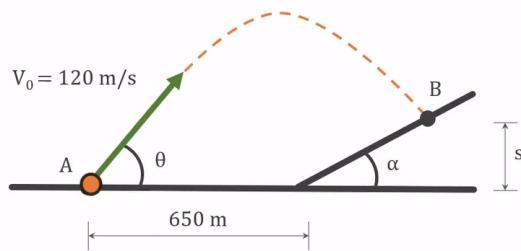


# Trajectory of Ball



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

Neglect all air resistances.

Using known expressions (for constant acceleration):

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

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

$$v(t) = at + v_0 \quad (3)$$

$$v = \frac{ds}{dt} \Rightarrow ds = vdt = (at + v_0)dt \quad (4)$$

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

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

*Solution:*

For the horizontal displacement in  $x$ -direction, equation (6) results in:

$$x(t) = \frac{1}{2}a_x t^2 + v_{x,0}t + s_{x,0} \quad (7)$$

Since  $a_x = 0 \text{ m/s}^2$  and  $s_{x,0} = 0 \text{ m}$ , the resulting equation reduces to:

$$x(t) = v_{x,0}t \quad (8)$$

Where  $v_{x,0} = v_0 \cos \theta$ . Substituting for  $s_{x,0}$  gives the final expression:

$$x(t) = v_0 t \cos \theta \quad (9)$$