

A particle is projected from a point A at an angle(Q) with the horizontal. At B it moves at right angle to its initial direction. Find time of Flight from A to B.



\vec{v}_0 - vector of initial velocity

\vec{v} - vector of current velocity

Suppose, at the time instant t \vec{v}_0 is perpendicular to \vec{v} . Then:

$$\vec{v}_0 * \vec{v} = 0$$

On the other hand:

$$\vec{v} = \vec{v}_0 + \vec{g}t,$$

where \vec{g} – gravitational acceleration.

Therefore:

$$(\vec{v}_0 + \vec{g}t) * \vec{v}_0 = 0$$

$$\vec{v}_0^2 + (\vec{g} * \vec{v}_0)t = v_0^2 + gv_0 \cos(a) t = 0$$

where a – angle between \vec{g} and \vec{v}_0 , $a = 90 + Q$

$$v_0^2 - gv_0 \sin(Q) t = 0$$

$$t = \frac{v_0}{g \sin(Q)}$$

$$\text{Answer: } t = \frac{v_0}{g \sin(Q)}$$