Chapter 11 - Projectiles + Circular Motion

§11-1 Projectile Motion

Today we will look at projectiles that are launched horizontally.

From the video analysis we know:

① Horizontally - the velocity is constant.

$$v = \frac{\Delta d}{\Delta t}$$

② Vertically - there is constant acceleration $(a = -9.81 m/s^2)$

$$a = \frac{\Delta v}{\Delta t} \quad (\text{where } \Delta v = v_2 - v_1)$$

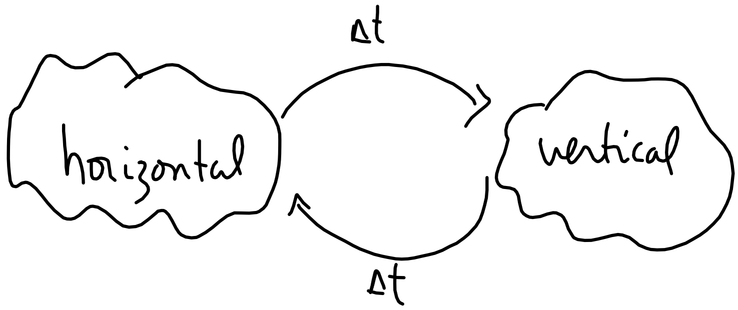
$$v_{ave} = \frac{\Delta d}{\Delta t} \quad \left(\text{where } v_{ave} = \frac{v_1 + v_2}{2}\right)$$

maybe useful:

$$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$$

$$\Delta d = v_2 \Delta t - \frac{1}{2} a (\Delta t)^2$$

$$v_2^2 = v_1^2 + 2a\Delta d$$



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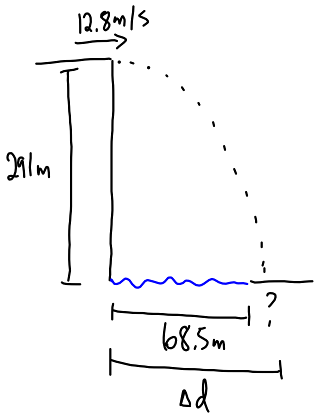


Vertically

$\Delta d = -291\,m$

$v_1 = 0$

$a = -9.81\,m/s^2$

$\Delta t = ?$

$\Delta d = \cancel{v_1 \Delta t}^{\,0} + \frac{1}{2}a(\Delta t)^2$

$\Delta d = \frac{1}{2}a(\Delta t)^2$

$(\Delta t)^2 = \frac{2\Delta d}{a}$

$(\Delta t)^2 = \frac{2(-291\,m)}{-9.81\,m/s^2}$

$\Delta t = 7.70\,s$

Horizontally

$v = \frac{\Delta d}{\Delta t}$

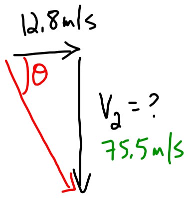
$\Delta d = v\Delta t$

$\Delta d = (12.8\,m/s)(7.70\,s)$

$\Delta d = 98.6\,m$

a) The rock lands on the other side of the river

b) When the rock hits the ground:



Vertically

$v_1 = 0$

$\Delta d = -291\,m$

$a = -9.81\,m/s^2$

$\Delta t = 7.70\,s$

$v_2 = ?$

$a = \frac{\Delta v}{\Delta t}$

$a = \frac{v_2 - v_1}{\Delta t}$

$a\Delta t = v_2 - v_1$

$v_2 = \cancel{v_1}^{\,0} + a\Delta t$

$v_2 = (-9.81\,m/s^2)(7.70\,s)$

$v_2 = -75.5\,m/s$

$c^2 = a^2 + b^2$

$c^2 = (12.8)^2 + (75.5)^2$

$c = 76.6\,m/s$

$\tan\theta = \frac{75.5}{12.8}$

$\theta = 80.4°$

The rock's velocity is 76.6 m/s [80.4° to the horizontal] when it hits the ground.

TO DO: PP|536 - 537