# Projectiles (Horizontal Launch)

**Projectile** - Any object that is thrown, kicked, etc., while in mid air (after release)
- in free fall
- only influenced by gravity (the only force)

## Examples

Footballs after being thrown

Frog after a jump (in mid air)

High jumper after leaving ground

## Not Examples

Airplane

Bird

Rocket

Gliders

Skydiver (parachute ope

Hang Glider

For projectiles,

① $\vec{a}_y = 9.8\ m/s^2$ [down] , on Earth (constant

$\vec{a}_y$ ↓ acceleration in y-direction only

∴ ② $\vec{v}_x$ is constant!!

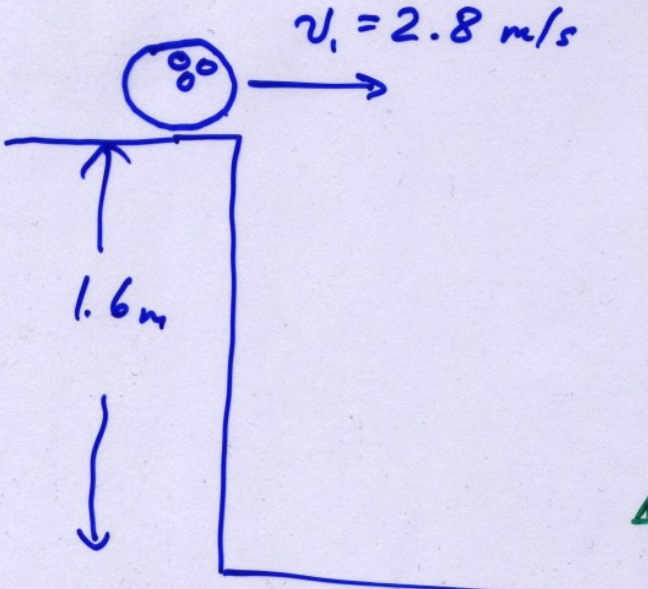
$\vec{v}_x$ ↓ velocity in x-direction only.

(3) Analyse the x and y directions separately! (Time is common to both directions)

Example: Selma's bowling ball rolls off her 1.6 m high counter with an initial horizontal speed of 2.8 m/s. Determine

(a) how long it takes for the ball to reach the floor (called "time of flight").

(b) the impact velocity of the ball.




(a) y-direction

$\vec{\Delta d} = -1.6\ m$

$\vec{a} = -9.8\ m/s^2$

$\vec{v}_i = 0$

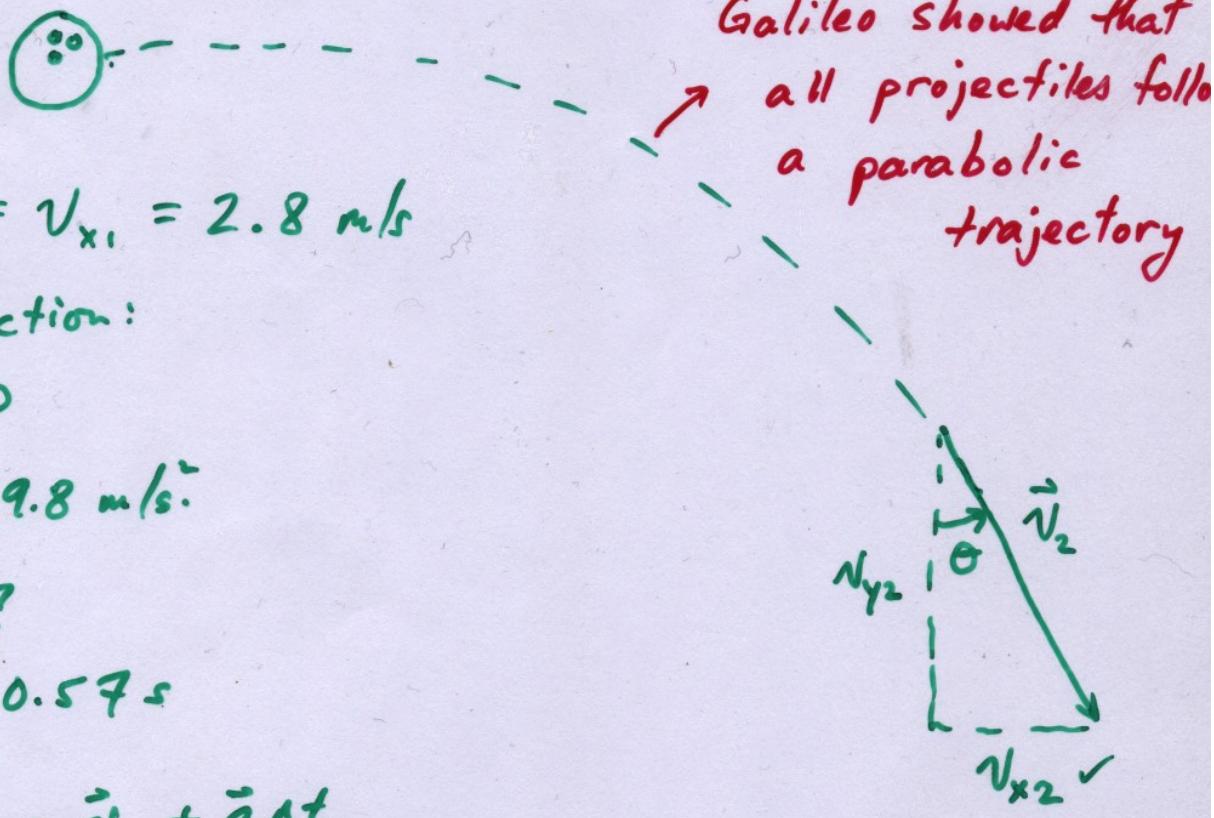
$\Delta t = ?$

$\vec{\Delta d} = \vec{v}_i \Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$-1.6 = 0 + \frac{1}{2}(-9.8)\Delta t^2$

$\Delta t = 0.57\ s$

(b)



Galileo showed that all projectiles follo a parabolic trajectory

$v_{x2} = v_{x1} = 2.8$ m/s

y-direction:

$v_{y1} = 0$

$a_y = -9.8$ m/s$^2$

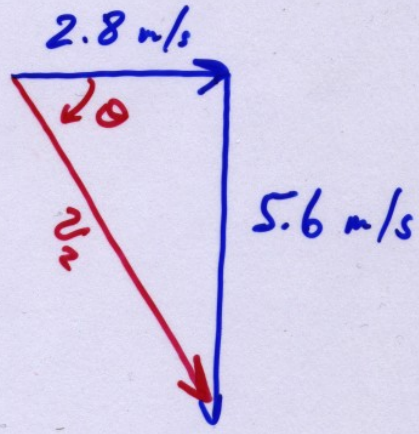
$v_{y2} = ?$

$\Delta t = 0.57$ s

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$= 0 + (-9.8)(0.57)$

$= -5.6$ m/s




$\vec{v}_2^{\,2} = (2.8)^2 + (5.6)^2$

$v_2 = 6.3$ m/s

$\vec{v}_2 = 6.3$ m/s [E 63.4° S]

$\text{Tan}\,\theta = \frac{5.6}{2.8}$

$\theta = 63.4°$